

**Drought + Deluge**

An Amphibious Neighborhood for Mexico City's Urban Poor

Kelsey Pierson

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Committee:

Robert Peña

Nina Franey

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Architecture

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**Abstract**

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Chair of the Supervisory Committee:

Robert Peña

Professor

Department of Architecture

Mexico City's water cycle is broken. Rain is falling but doesn't make it underground to the aquifer of potable water, causing severe floods. Evapotranspiration is accelerated before water can be used by people, causing severe droughts and subsidence. The city is in a state of paradox of excess and lack of water, worsening the effects of climate change. The issue of equity becomes stronger in this imbalance, where the wealthy have the best access at the center of the city, while the poorer communities have the least at the periphery. If this continues, the aquifer will dry up, the city will continue to sink, and Mexico City will have no means of potable water.

In order to mitigate these series of issues, the water cycle must be healed at the large scale and the small scale. At the large scale, rain must be able to infiltrate the ground to replenish the aquifer and prevent further subsidence. At the small scale, localized means of collecting water must be used to lessen dependence on extraction from the aquifer for potable water, and to lessen issues of heat island effect.

The position of this thesis is to leverage the poorer communities at the periphery of the city to act as precedents in city-wide efforts for water infiltration, as well as community level water collection and reuse.

This project explores an overall strategy to approach development along The Blue Ring while remaining attuned to the needs of the urban poor, and proposes an integrated design to mitigate floods through the means of dual-purpose architecture.

## **Acknowledgments**

To Rob and Nina : Thank you for prodding, for adjusting and fine-tuning, and for your continual encouragement. I am so grateful to have had you as my committee members.

To my parents, Auntie Susie, Brett, and Jacqueline, and the rest of my family: Thank you for your relentless support and for always checking on my physical and mental well-being. I would not be where I am without your grounding energies.

To my cohort: Or better put: to my studio family. From early mornings to late nights over three-and-a-half years, I have been in awe of everyone's consideration and kindness to one another. Thanks for your constant presence and always being open to talk about what we all love to talk about. In truth, I learned the most from you and have been made by you.

# DROUGHT + DELUGE

AN AMPHIBIOUS NEIGHBORHOOD for  
MEXICO CITY'S URBAN POOR

KELSEY PIERSON  
M.Arch Thesis Document  
13 December 2019



## Contents

<b>1</b>	<b>1 / INTRODUCTION</b>
2	Introduction
<b>5</b>	<b>2 / THEORETICAL FRAMEWORK</b>
7	2.1 - History of Lake Texcoco
9	2.2 - Cost of an Expanded City
13	2.3 - Urban Water Control (The Infrastructure)
14	2.4 - Water Response (The Architecture)
<b>17</b>	<b>3 / METHODOLOGY</b>
19	3.1 - Catalogue of Water Strategies
23	3.2 - Design Beginnings: Fusing Control + Response
25	3.3 - The Blue Ring: Ghost of Texcoco
27	3.4 - Developing a Water Language
28	3.5 - Methods for Site Selection
31	3.6 - La Presa, Ecatepec de Morelos
32	3.7 - Ritual + Procession
<b>35</b>	<b>4 / PROJECT</b>
37	4.1 - A Water Pilgrimage
40	4.2 - The Pavilion : Retain + Regenerate
44	4.3 - The Zocalo: Delay + Store
48	4.4 - The Mercado: Retain + Store
52	4.5 - The Bodega: Delay + Regenerate
56	4.6 - The Chapel: Clean + Reuse
60	4.7 - The Lookout: Reuse + Store
64	4.8 - Conclusion
<b>67</b>	<b>5 / LITERATURE REVIEW + FIGURES LIST</b>
68	5.1 - Literature Review
70	5.2 - Figures List





C H A P T E R O N E

# INTRO- DUCTION

## Introduction

Mexico City's water cycle is broken. Rain is falling but doesn't make it underground to the aquifer of potable water, causing severe floods. Evapotranspiration is accelerated before water can be used by people, causing severe droughts and subsidence. The city is in a state of paradox of excess and lack of water, worsening the effects of climate change. The issue of equity becomes stronger in this imbalance, where the wealthy have the best access at the center of the city, while the poorer communities have the least at the periphery. If this continues, the aquifer will dry up, the city will continue to sink, and Mexico City will have no means of potable water.

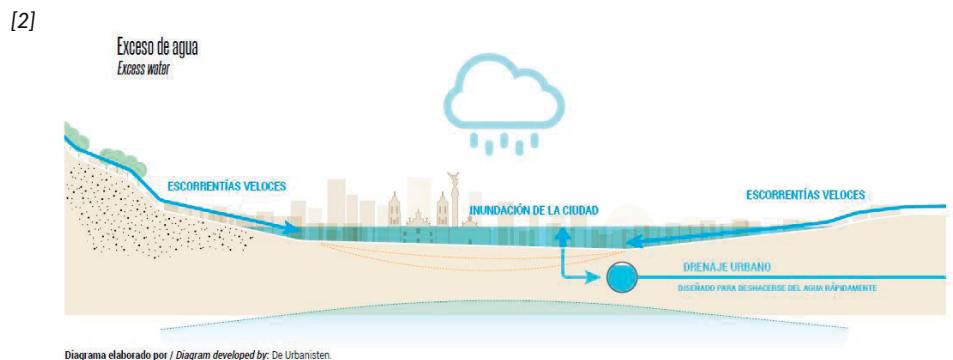
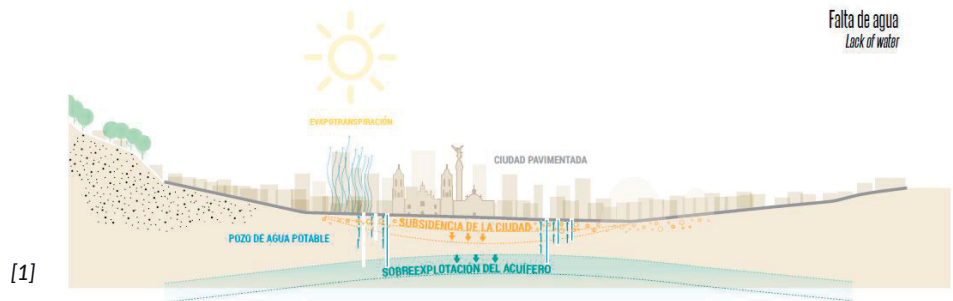
### Lack + Excess

The diagrams below show the dual nature of the city:

LACK shows the depletion of the aquifer, the fast evaporation of what water there is due to heat waves, and the subsidence of the city as the aquifer is overexploited. Parts of the city are sinking at a rate of up to 9 inches a year.

EXCESS shows fast water run-off from the mountains, the flooding of the city, and attempts to drain the water elsewhere.

This paradox of lack and excess leaves the city unbalanced while remaining heavily reliant on the aquifer for water.



(Figures 1 + 2)

Diagrams showing lack and excess of water in Mexico City (source: De Urbanisten)

(Figure 3)

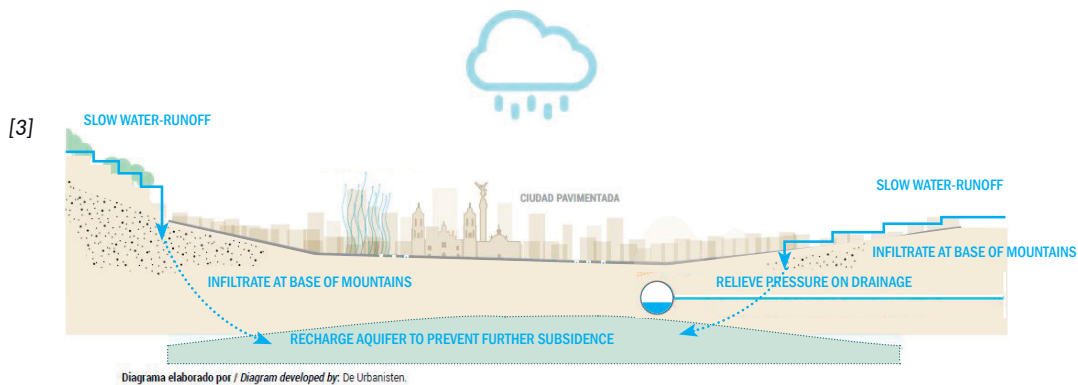
Diagram to heal broken water cycle in Mexico City

## Healing the Broken Water Cycle

In order to mitigate these series of issues, the water cycle must be healed at the large scale and the small scale. At the large scale, rain must be able to infiltrate the ground to replenish the aquifer and prevent further subsidence. At the small scale, localized means of collecting water must be used to lessen dependence on extraction from the aquifer for potable water, and to lessen issues of heat island effect.

The position of this thesis is to leverage the poorer communities at the periphery of the city to act as precedents in city-wide efforts for water infiltration, as well as community level water collection and reuse.

This project explores an overall strategy to approach development along The Blue Ring while remaining attuned to the needs of the urban poor, and proposes an integrated design to mitigate floods through the means of dual-purpose architecture.



C H A P T E R T W O

# THEORETICAL FRAMEWORK





TULA

TENOTHLAN

TEPEACAPAN



TEPEAC

TEPEAC



TEPEAC

TENOCHTITLAN

TEPEAC

TEPEAC

TEPEAC

TEPEAC

TEPEAC



TEPEAC

[4]  
Lake Texcoco in Mexica times

## 2.1 - History of Lake Texcoco

Mexico City's origin is intimately rooted in its relationship to water. What is now one of the largest cities in the world was once occupied by a system of interconnected lakes that dominated the plains of the Basin, known as Lake Texcoco. The lake provides for the ancient Mexica civilization, acting as a resource for agriculture and transportation. The Mexicas were able to harness the lake's assets, but as this lake was infilled over the many centuries due to colonization, the old ways were lost and the geology of the lake proved to be problematic rather than beneficial in this new era of a European grid system.

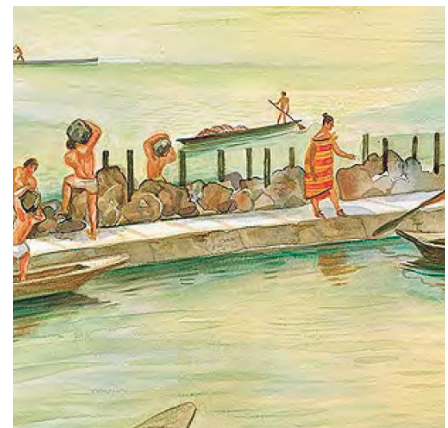
Shallow but vast, the lake possessed a total surface area of more than 1,100 square kilometers (De Urbanisten, 37). Generation after generation tell the story of how the ancient Mexicas' deity Huitzilophtli instructed his people to build their city where they found "an eagle perched over a nopal [cactus] with the wings extended" (Gallegos, 2015). The Mexicas found this evidence of providence on a small island in the middle of the lake, and thus constructed their city of Tenochtitlan. Due to the nature of building on a lake, the Mexicas developed a deep understanding of the waterscape and used this to their advantage. They learned of the basin's endoheric nature; a closed drainage basin that retains water and allows no outflow to other external bodies of water such as rivers (De Urbanisten, 41).

The Mexico City Basin stored water from rain and streams that run down from the surrounding Sierra de Chichinautzin, and this water very slowly infiltrated into the ground due to a thick layer of impervious sediment called the aquitard (De Urbanisten, 37). As a result, this caused frequent flooding of the island during the rainy season. Instead of fighting this natural cycle, the Mexicas learned to harness this water for their own use. As a means of water control, they created an elaborate system of dams to divide the eastern salinated water from the western fresh water, which also controlled the varying water levels of the lake (De Urbanisten, 41). In addition, the Mexicas built a water responsive strategy and developed the chinampa, a clever system that allowed them to build artificial arable land in the lake surface using a soil filling method (De Urbanisten, 41). By implementing an integrated strategy to control the water as well as adapt to it, the Mexicas maintained a balanced and healthy relationship to the nature of the lake.

Amidst the city's successful connection with the surrounding water, the Mexica civilization was conquered and colonized by Hernán Cortés and the Spanish crown in the 16th century. At the time of Cortés's arrival, Tenochtitlan had an estimated population of at least 200,000 people and consisted of a large central square surrounded by alleys and channels. In an effort to reflect the new European city model, the Spanish made efforts to build elevated causeways radiating from the city center in all directions (Correa, 40) and to drain the lake by

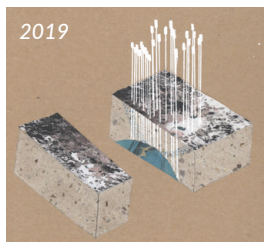
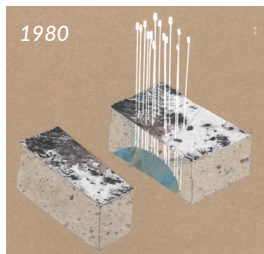
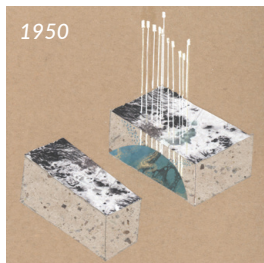
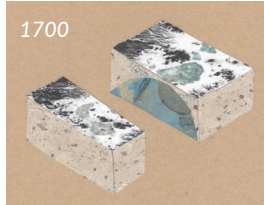
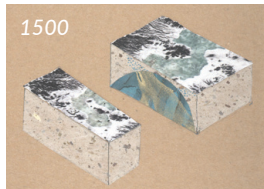


[5]  
Dike of Nezahualcoyotl



[6] Mexica chinampas





means of the Huehuetoca canals and the Nochistongo Cut (De Urbanisten, 45). As if by the lake's wrath, the new city was ravaged by a series of floods due to the rising levels of the lake and delayed construction works. The flood of 1629 inundated the city for five years and left Tenochtitlan all but abandoned, resulting in accelerated reconstruction and an aggressive drainage program to mitigate future inundations (Correa, 48). Facing both an unruly lake and the still hostile native population, the Spanish confined themselves to the traza, a Renaissance reconstruction delineated by existing canals and causeways at the city center, while the natives inhabited the margins of the city in their traditional calpullis ruled by the surviving Aztec nobility (Correa, 48).

It is at this point that we begin to see the severity of equity across the city, with the conquering elite at the center of the city and the marginalized pushed to the periphery. The continued construction of canals and gates to control irrigation further segregated creoles and mulattos from the indigenous (Correa 54), and the draining of the basin drastically reduced the footprint of surface water bodies (De Urbanisten 53). The Lake of Texcoco and the way of life it supported faded into memory. The Nezahualcoyotl Dam was destroyed, the chinampas were reduced to a small portion in Xochimilco to the south of the city, and older major canals such as the Canal de la Viga used for primary passage were decked with streets. What once was a symbiotic relationship, the city benefitting from the lake without causing direct harm while feeding the basin, had now become parasitical, completely sucking the life out of the lake to reach idealistic city standards. The rich foreigners lived at the city center and benefit from the urbanistic opportunities of clean water systems, while the natives were pushed out and lost all opportunities for sophisticated water infrastructure being built.

← [7]  
Progression of Lake  
Texcoco's drainage and  
relation to the aquifer from  
1500 to present day

## 2.2 - Cost of an Expanded City

After centuries of battling with a volatile lake, Mexico City's water source by means of the aquifer below the former lake today has been pushed to the brink of extinction. As the city's best chance for safe drinkable water, extraction by drilling deeper continues to weaken the ancient clay lake beds, causing the city to crumble (Kimmelman, paragraph 4). While the drilling has been ongoing for many years, it is only made worse by climate change. This has two effects: heavier, more intense rains, which means more floods, but also more frequent and longer droughts. (27).

"More heat and drought mean more evaporation and yet more demand for water, adding pressure to tap distant reservoirs at staggering costs or further drain underground aquifers and hasten the city's collapse" (5).

Despite this advancing threat, the city has no large-scale operation for recycling wastewater or collecting rainwater. In times of flooding, the city is forced to expel over 200 billion usable gallons of water to the failing sewage system, including the "Grand Canal", built to move sewage out of the city. As a result, Mexico City now imports as much as 40 percent of its water from remote sources — then squanders more than 40 percent of what runs through its 8,000 miles of pipes because of leaks and pilfering (24). The inequity of water distribution is felt most by the communities on the outskirts of the city center that lack proper water

"...the government acknowledges that nearly 20 percent of Mexico City residents — critics put the number even higher — still can't count on getting water from their taps each day. For some residents, water comes only once a week, or once every several weeks, and that may mean just an hour of yellow muck dripping from the faucet. Those people have to hire trucks to deliver drinking water, at costs sometimes exponentially higher than wealthy residents pay in better-served neighborhoods (25).

infrastructure.

While an average wealthy resident closer to the reservoirs consumes about 100 gallons per day, a poorer resident can only manage 10 gallons per day, relying on pipa trucks for water delivery and paying ten times more than the wealthy resident (57-58). For the poorer communities, such as Tlapan to the southwest of the city, it would require a pipa truck to make 500 trips a day in order to meet the needs of the district (43).

Social ramifications of poor water access aside, a depleting aquifer transforms and exaggerates the physical landscape. Due to its lake history, below the city and above the aquifer lies a mix of impervious clay and permeable volcanic soil. The mixture of the two results in subsidence, as water is unevenly absorbed into the ground creating a ripple effect in buildings across the city.

[8] Water collection due to poor infrastructure and access



[9] Frequent flooding due to more intense rainfall



[10] Rippling subsidence throughout the city





**[11] (left)**  
Angel of Independence showing  
subsidence from 1910 - 2016

**[12] (right)**  
Mexico City sinks an average of  
9 inches per year, as exhibited in  
these stacked barrels



[13] The people on the outskirts of the city must rely on 'pipa' trucks to deliver water. The truck deliveries may not bring water frequently enough and have been subject to corruption. The highest bidder will get the water. This results in the urban poor paying the most for water than the wealthy at the center of the city.

[14] The Aqueduct of Segovia in Segovia, Spain becomes an organizer of the city as well as monument to celebrate the transport of water



## 2.3 – Urban Water Control (The Infrastructure)

The nature of controlling water salination and water levels by means of the Nezahuacotyl Dam defined Mexico City's physical landscape and identity for many years before its conquer by the Spanish. However, the act of capturing and redirecting water for the benefit of the city has been practiced for centuries in low-lying countries all over the world. Like the elaborate canal system in Amsterdam, or the ancient Roman aqueducts bringing fresh water into the city, water infrastructure is an integral part of the city. At times there is too much water, and the city must contend with flooding by redirecting and delaying flow as much as possible. At other times there is not enough water, and the city is left with empty shells of infrastructure. In these cases, we can understand the large-scale importance of water, even when it is not present.

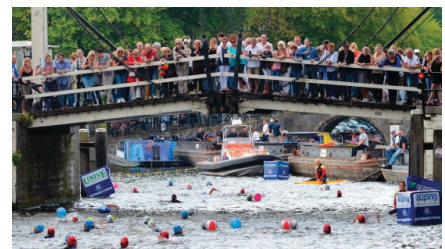
### Canals

Amsterdam's intricate canal system has become part of the city DNA due to its flat, sea-level, flood-prone landscape. Instead of forcing the frequent flood waters back, these cities welcomed the water and used it to the city's advantage. The canals offer not only a legible grid and means of organizing the city, but defended the city from enemies, and transformed transportation into ritualistic procession. In its contemporary state, the canal system has allowed for commercial and residential redevelopment to bring life along the water. Some of that development includes living directly on the water in houseboats, forever protected from the fluctuating water levels.

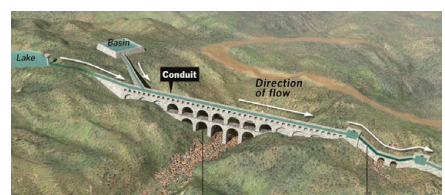
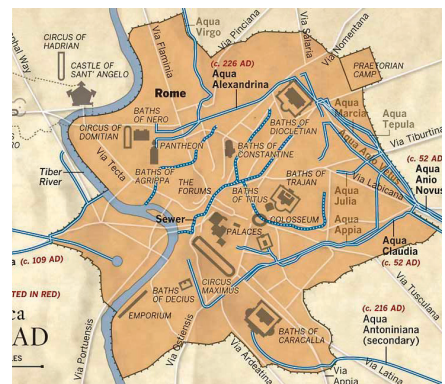
### Aqueducts

Even the Roman aqueducts have framed Rome and other cities' capture and control of water. Its usages spanned a wide range, from irrigation for agriculture to channeling fresh water into the city for public baths and drinking fountains. These aqueducts coming into the city often terminated in main trading markets, offering water to all walks of life. Water was always seen as a public amenity and was treated as such. It became ritualistic for households to gather in the main square to retrieve water and bring back to the home, all while engaging in community. Mexico City's origin city even had its own aqueduct, starting in what is now Chapultepec Park and bringing fresh water to the center of the city where the Zocalo now resides. While aqueducts have declined in use, their presence remains integral in telling the story of the city, even in the absence of water.

[15, 16, 17] Amsterdam canals provide flood control and bring life along the waterfront



[18, 19] Roman aqueducts bringing water into city and terminating in gathering spaces



## 2.4 – Water Response(The Architecture)



[20, 21, 22, 23]

Benthemplein Water Square acts as public space in dry periods and water collection in floods, celebrating water as art

[24, 25]

Prithula Prosun's LIFT House project in Bangladesh uses local materials and labor to create two amphibious homes for the urban poor

The Mexico's chinampa responded to the frequent flooding of the basin by being a structure that allowed for and even benefitted from the flooding, maintaining saturated and arable farmland. While “water control” typically refers to city-wide initiatives and large-scale infrastructure, “water responsive” might pertain to specific neighborhood or an individual structure – like the chinampa. For example, a structure built in a flood plain will likely be raised on stilts to dodge the fluctuated water levels, or a home trying to collect water will shaped the roof to capture and direct water for the household’s use. These localized means of water protection and water collection give leverage to neighborhoods to fend for themselves. They take initiative in the architecture to provide a small-scale response to the water needs of the immediate community.

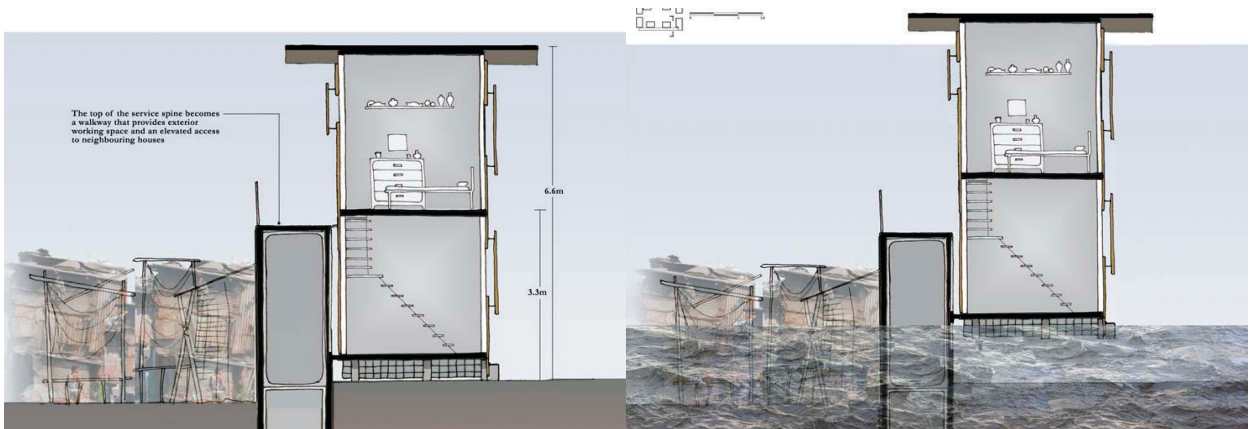
### Dual Purpose

Because many places in the world are not in a constant state of rain or dryness, spaces and structures may be built to serve a dual purpose; to anticipate wet and dry conditions. Due to its low-lying nature, Rotterdam is one such city that has been designed to anticipate floods. Many of its public spaces act as water retention in periods of heavy rain and to as playgrounds in periods of dryness. De Urbanisten’s design for the Benthemplein Water Square combines water storage with the improvement of the quality of urban public space. In times of rain, the square holds water storage below, making the infrastructure visible and enjoyable. Since the square is dry most of the time, it is used as a recreational space, including a basketball court basin and skating basin. In periods prone to flooding, the basins fill with water to delay water from overwhelming the stormwater system. The water even becomes an art piece, using gravity to pressurize points and create water fountains and water saturated designs.

### Amphibious Architecture

Structures may even be able to take on the dual nature of a floating home and a grounded one. Amphibious buildings can deploy in times of flooding, while maintaining their relationship to the ground the remainder of the time. This type of building can also be incredibly expensive. For instance, the pilot project for amphibious Homes in Maasbommel, Netherlands cost a colossal €300,000 (approximately \$390,000 USD) for construction of 1290 square feet. However, Prithula Prosun, an architecture graduate student at the University of Waterloo, proved that amphibious housing could even be for those of extremely low income. Her “LIFT” House project focused on the poor communities of her home country, Bangladesh, that were deeply affected by frequent flooding of the plains in which these communities resided. Using local building methods, labor, and materials (including recycled plastic bottles), Prosun managed to build two amphibious homes for only \$10,000 Canadian. A shared core between the two homes acts as the mooring when the building needs to deploy and float in times of floods, and as a communal garden in its normal, dry state. The LIFT House is proof that an amphibious structure can be made sensitive to its context while providing for those in serious need.

[24]



[25]

Grand Canal

Sierra de Guadalupe

1

C H A P T E R T H R E E

# METHODOLOGY

2

Sierra

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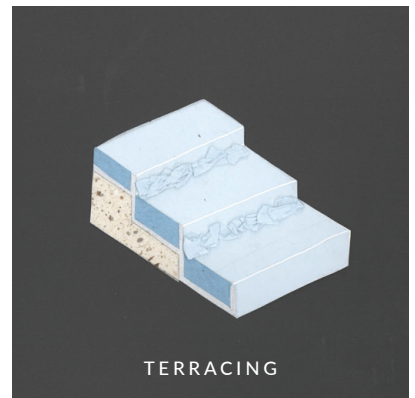
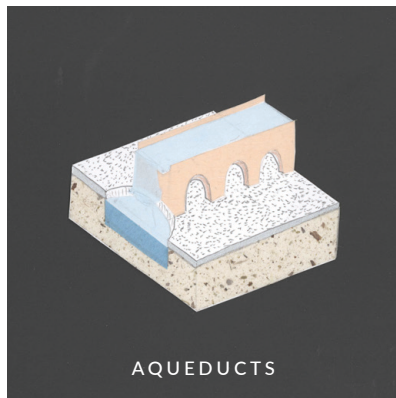
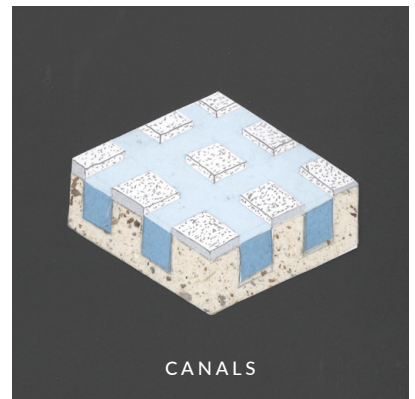
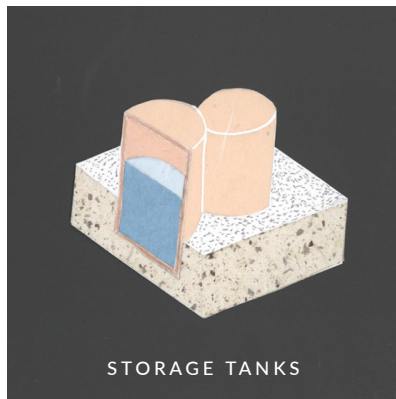
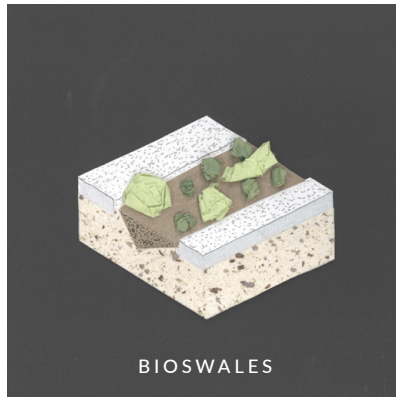
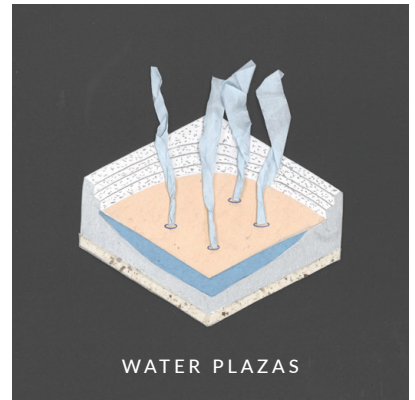


3

6

5

4



[26]  
Water infrastructure catalouge  
Collages created by author

## 3.1 – Catalogue of Water Strategies

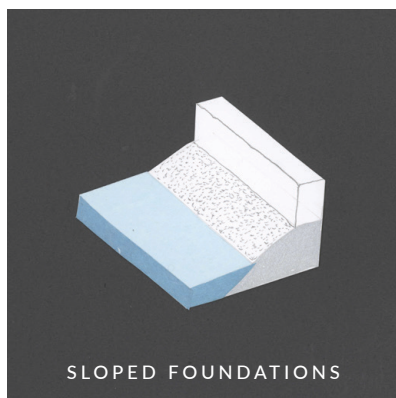
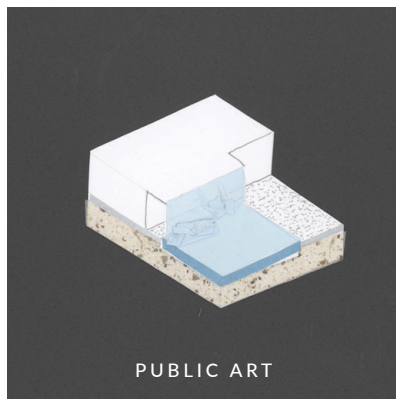
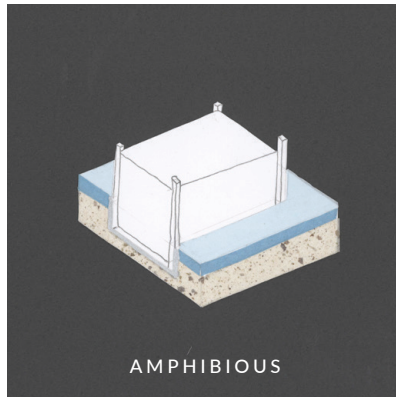
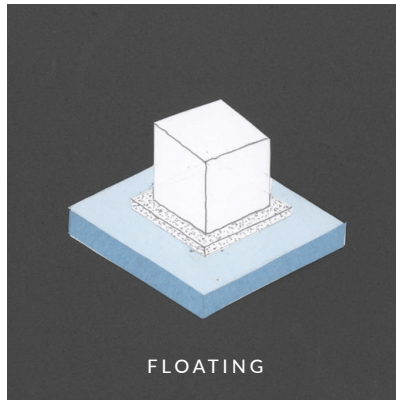
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Taking a cue from the Mexicas, a catalogue series of water strategies was created to address large scale and small scale interventions, similar to the roles of the Mexica dam and the chinampas. After analyzing world wide approaches to water management researched in the previous chapter, it became imperative to define the elemental aspects to these projects and separate from their immediate context. By piecing apart the engineering and built aspects that made each project successful specific to their water management, the design project for this thesis can maintain a language that applies the strategies based on its physical and cultural context.

### Strategies for Water Control: The Infrastructure

Below are some strategies for urban water control infrastructure that may be applicable for a site in the urban periphery of Mexico City:

- Water streets: Designed to flood intelligently during emergency situations
- Water plazas: Dual nature of urban squares becoming flood basins when needed
- Bioswales: Integration of infiltration areas along existing roads
- Rain gardens: Redirecting water from roads into rain collection gardens
- Storage Tanks: Built underground to collect during rain and reserve for drought periods
- Canals: Act of redirecting water; can also act as means of transportation
- Aqueducts: Channeling water collected to areas of high need
- Terracing: Delaying water course and adapting landscape

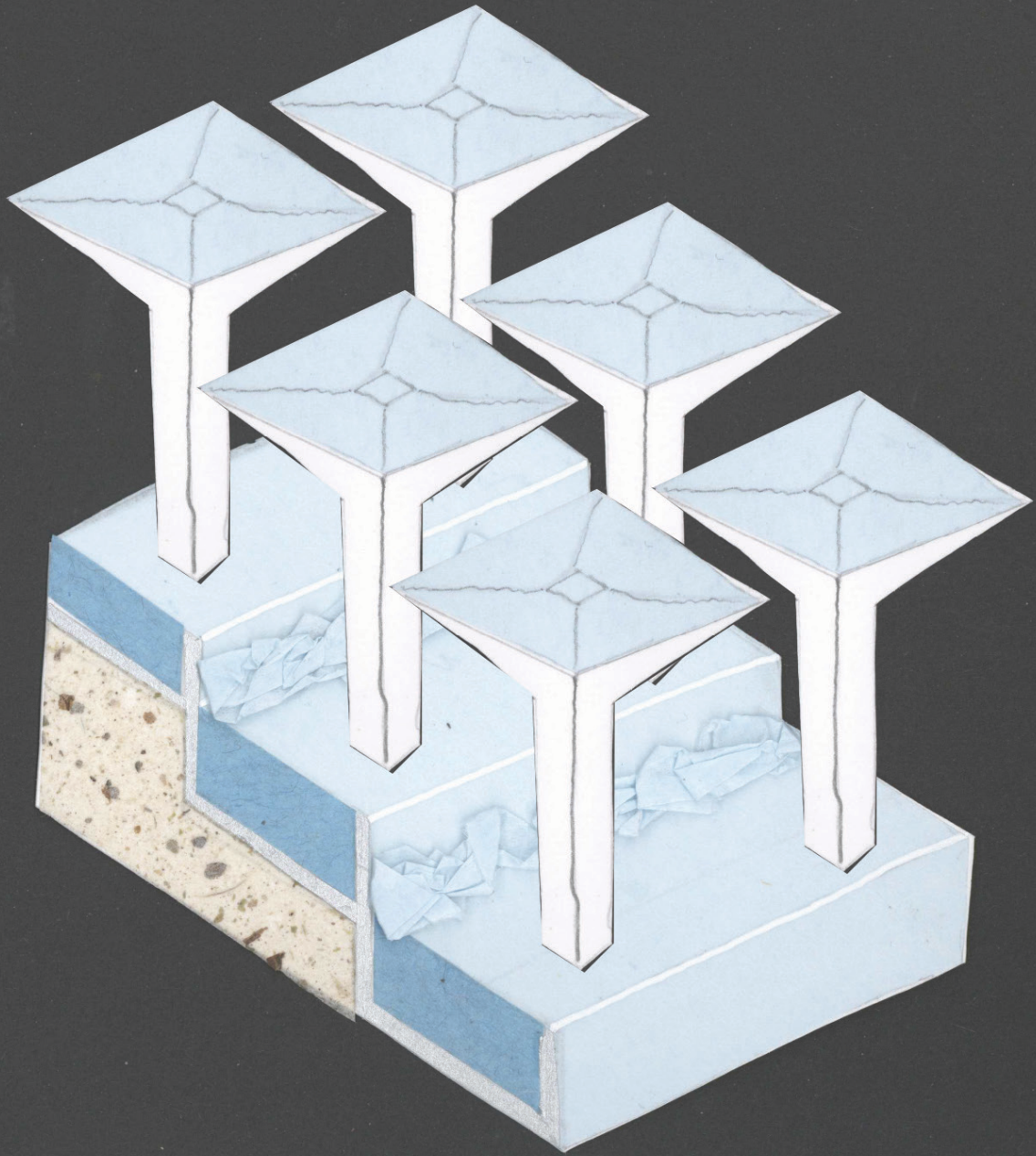


[27]  
Water and architecture catalogue  
Collages created by author

## Strategies for Water Response: The Architecture

Below are some strategies for urban water responsive architecture that may be applicable for a site on the urban periphery of Mexico City:

- Floating structures: Ability to permanently exist on water
- Stilted structures: Dodging flash floods
- Amphibious structures: Deploy in emergency situations
- Roof shape: Potentials in rainwater catchment
- Public Art: Collected water to exhibit the nature of water to be celebrated
- Underwater: Dual life when there is water and when there is none
- Sloped foundations: serve as dikes to protect important infrastructure and buildings
- Blue/Green roofs: Catch water while providing cooling to prevent heat island effect

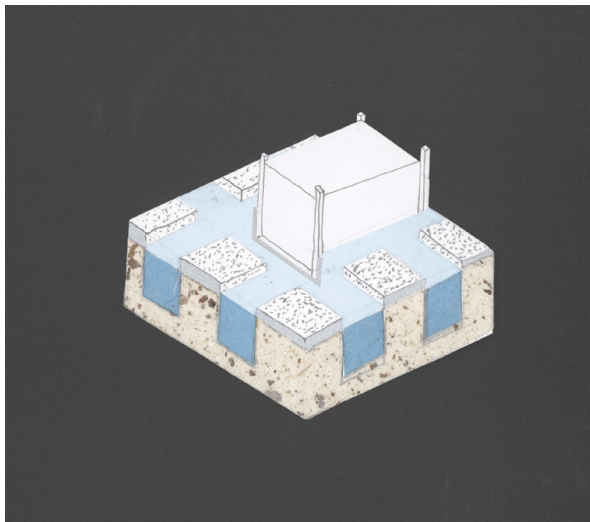


[28]  
Combining strategies of  
infrastructure and architecture  
to create context-specific water  
management strategies

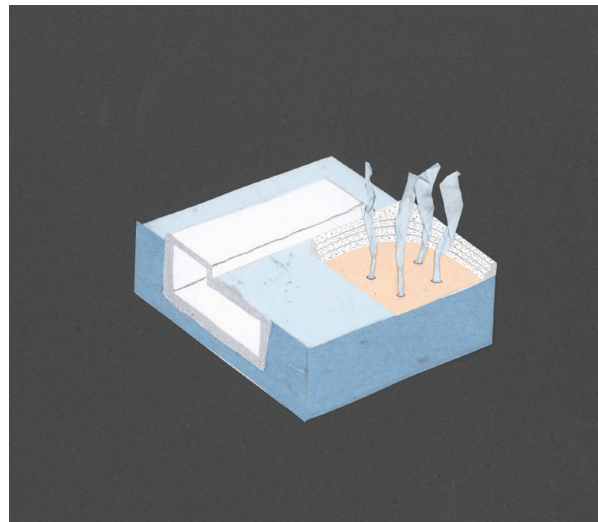
## 3.2 – Design Beginnings: Fusing Control + Response

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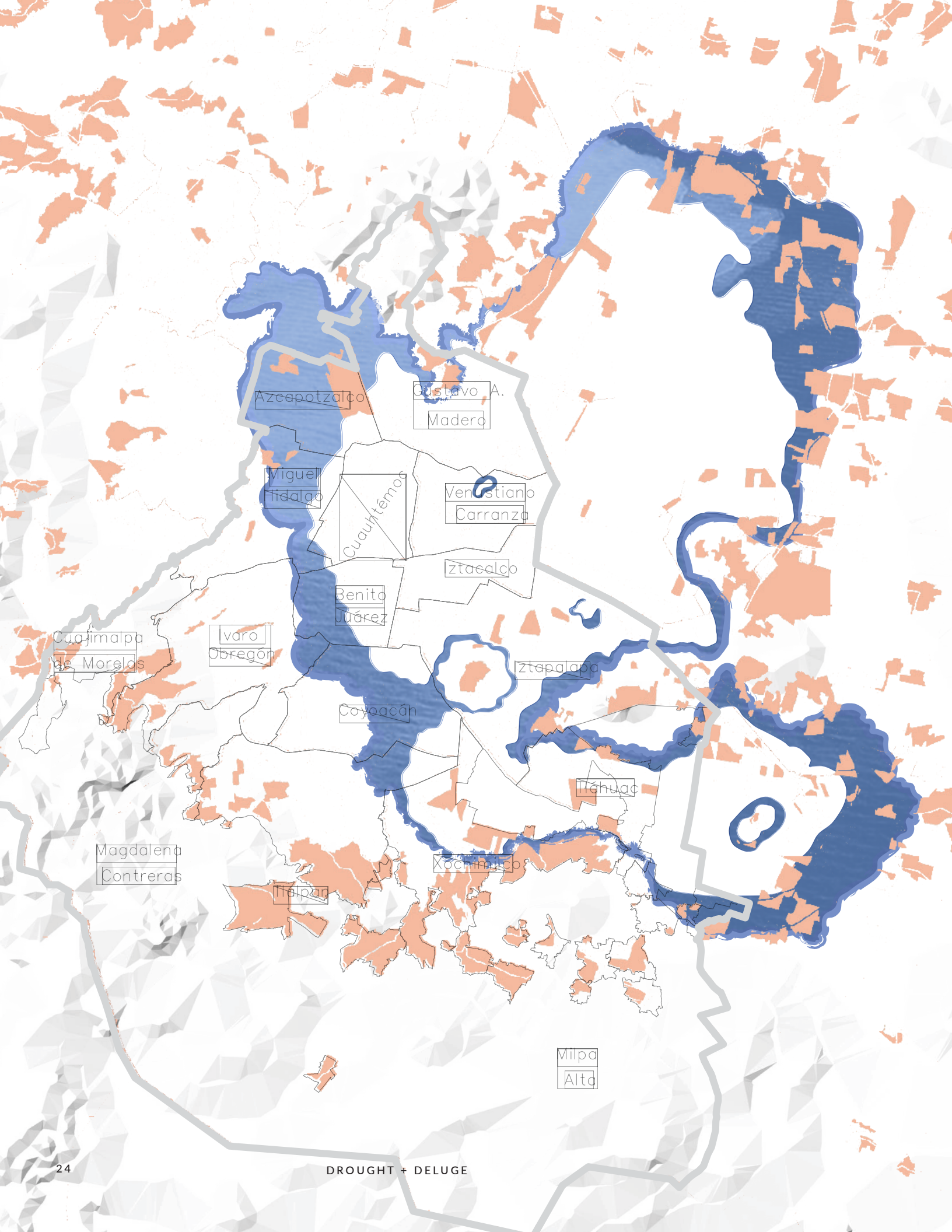
By defining the characteristics of water control and water response, various spatial conditions as well as programs result by fusing the two and provide an integrated strategy for managing water. How can the two work together to create context-specific, amphibious strategies for Mexico City that are appropriate for urban poor conditions? As this thesis exploration continues, investigations and design proposals will be made to incorporate the management, as well as the celebration of water, to a city long tormented by this relationship. It is the hope that this project will work towards a healing process between water and city and live in harmony once more.



[29]



[30]



### 3.3 - The Blue Ring: Ghost of Texcoco

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The volcanic soil in Mexico City, described above as porous and stable, is found mainly along the perimeter of where Lake Texcoco once resided, and absorbs water to deliver it to the aquifer. It is at this location along the city that stands the best chance to replenish the aquifer and prevent the calamities of a sinking city. The issues emerge when this land becomes developed, becoming further impervious with its concrete roads and building foundations.

[Volcanic soil is] stable and porous. Picture a bucket filled with marbles. You can pour water into the bucket, and the marbles will hardly move. Stick a straw into the bucket to extract the water, and the marbles still won't move. For centuries, before the population exploded, volcanic soil guaranteed that the city had water underground.

Mexico City's water crisis today comes partly from the fact that so much of this porous land — including large stretches of what Mexico City has supposedly set aside for agriculture and preservation, called "conservation land" — has been developed. So it is buried beneath concrete and asphalt, stopping rain from filtering down to the aquifers, causing floods and creating "heat islands" that raise temperatures further and only increase the demand for water (De Urbanisten 30-32).

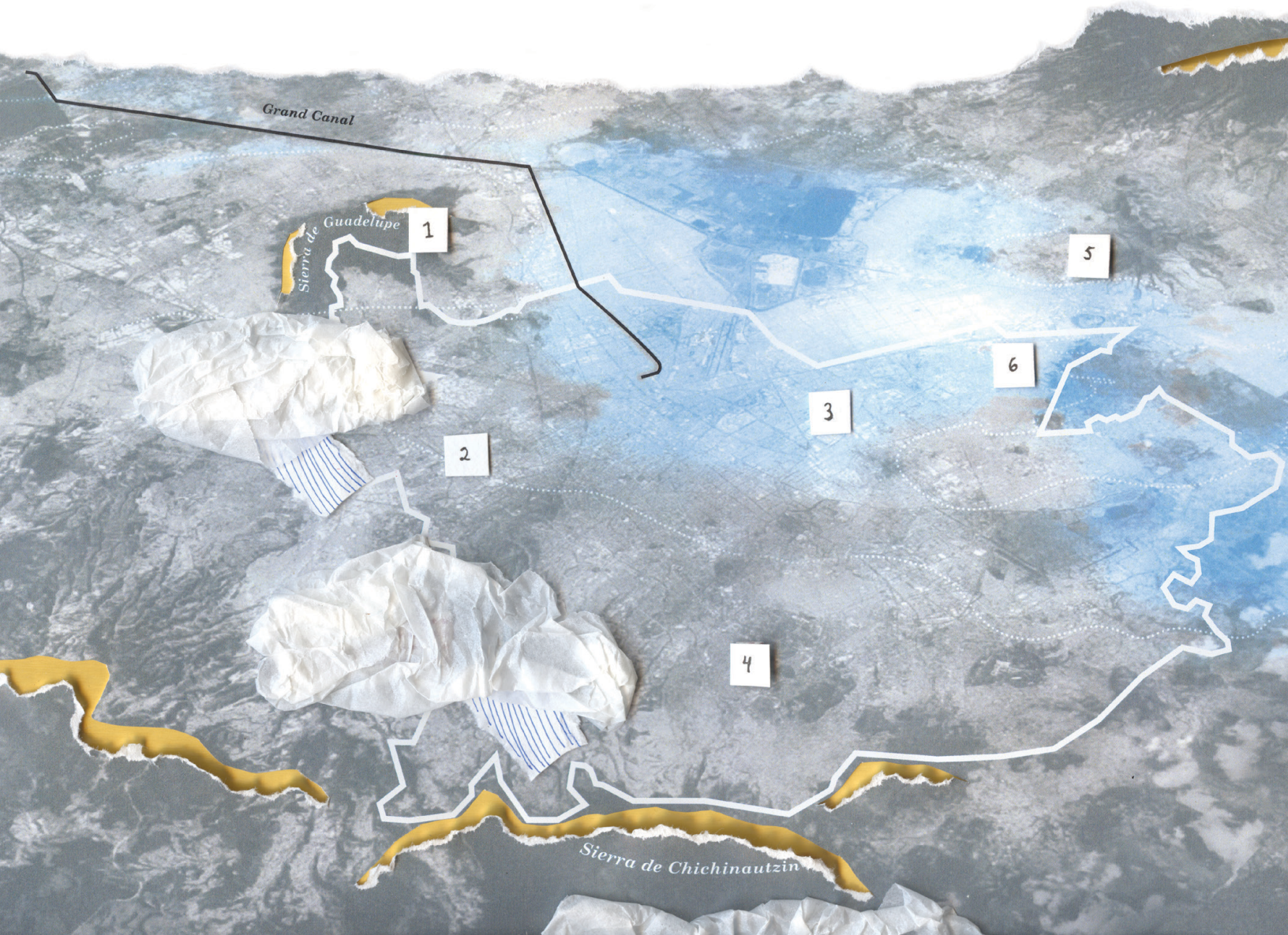
The pervious zone that encircles the city, designated in this proposal as The Blue Ring, becomes a design opportunity to address issues in water access and inequity. By identifying these areas of the city that overlap with the infiltration/transition zone, design has the potential to relieve dependence on the aquifer extraction by giving communities leverage to collect and treat their own drinking water, protect homes from floods, and provide opportunities for infiltration to recharge the aquifer.

It is predicted that by 2080, Mexico City's average temperature will rise several degrees and annual rainfall will decrease by 20 percent (60). If this is true, it is paramount that the city make moves to both use land along this transition zone in a much more mindful manner to allow water to infiltrate back into the aquifer, and provide adequate means of collecting water in preparation for droughts.

**[31] (Previous page)**

The permeable soil at the perimeter for the ancient lake, called The Blue Ring in this thesis, intersecting with areas without water access in Mexico City

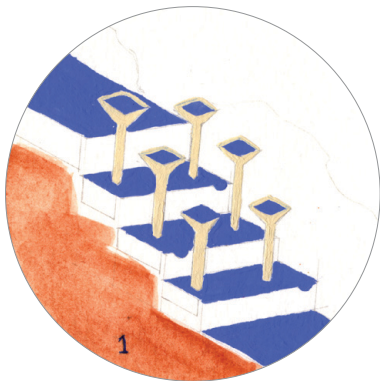
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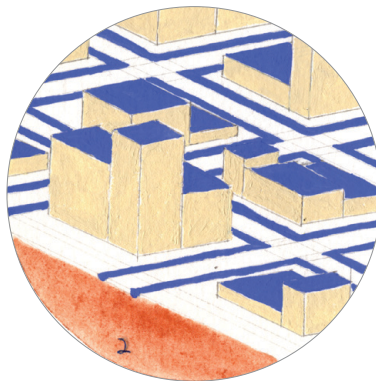
### 3.4 - Developing a Water Language

First diagram looks at Mexico City and its relationship to the ancient lake. The “Blue Ring” at the perimeter of this now extinct lake is the most permeable area of the city, bringing water down to replenish the aquifer, where 70% of the city’s potable water comes from. The diagram to the left looks at 6 different parts of the city, acknowledging combinations between wet and dry areas, mountainous and flat areas, and urban and rural areas. For each of these studies, the schemes use a language of **delay, store, retain, reuse, clean, and regenerate** based on this contextual needs. For example, a rainy urban area might benefit from a stacked means of collecting, conveying, and infiltrating due to tight area constraints, while a rural dry area could utilize a larger surface area to collect any water that does fall, while relying on transferring water collected in a rainy area of the city. Ultimately, this study takes into account how no one solution is wise for any part of the city based on its geological conditions, and provides a language of collection, conveyance, and infiltration needed at all points along the Blue Ring.

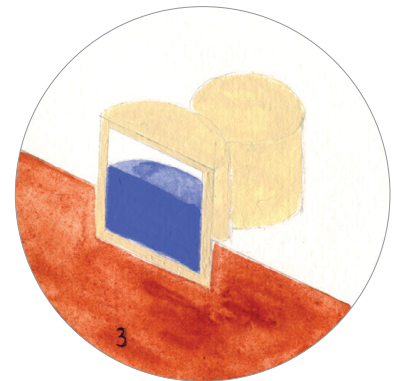
[33] RAINY / MOUNTAINOUS  
Delay + Store



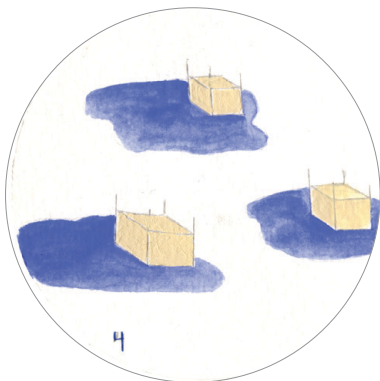
[34] RAINY / URBAN  
Delay + Retain



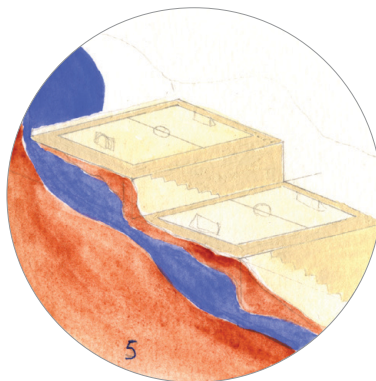
[35] DRY / URBAN  
Store + Reuse



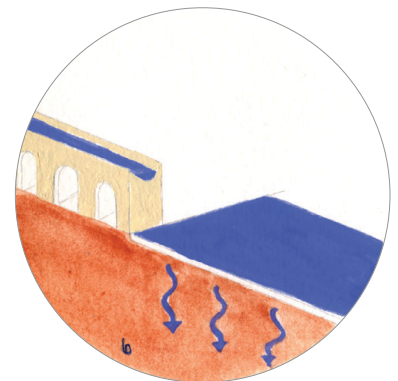
[36] RAINY / RURAL  
Clean + Regenerate



[37] DRY / MOUNTAINOUS  
Store + Clean



[38] DRY / RURAL  
Retain + Regenerate



## 3.5 – Methods for Site Selection

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Through a series of mapping and continued layering, the site was determined based on the following:

1. Site's location along The Blue Ring and overlaps with informal settlements
2. The land's efficiency for infiltration
3. An area that suffers from both floods in the rainy season...
4. And drought in the dry season

Based on this criteria, the one of the most appropriate areas to pursue in this thesis will be just north of the city in the Ecatepec de Morelos, located at the base of the Sierra de Guadalupe. This area overlaps with the Blue Ring, and has an infiltration efficiency rate of 30%, second to the highest infiltration efficiency area of the Conservation land along the Sierra del Chichinautzin to the south, with 35% efficiency. However, the southern areas should remain largely undeveloped due to their conservation land designation. Ecatepec de Morelos also suffers from floods in the rainy season with about 15 flash flood events a year, and 30-40 heat waves with high levels of evapotranspiration in the dry season. This area of the city is largely self-built, with very poor infrastructure to water access, where most of the development is located up the mountain slopes.

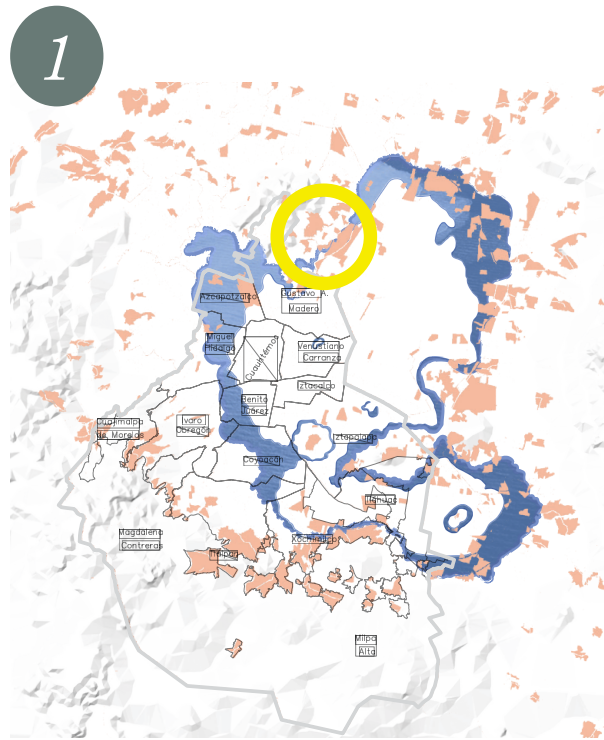
[39]

Created by author

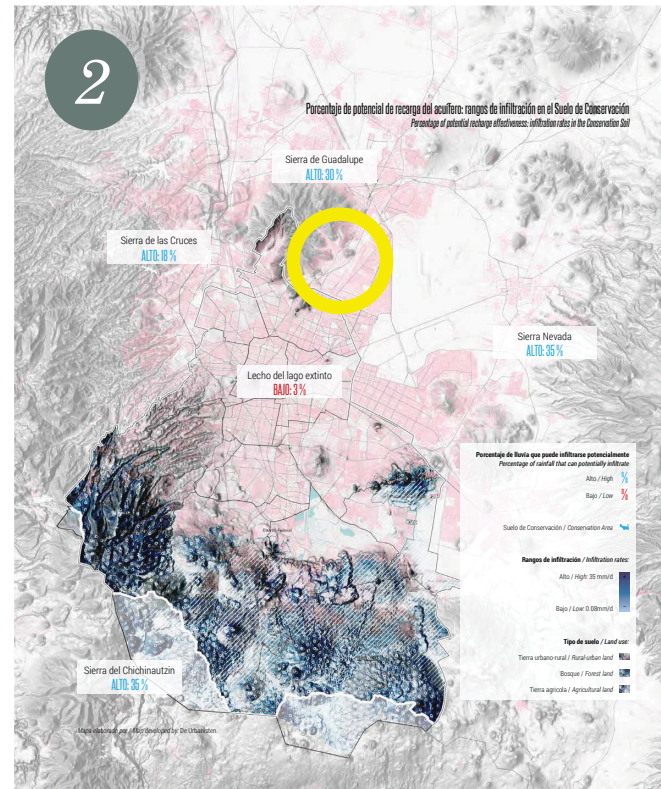
[40, 41, 42]

recreated by De Urbanisten

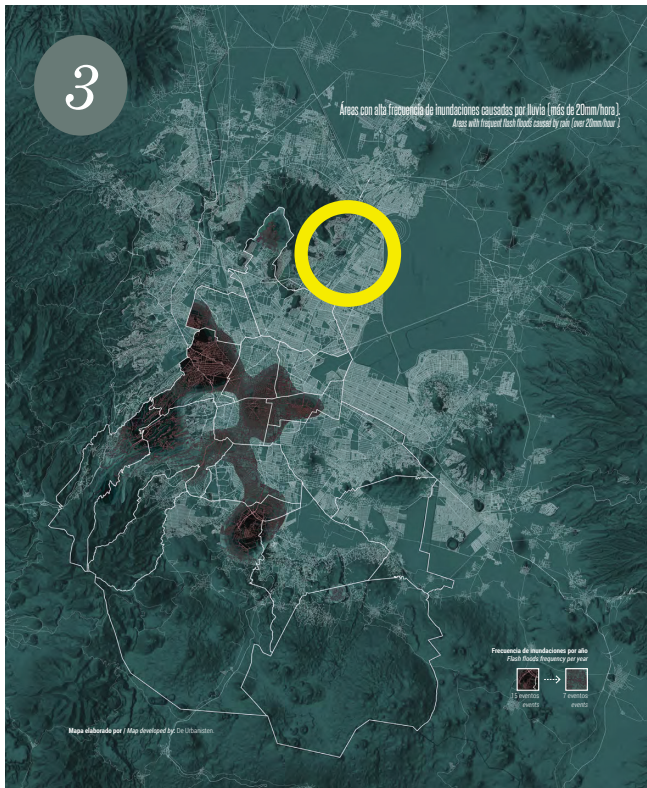
[39]



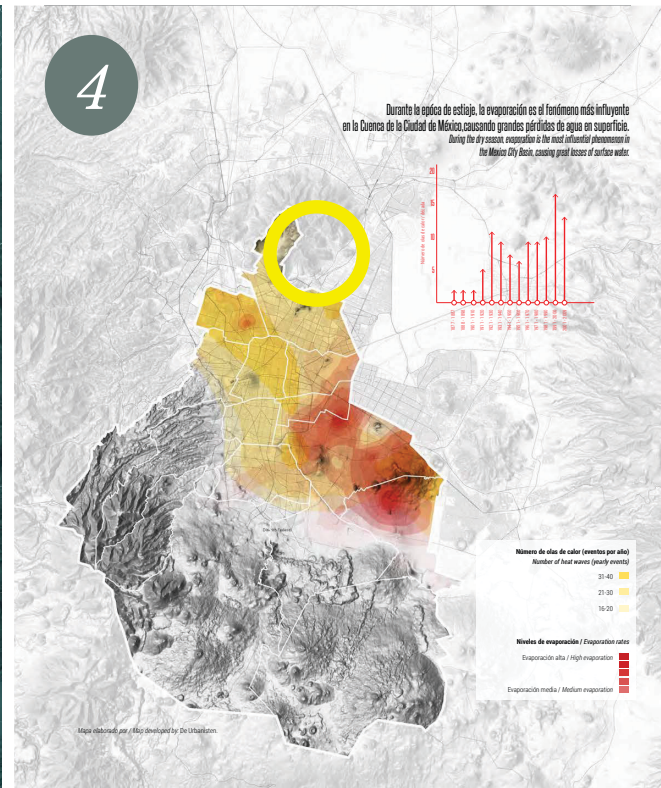
40]

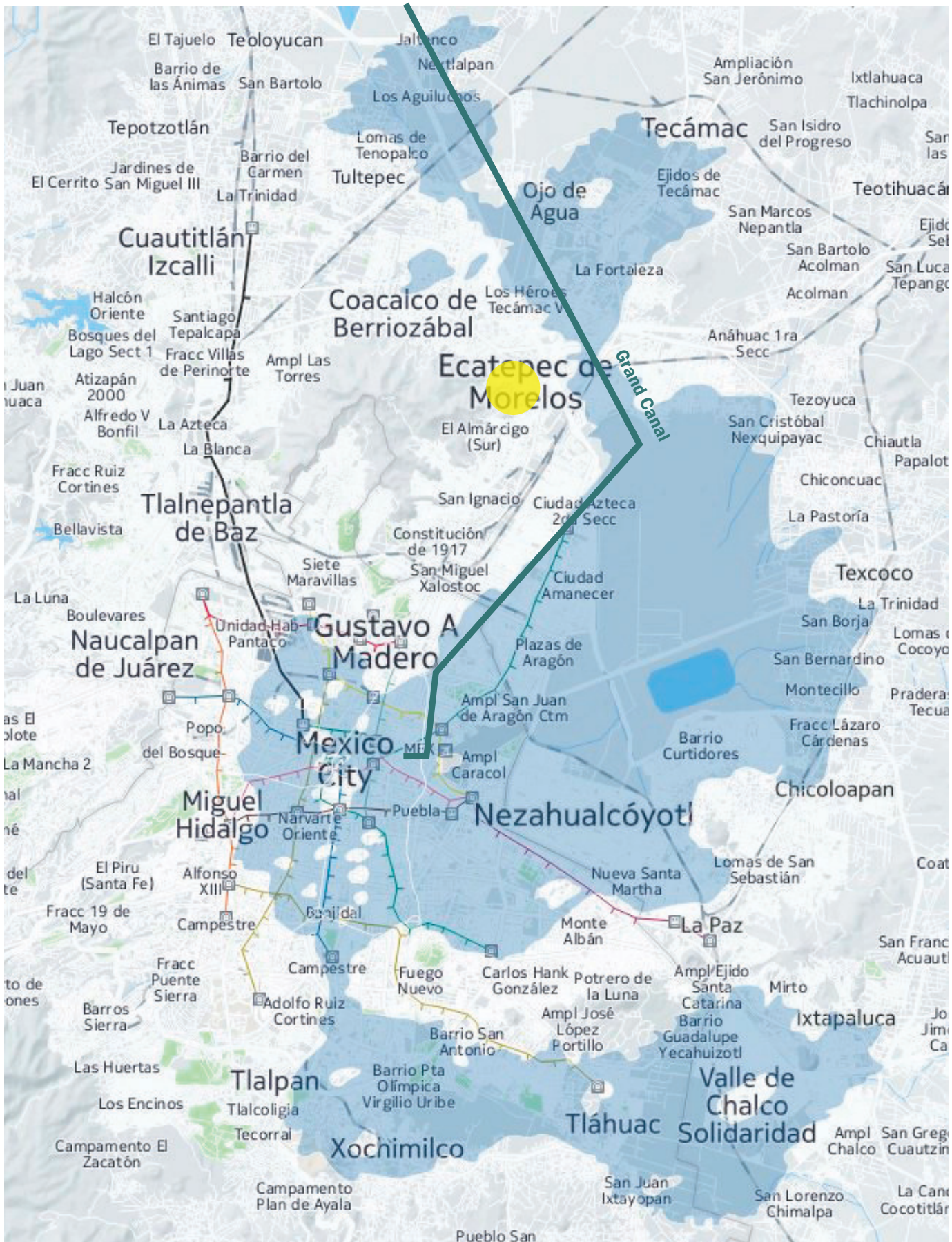


[41]



42]





[43]

### 3.6 - La Presa, Ecatepec de Morelos

La Presa, a neighborhood of Ecatepec de Morelos, is a self-built settlement that extends into the hills of the Sierra de Guadalupe. The hillside faces east, toward the main highway exiting the city running north. It also slopes toward the Grand Canal, Mexico City's largest open air sewage drainage out of the city. As Ecatepec de Morelos floods from the mountain run off of the Sierra de Guadalupe, the Grand Canal overflows with stormwater and sludge.

Ecatepec de Morelos is a city of 1.6 million people, and the area of La Presa is also known to be one of the most dangerous and violent parts of Greater Mexico City, with over 200,000 violence related deaths in the last decade. It is the hope that this thesis exploration provides a place of healing, not only to the basin's hydrological health, but to the neighborhood's sense of peace. This established a site and a program for a Water Culture & Education Center, to provide awareness and education for water centric development.

[44]



[45]



[46]



### 3.7 – Ritual + Procession

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With the mountain site located, procession of water was abstractly diagrammed as it cascades down the mountain-side. As a result, a conceptual narrative for this project was developed from the importance of procession, the sense of the next stage, and ritual.

[47]

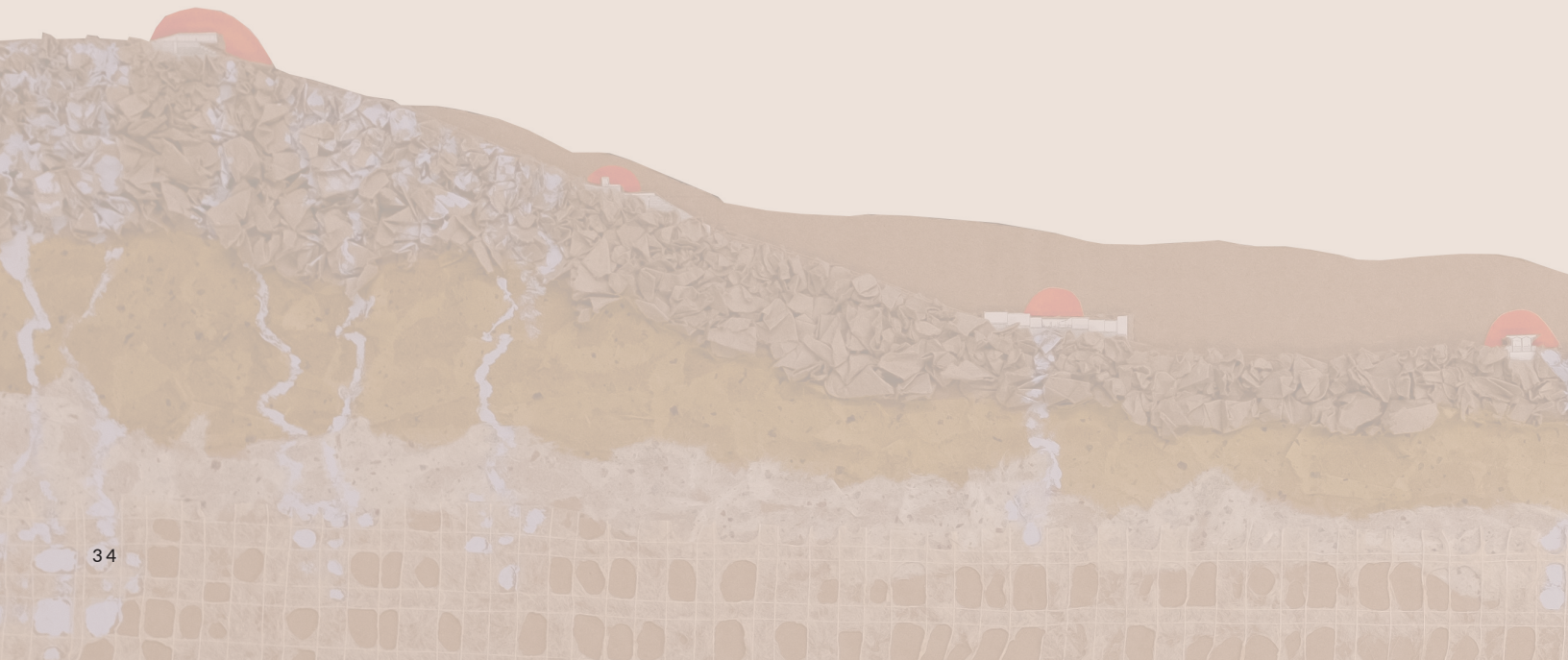


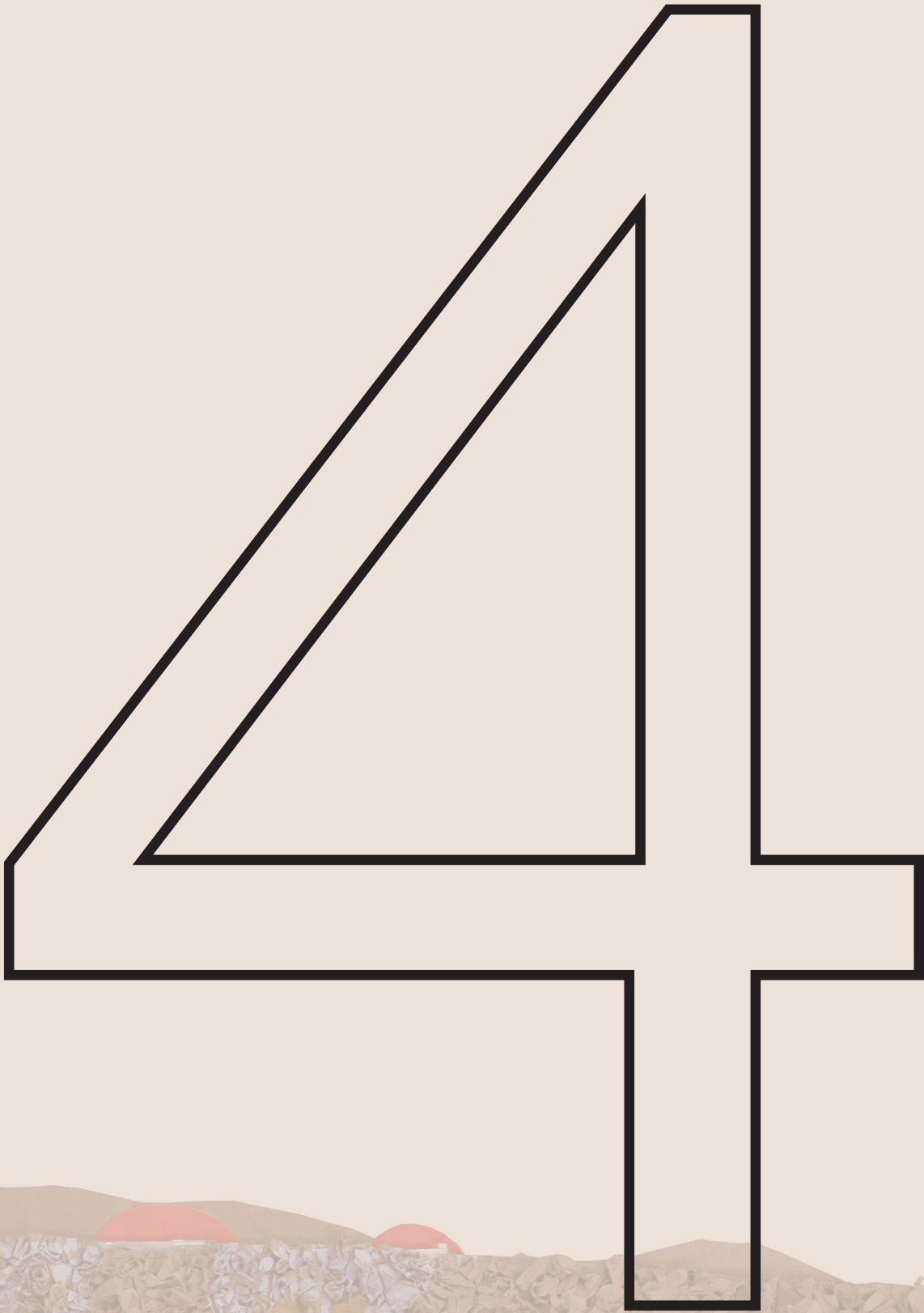


[48]

C H A P T E R F O U R

# PROJECT





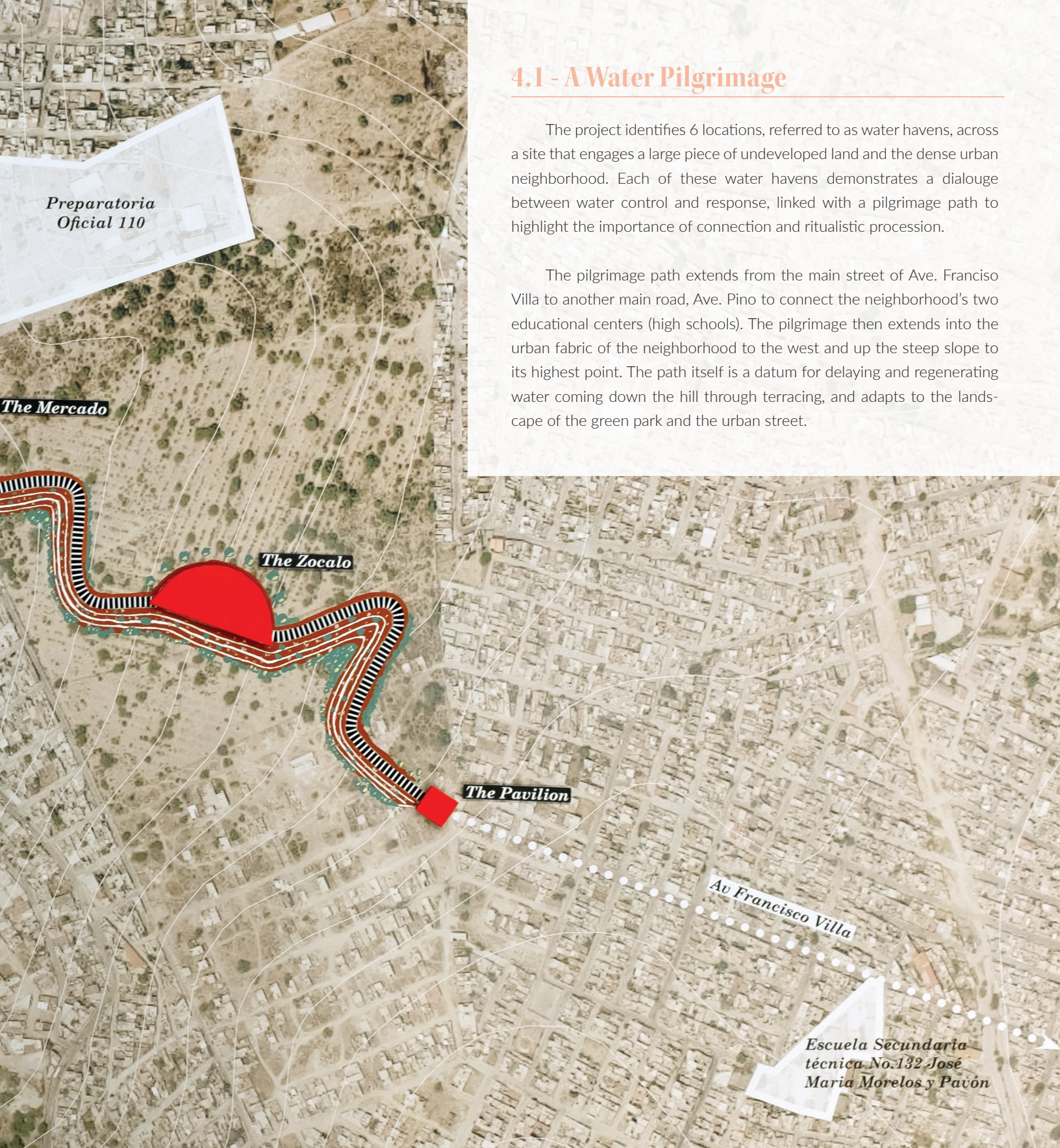


[49]

## 4.1 - A Water Pilgrimage

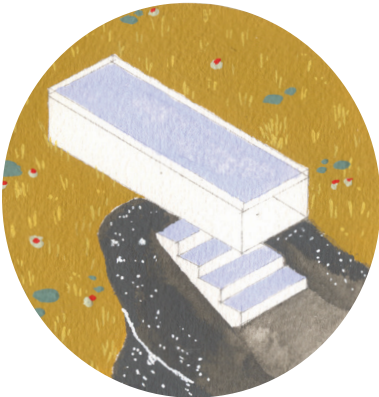
The project identifies 6 locations, referred to as water havens, across a site that engages a large piece of undeveloped land and the dense urban neighborhood. Each of these water havens demonstrates a dialogue between water control and response, linked with a pilgrimage path to highlight the importance of connection and ritualistic procession.

The pilgrimage path extends from the main street of Ave. Francisco Villa to another main road, Ave. Pino to connect the neighborhood's two educational centers (high schools). The pilgrimage then extends into the urban fabric of the neighborhood to the west and up the steep slope to its highest point. The path itself is a datum for delaying and regenerating water coming down the hill through terracing, and adapts to the landscape of the green park and the urban street.



# SIX WATER HAVENS

## The Lookout



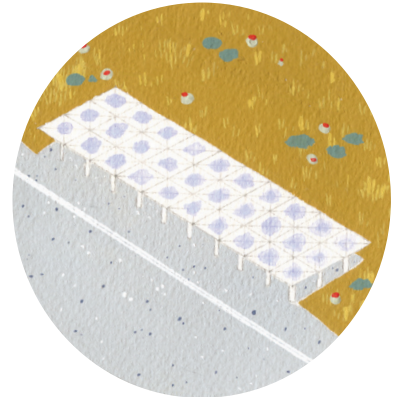
[50]

## The Chapel



[51]

## The Bodega



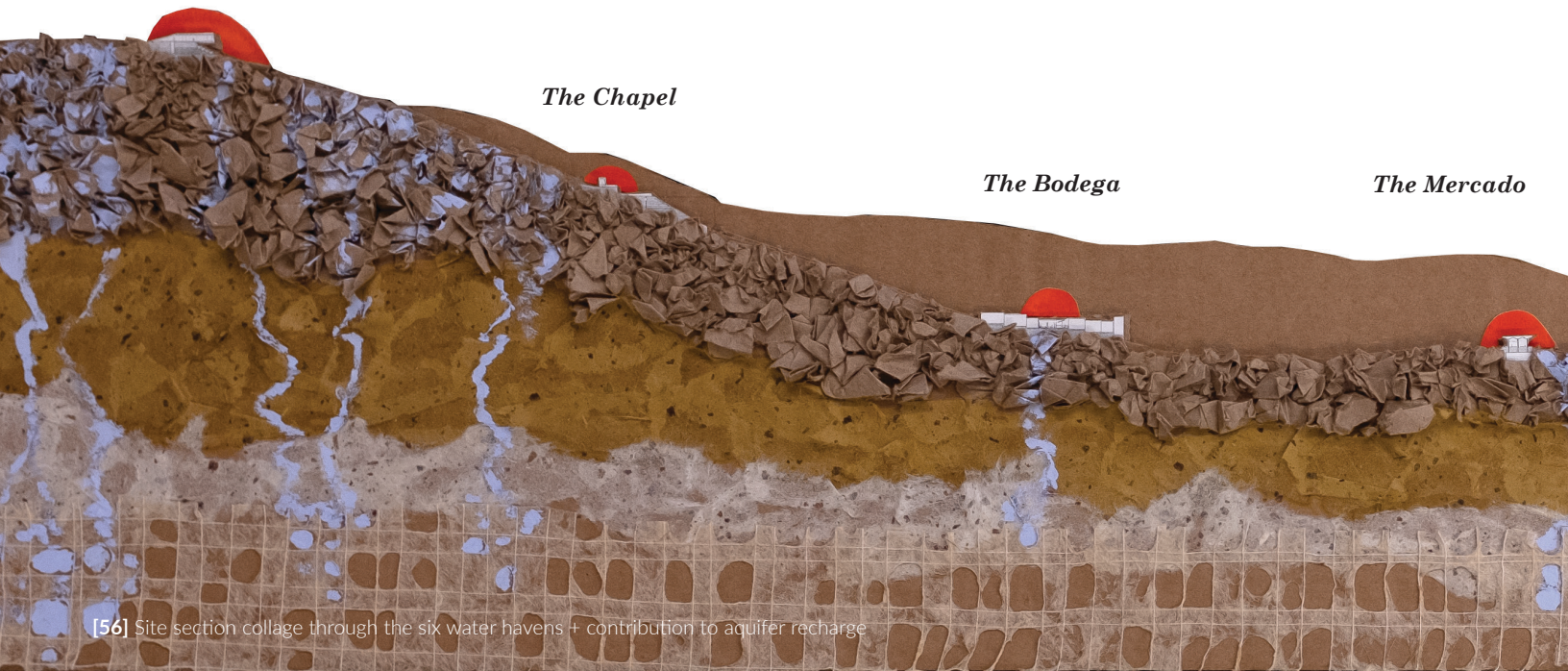
[52]

### *The Lookout*

### *The Chapel*

### *The Bodega*

### *The Mercado*

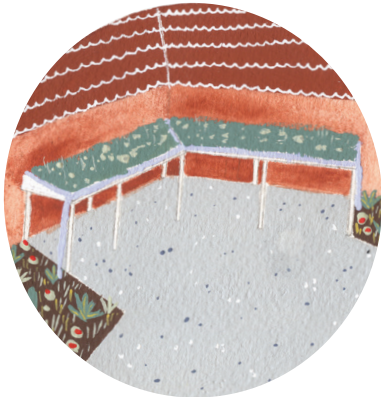


[56] Site section collage through the six water havens + contribution to aquifer recharge

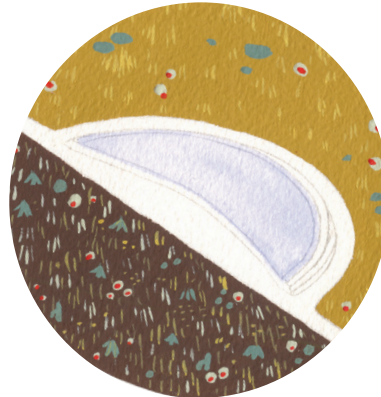
The Mercado

The Zocalo

The Pavilion



[53]



[54]



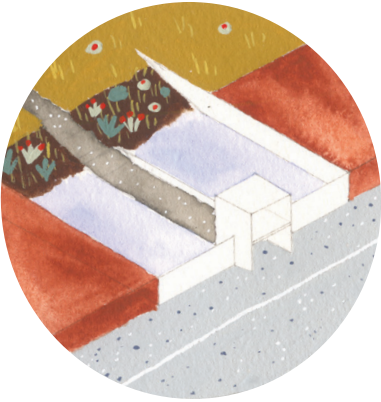
[55]

*The Zocalo*

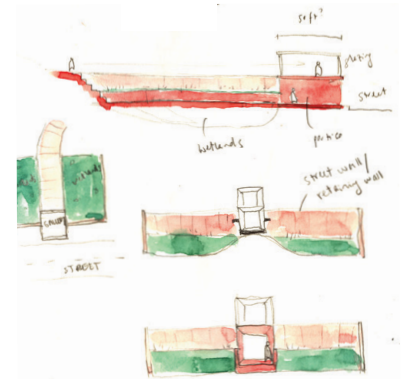
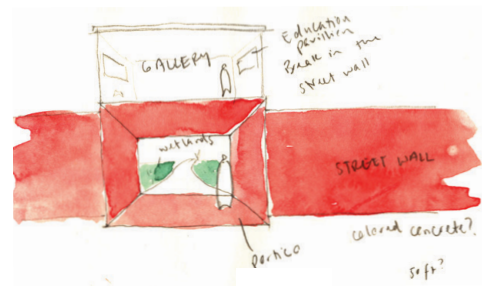
*The Pavilion*



## 4.2 – The Pavilion : Retain + Regenerate



The pilgrimage begins with a water education pavilion, intended as a transition between the neighborhood to the east and the park. Here, one enters under the pavilion that serves as a gallery space and a perch for looking upwards to the path and the next haven. The pavilion demonstrates retaining water using street walls that act as retaining walls, in addition to regeneration with constructed wetlands on a green site on either side of the path. This demonstration of retaining and regenerating water aims to plant the seed of treating areas in the neighborhood using similar tactics with existing retaining walls and street edges.



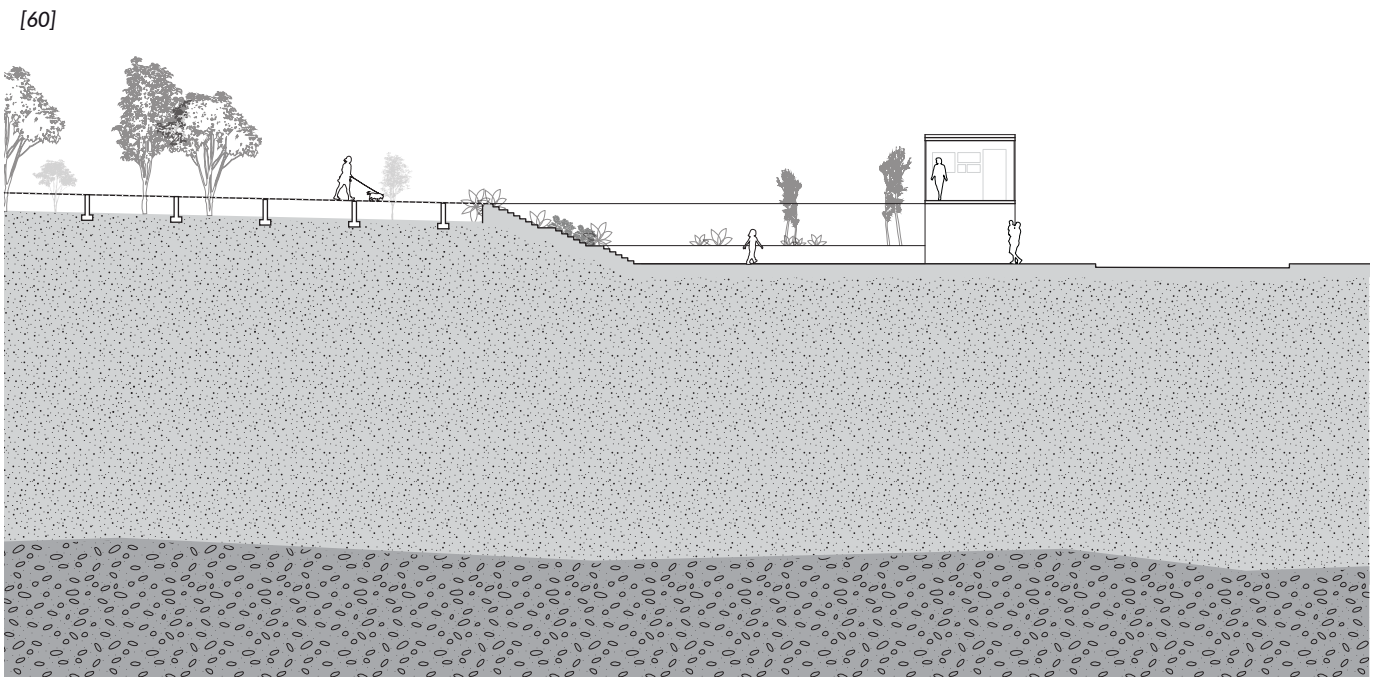
[57]



[58] Neighborhood application



[59]

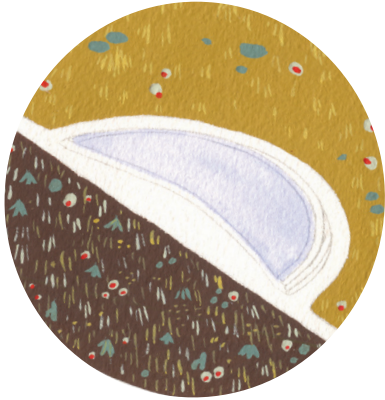


[60]

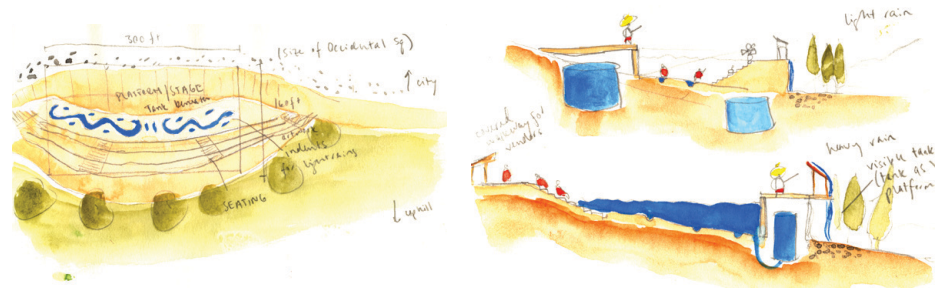




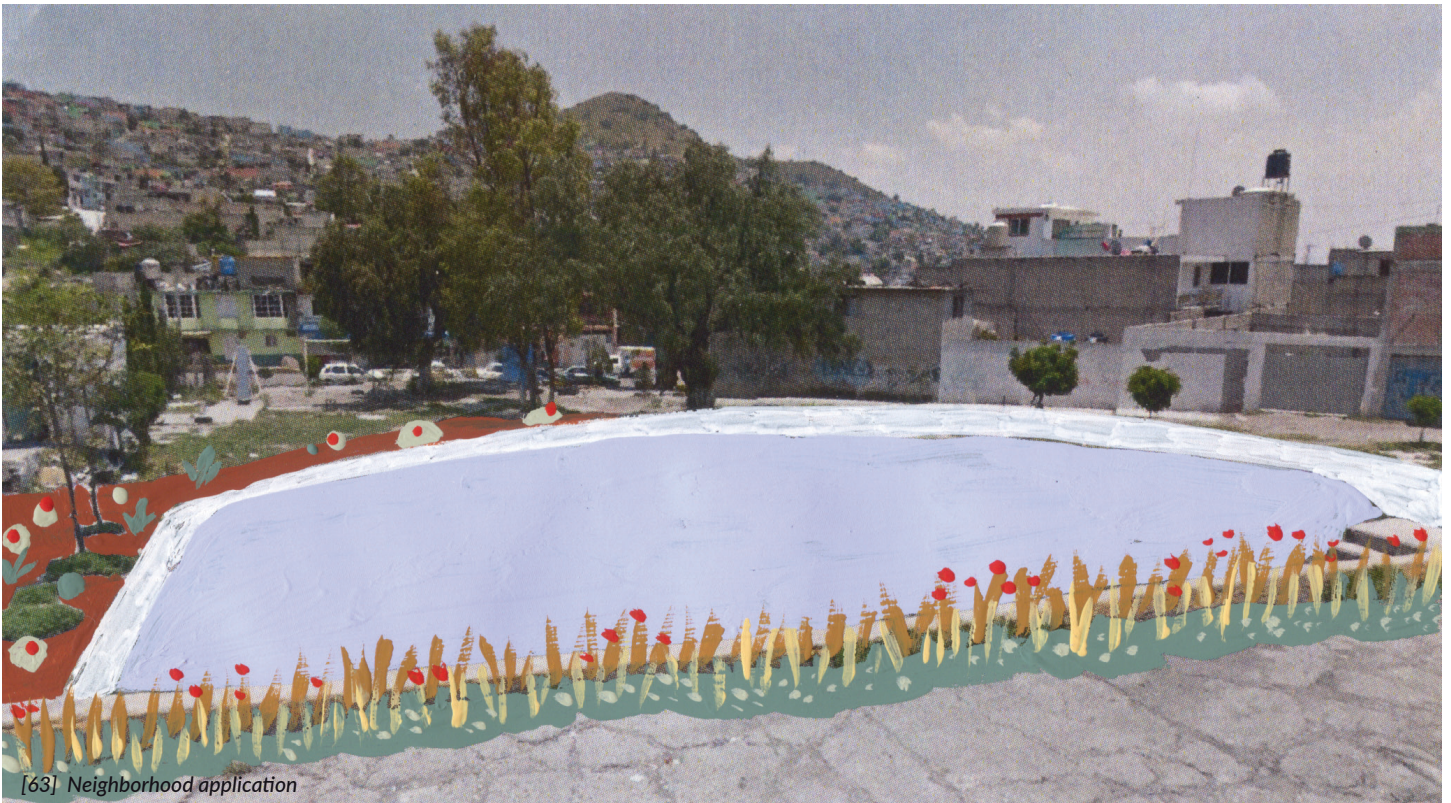
### 4.3 – The Zocalo: Delay + Store



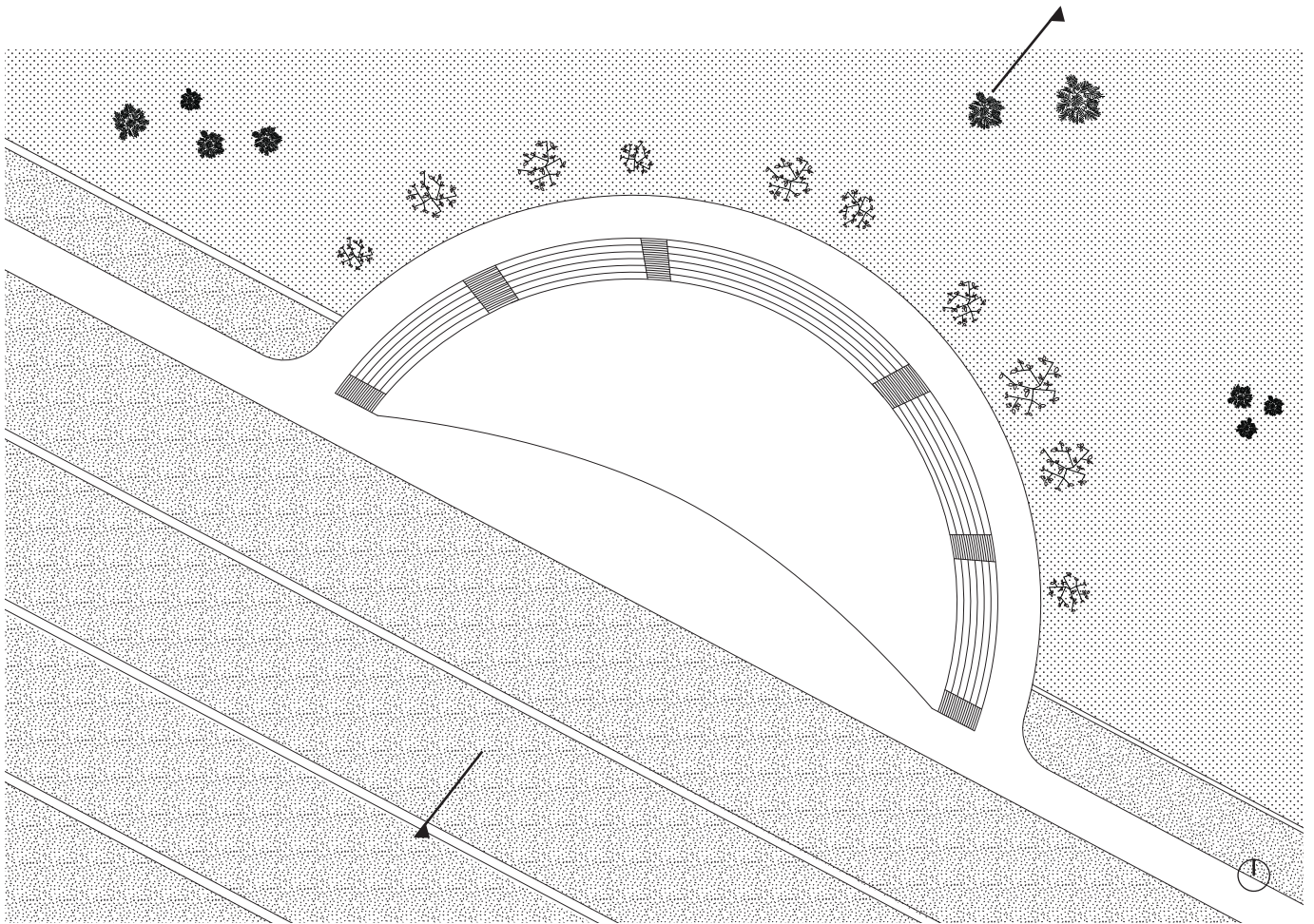
The next haven is the zocalo, located at the heart of the park. This haven demonstrates delaying and storing water by providing a water park designed to flood and store water beneath the stage in the rainy season, and act as a theater during the dry season. This demonstration may then be applied to other green areas and parks of the existing neighborhood.



[62]



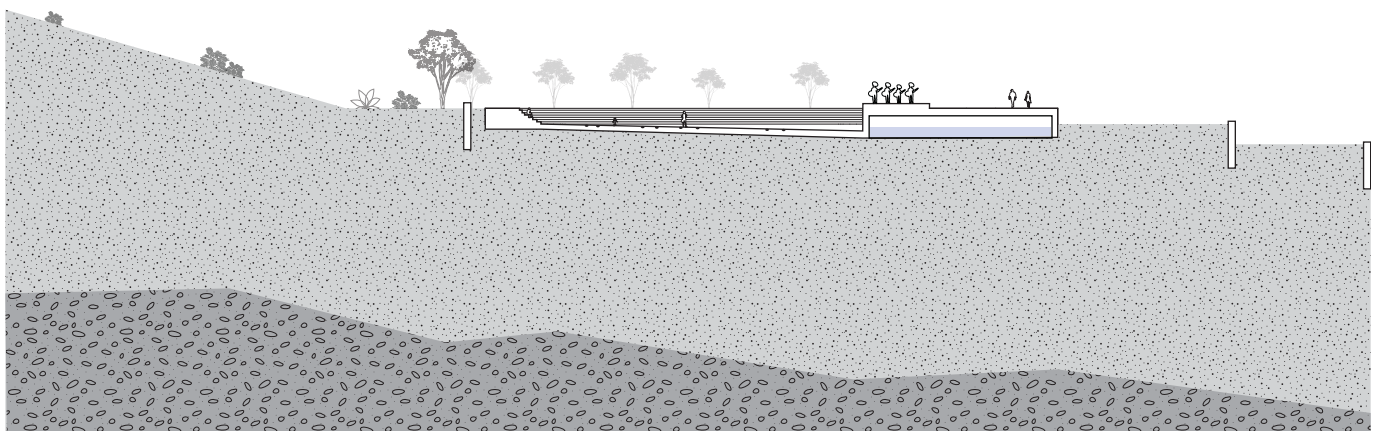
[63] Neighborhood application



[64]



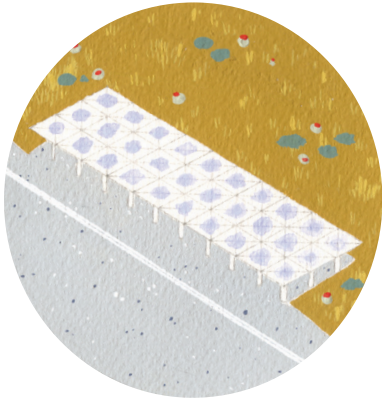
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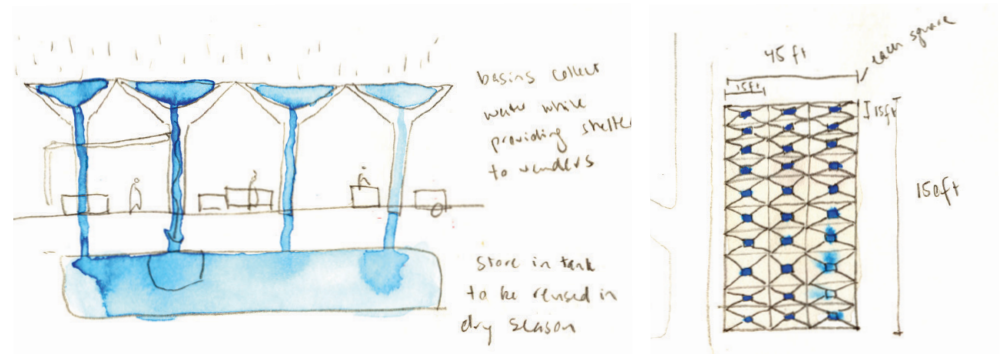




## 4.4 – The Mercado: Retain + Store



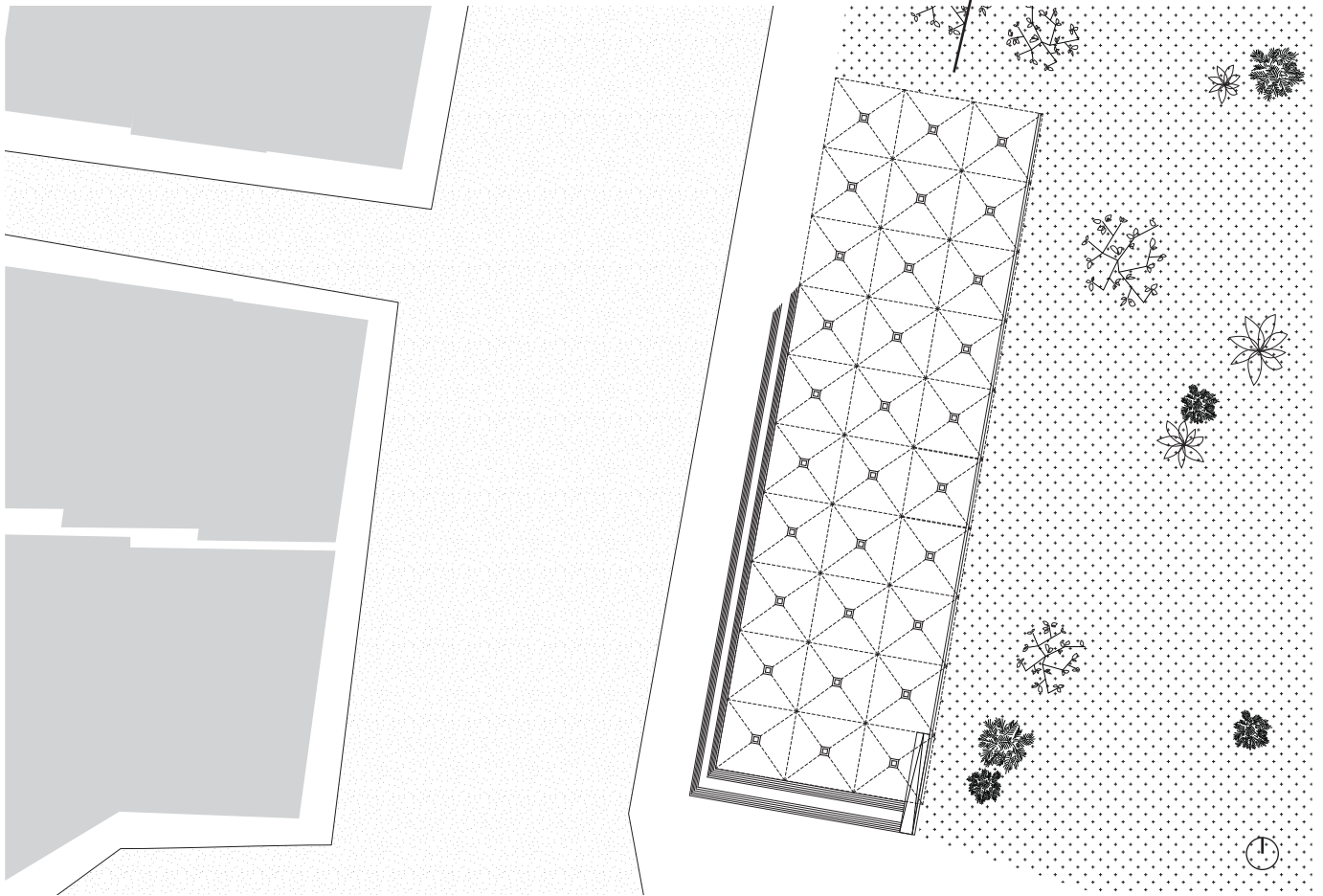
The third haven takes the form of a mercado, and is located at the western edge to the park, leading up to the school and the western urban neighborhood. The mercado also demonstrates retaining and storing water in an urban condition, where umbrella structures act as a shelter for the market stalls while also collecting water during the rainy season to be saved for reuse in the dry season. This demonstration may take root in other urban developments in the neighborhood.



[67]



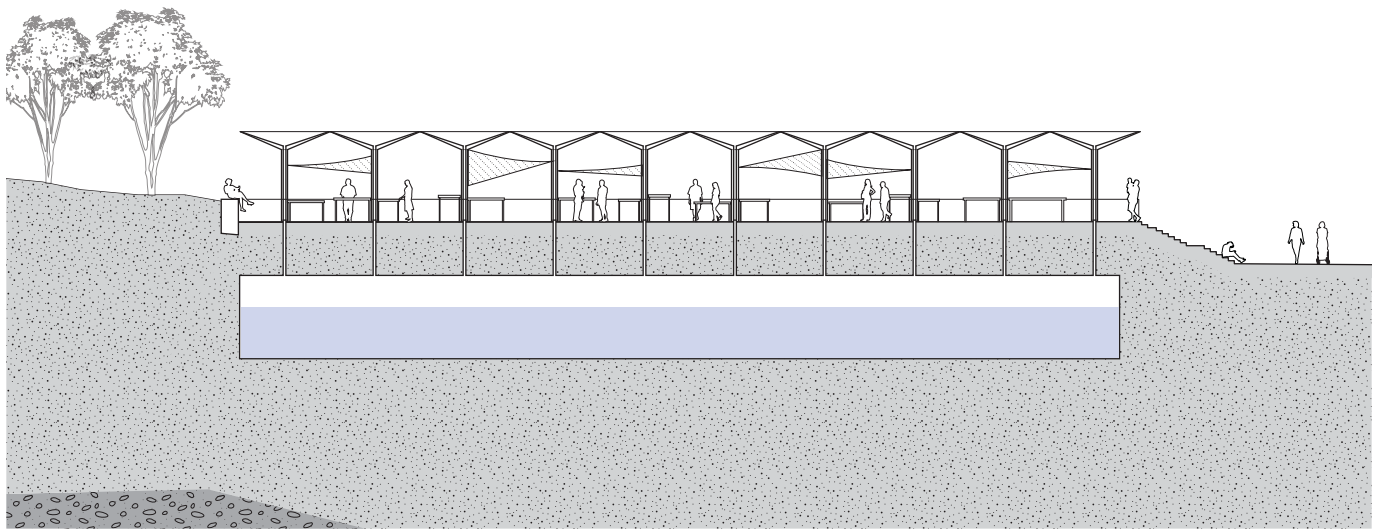
[68] Neighborhood application



[69]



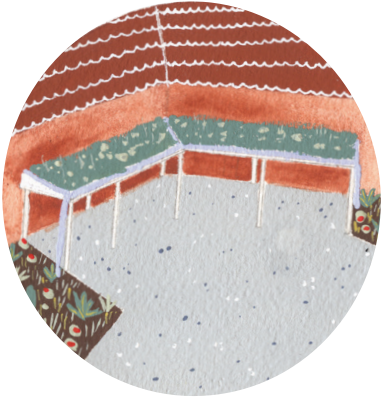
[70]



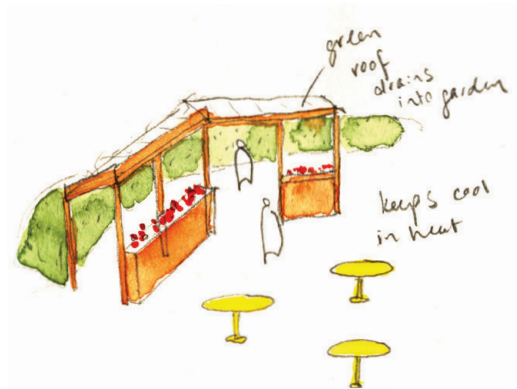




## 4.5– The Bodega: Delay + Regenerate



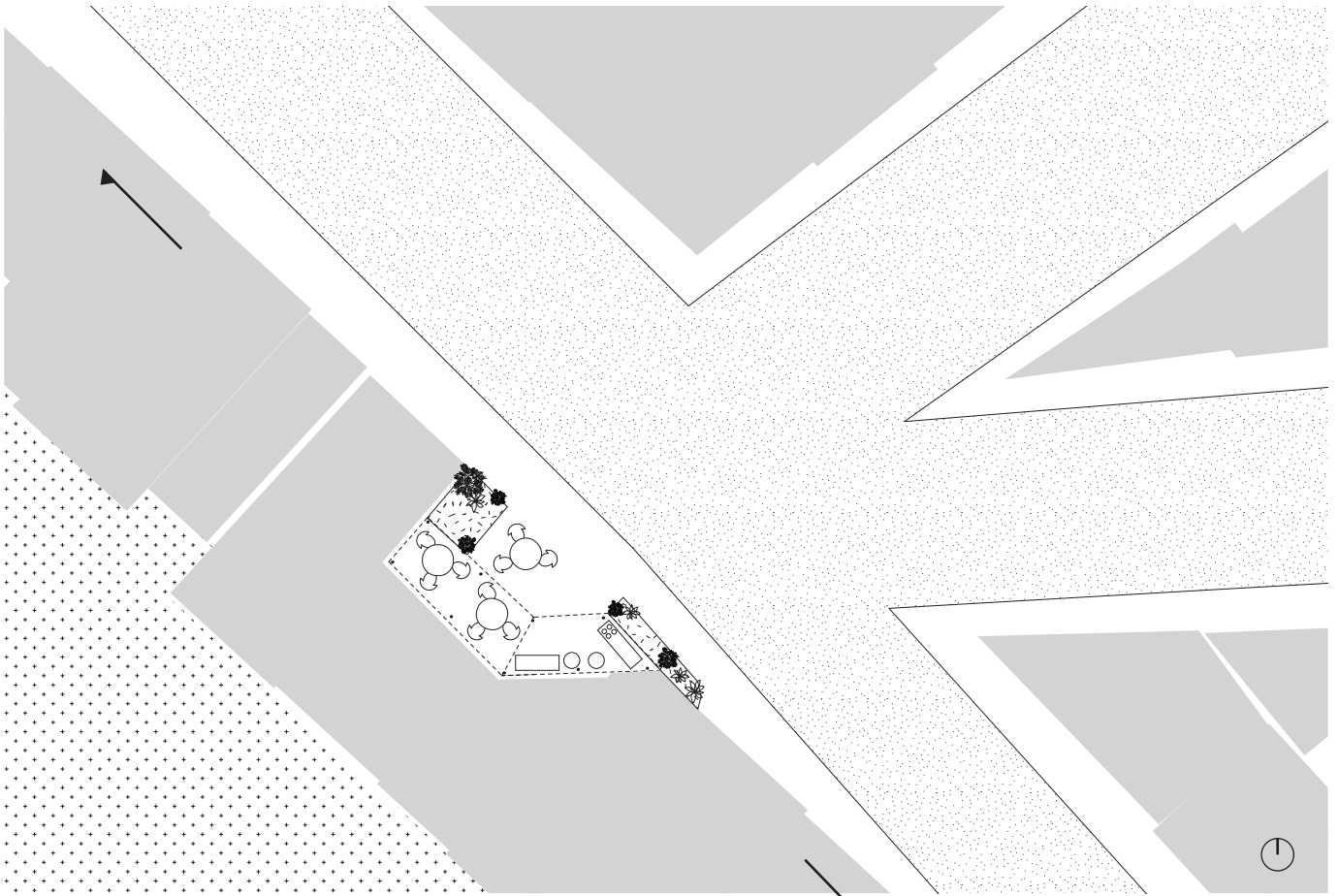
The fourth haven is a bodega that serves as the hinge point of the pilgrimage path, and demonstrates delay and regeneration in an urban condition. A sloped roof collects water from adjacent buildings and redirects water to rain gardens on either side of the bodega. The bodega demonstrates how even temporary structures can still play a role in healing the water cycle, and may inspire similar local street vendors to do the same.



[72]

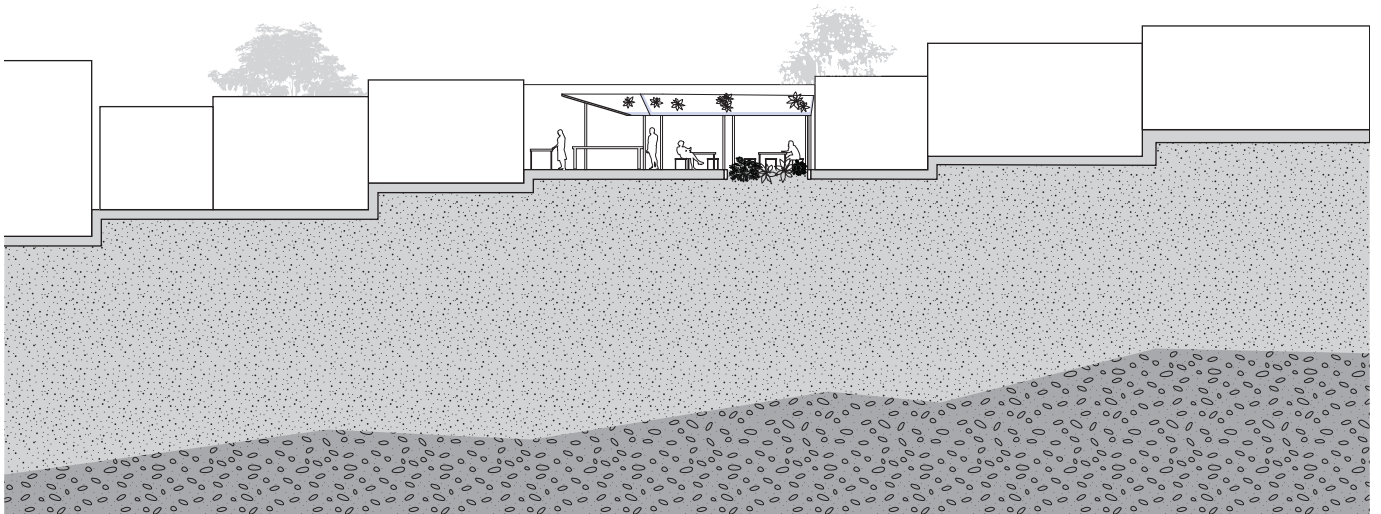


[73] Neighborhood application



[74]

[75]



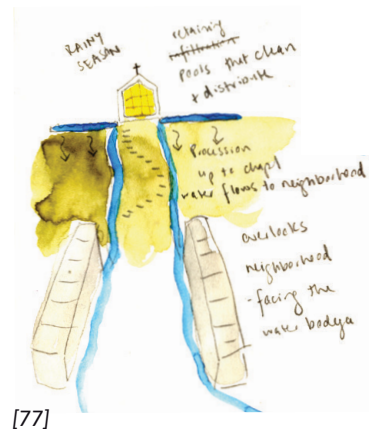




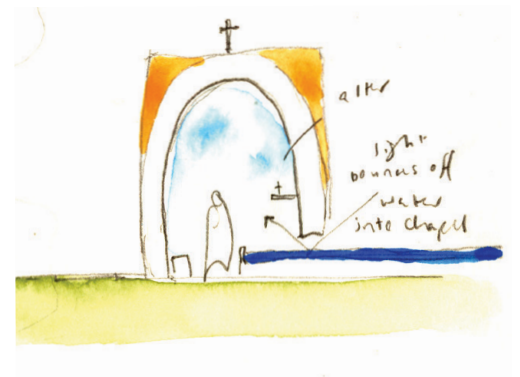
## 4.6 – The Chapel: Clean + Reuse



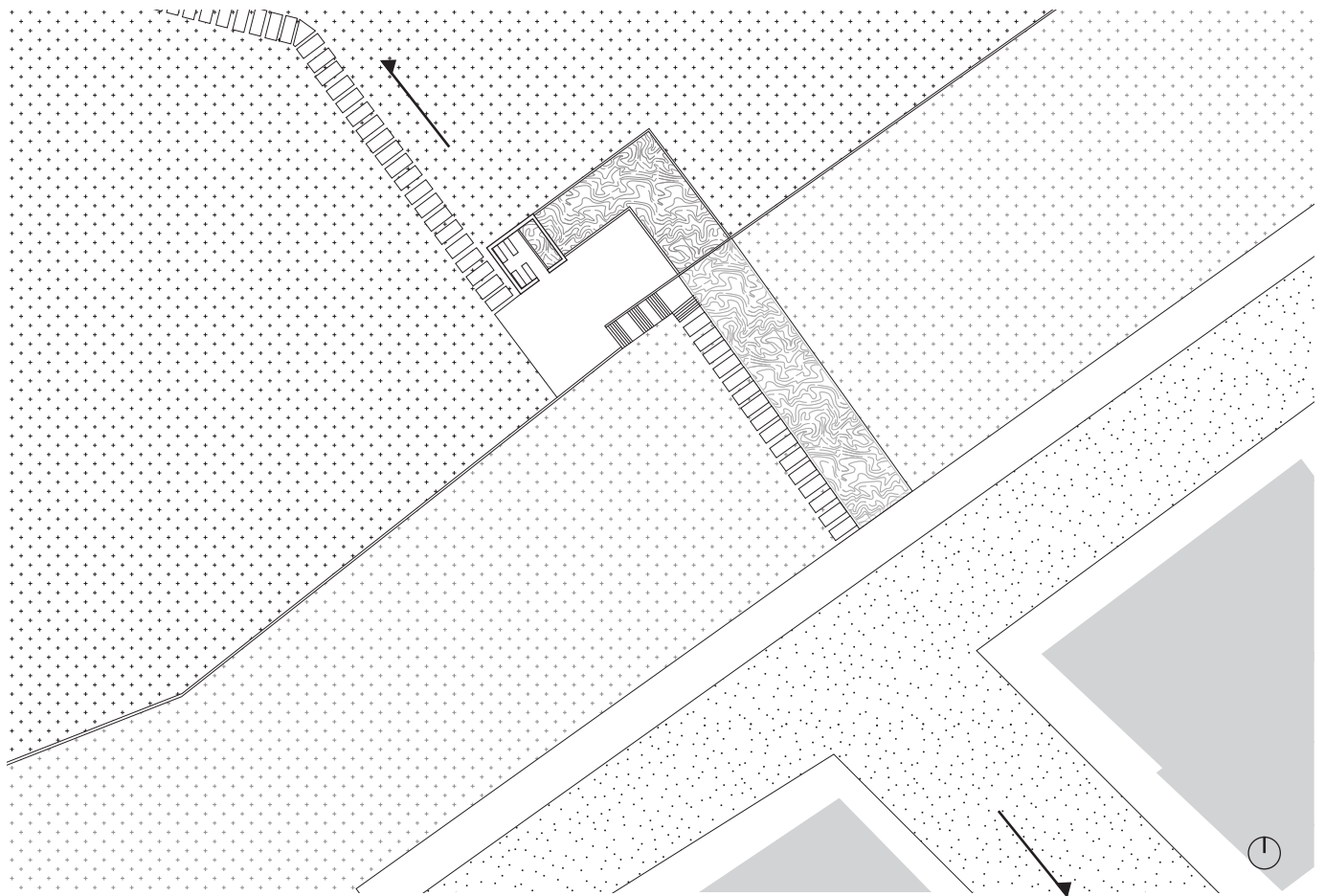
The fifth haven involves a hike up the urban street and into the rural hills to a chapel. A place of solitude and meditation, the chapel demonstrates the cleaning of water for distribution, and reuse with a reflecting pool that cascades over the mountain's edge. The water collected is then filtered and distributed as water fountains for the homes down the hill. The chapel also highlights the beauty of water, reflecting from the pool into the space from below to celebrate the sacred resource. Through this demonstration, water may be used as public art as well as filtered and distributed around the neighborhood to continue being celebrated.



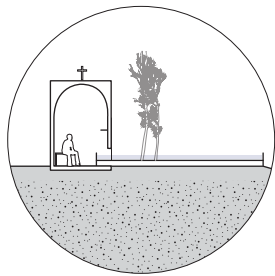
[77]



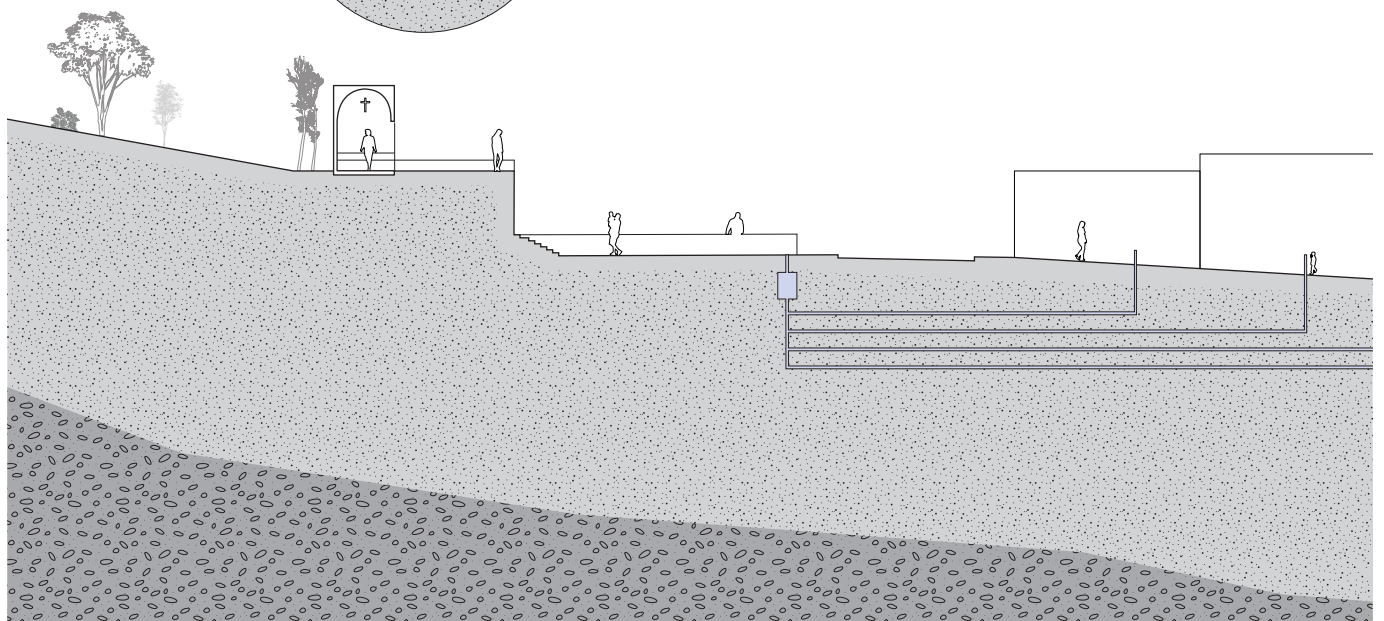
[78] Neighborhood application

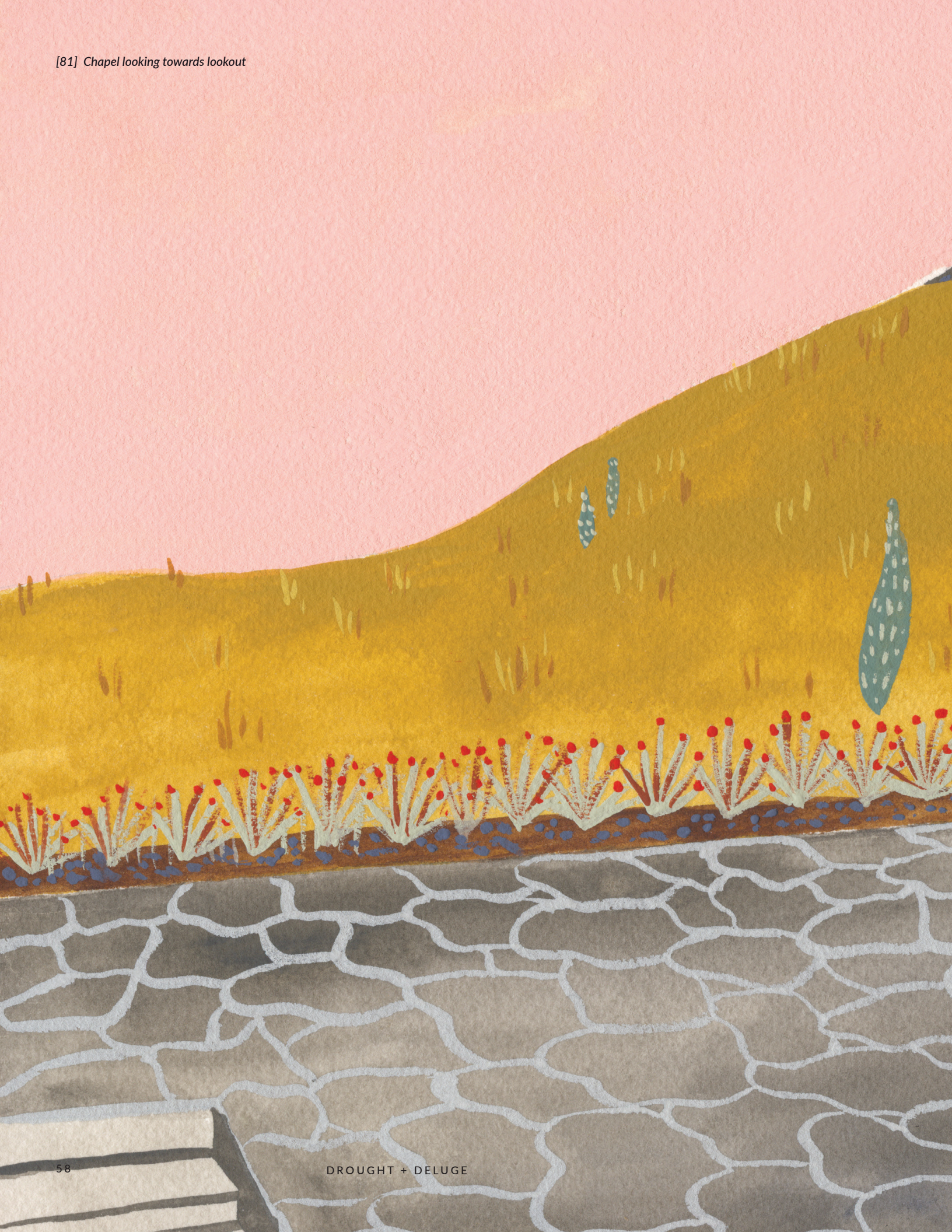


[79]



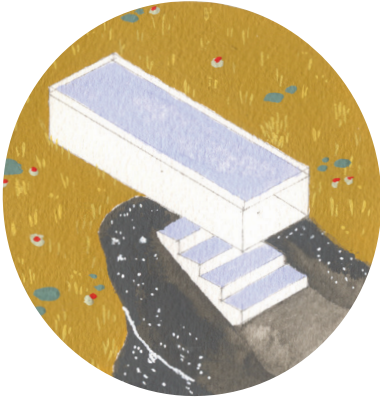
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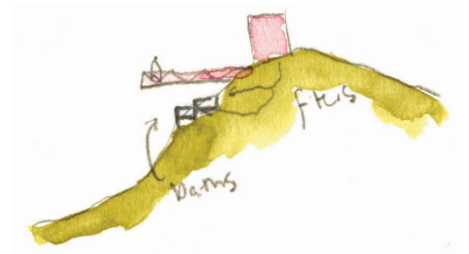
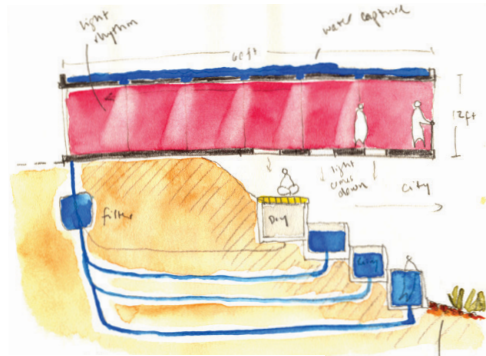




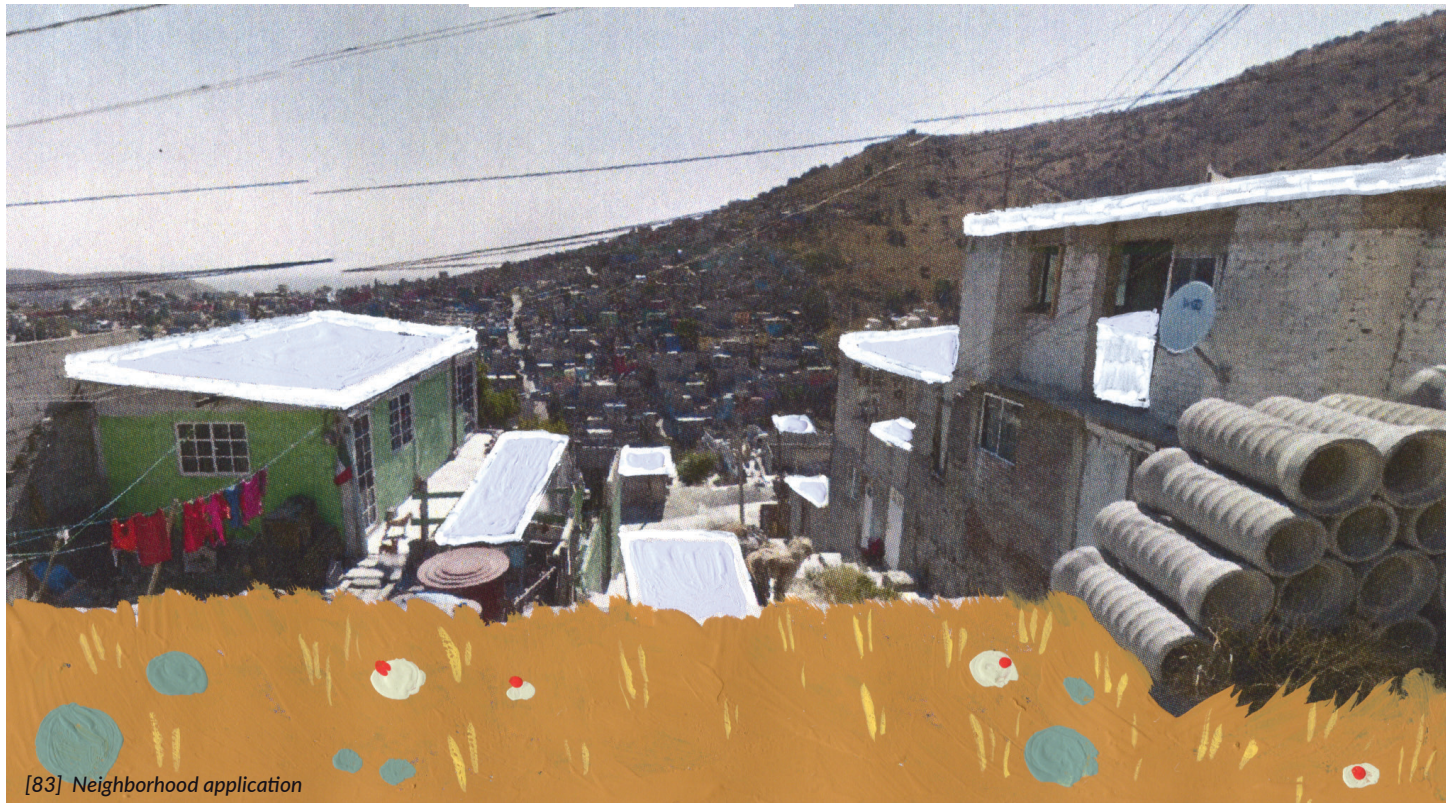
## 4.7 – The Lookout: Reuse + Store



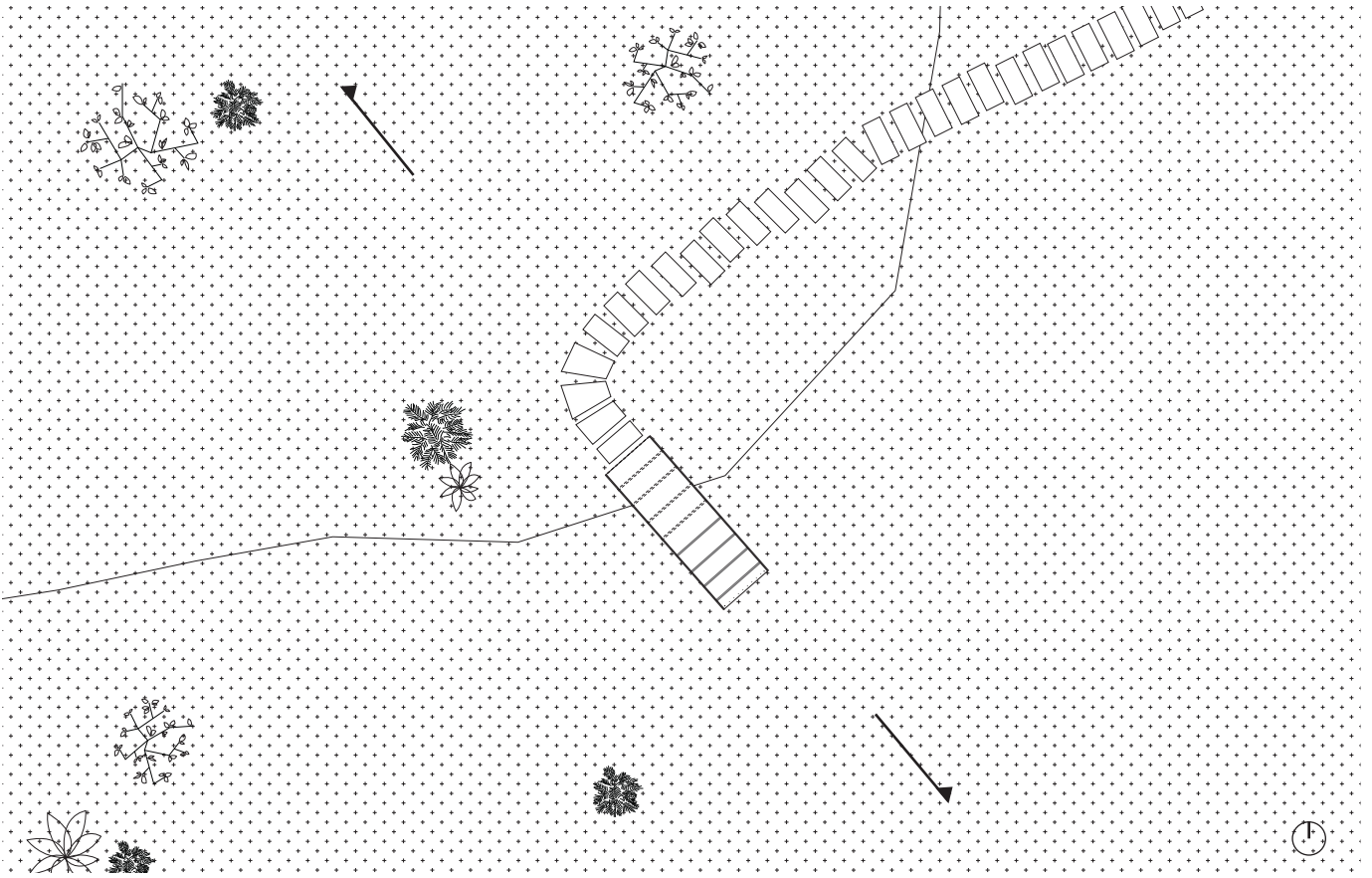
The final haven is located at the very top of the hill, a lookout point that demonstrates water reuse and storage. In the rainy season, water is collected at the roof with light wells to experience water from below. The water is then cleaned using a filtration system and pumped into baths sheltered by the cantilevered volume. In the dry season, these baths can act as covered storage tanks and viewing platforms. The lookout is a viewpoint to the pilgrimage path and the previous water havens in their connection to La Presa and the rest of the city. This demonstration of reuse and storage may be adopted by homes in the neighborhood, even in tight urban conditions.



[82]

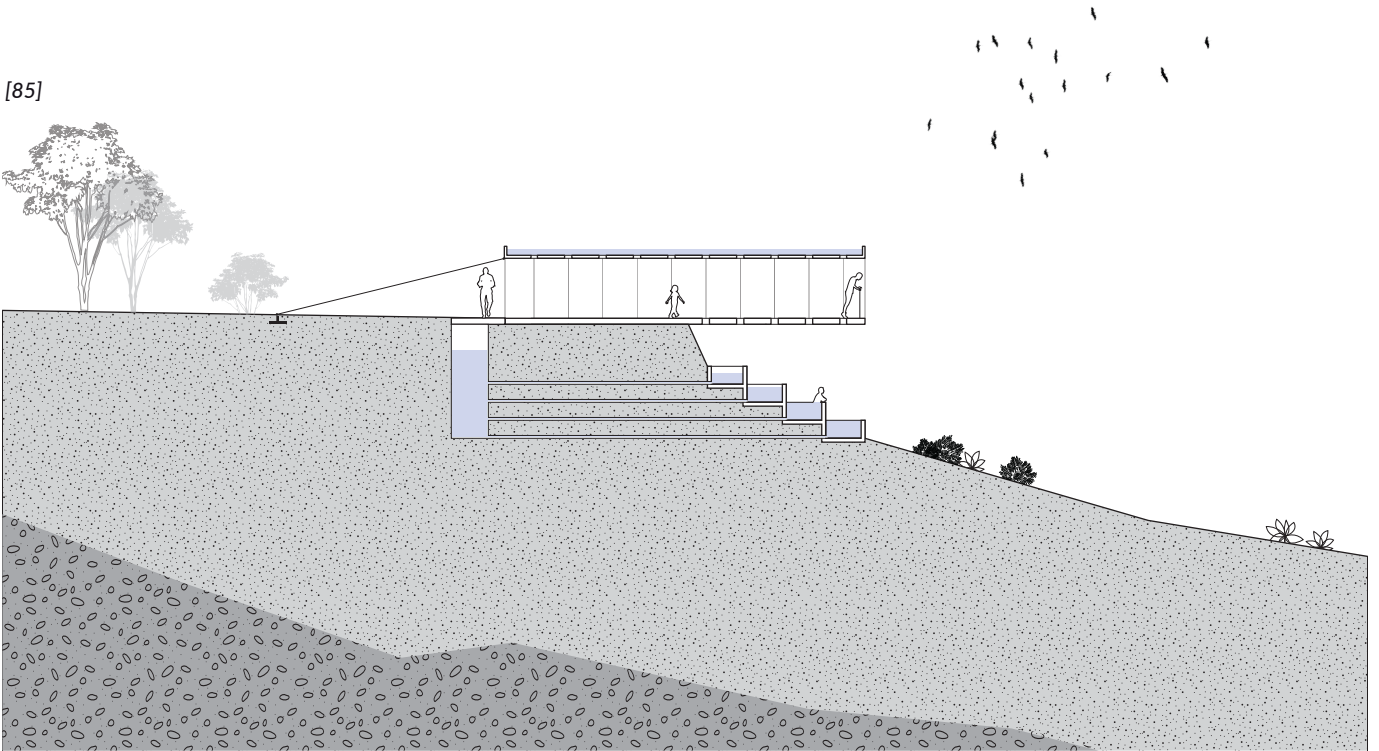


[83] Neighborhood application



[84]

[85]







## 4.8 – Conclusion

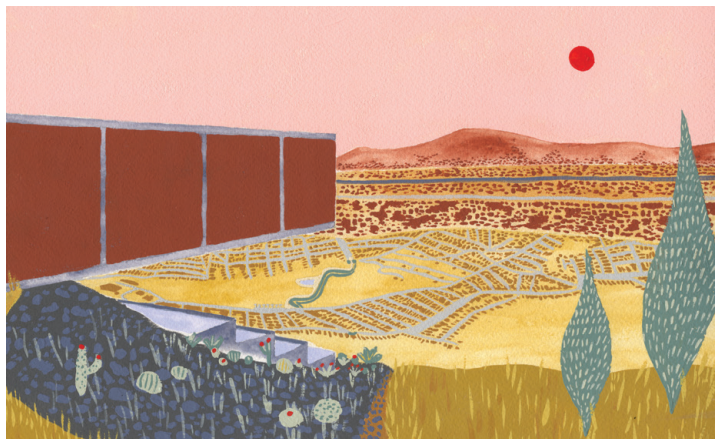
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In the face of Mexico City's broken water cycle, action must be taken immediately. Climate change is an issue, not of the future, but of the present. It may be perceived that only large and expensive infrastructural projects will make any difference in a city of 25 million people. The issue appears too grand and overwhelming, causing a paralysis in understanding how to face healing the basin.

Once determining at its largest scale that basin healing would be most beneficial at the surrounding mountains, grassroots methods in effected communities can emerge. Water infrastructure as public space and neighborhood vernacular can provide water management at its smallest scale. Underserved communities have had the most to lose in the city's existing and inefficient water management, and have the most to gain using small systems. This thesis project demonstrates a series of tangible closed-loop systems, all connected with a processional path highlighting the physical journey between the water havens. The water pilgrimage instills the need for water ritual; to celebrate water as a sacred healer.

It is the hope with this thesis that the seeds of delaying, storing, retaining, reusing, cleaning, and regenerating will take root in the community's housing roof shapes and rain gardens, in the terracing at existing self-built community stairs, and at parks and church pavilions. In doing so, a neighborhood, even a self-built development, can provide healing for the basin and for the immediate community.

Poor water management and climate change is not an issue that is isolated to Mexico City. It is a global emergency that will determine the survival of cities around the world. While it may appear overwhelming to take on such a colossal task, it cannot paralyze individuals from actively working to mitigate the detrimental effects for generations to come. Above all, it is the power of millions of people making small, domestic level adjustments, not a few large, expensive projects that will create the cultural movement needed to make a true difference. It's a vast, dehydrated and unbalanced landscape to heal, but let's start in our own neighborhood.



C H A P T E R F I V E

# LITERATURE REVIEW + FIGURES LIST



## 5.1 – Literature Review

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### MEXICO CITY - HISTORY + PRESENT

Correa, Felipe, and Garcavelez Alfaro, Carlos. Mexico City : Between Geometry and Geography = Entre Geometría Y Geografía. First ed. Novato, CA]: Applied Research and Design Publishing, 2014.

De Urbanisten. Towards a Water Sensitive Mexico City., 2016. [http://www.urbanisten.nl/wp/wp-content/uploads/2016.07.21\\_Reporte\\_CAF\\_Urb-AEP\\_Ir-2.pdf](http://www.urbanisten.nl/wp/wp-content/uploads/2016.07.21_Reporte_CAF_Urb-AEP_Ir-2.pdf)

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World Bank. Climate Change and the Urban Poor: The Case of Mexico. May 31, 2011. <https://www.youtube.com/watch?v=cUIM16jblg>

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Klee, P. (Ed.), 2013. Adding new value to cities with urban water - Sustainable solutions of integrated urban water management. The Rethink Water network and Danish Water Forum white papers, Copenhagen. Available at [www.rethinkwater.dk](http://www.rethinkwater.dk)

“The Port of Copenhagen – from a Heavily Polluted Industrial Port to a Clean and Thriving Aquatic Environment.” The Danish Eco-Innovation Program. Accessed October 15, 2018. [https://eng.ecoinnovation.dk/media/mst/8051440/Havn\\_baggrundsartikel\\_print.pdf](https://eng.ecoinnovation.dk/media/mst/8051440/Havn_baggrundsartikel_print.pdf).

<https://www.urbangreenbluegrids.com/projects/ijburg-amsterdam-the-netherlands/>

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## WATER RESPONSIVE ARCHITECTURE

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## 5.2 – Figures List (All Images by the Author Unless Otherwise Noted)

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- Figure 1: Diagram showing lack of water in Mexico City (source: De Urbanisten)
- Figure 2: Diagram showing excess of water in Mexico City (source: De Urbanisten)
- Figure 3: Diagram to heal broken water cycle in Mexico City (source: De Urbanisten + author)
- Figure 4: Lake Texcoco in Mexica times (source: <https://en.wikipedia.org/wiki/Aztecs>)
- Figure 5: Dike of Nezahualcoyotl (source: Mexico Desconocido: <http://www.memexicodesconocido.com.mx/texcoco-capital-cultural-del-mundo-mexica.html>)
- Figure 6: Mexica chinampas (source: <https://www.ancient-origins.net/ancient-places-americas/chinampas-floating-gardens-mexico-001537>)
- Figure 7: Progression of Lake Texcoco's drainage and relation to the aquifer from 1500 to present day
- Figure 8: Water collection due to poor infrastructure and access (source: Josh Haner, New York Times, 2017)
- Figure 9: Frequent flooding due to more intense rainfall (source: De Urbanisten)
- Figure 10: Rippling subsidence throughout the city (source: Josh Haner, New York Times, 2017)
- Figure 11: Angel of Independence showing subsidence from 1910 - 2016 (source: De Urbanisten)
- Figure 12: Mexico City sinks an average of 9 inches per year, as exhibited in these stacked barrells (source: designboom, 2017)
- Figure 13: Pipa trucks (source: Luc Forsyth, 2016)
- Figure 14: Aqueduct of Segovia (source: <https://www.ancient-origins.net/ancient-places-europe/segovia-aqueduct-0012747>)
- Figure 15: Amsterdam canals aerial (source: aerostockphoto.com)
- Figure 16: Amsterdam waterfront (photograph by author)
- Figure 17: Swimmers in the Amsterdam canals (iamamsterdam.com)
- Figure 18: Roman aqueduct map (source: Los Angeles Times, 2013)
- Figure 19: Roman aqueduct diagram (source: Los Angeles Times, 2013)
- Figure 20: Benthemplein Water Square aerial (source: <http://www.urbanisten.nl/wp/?portfolio=waterplein-benthemplein>)
- Figure 21: Benthemplein Water Square dry period (source: <http://www.urbanisten.nl/wp/?portfolio=waterplein-benthemplein>)
- Figure 22: Benthemplein Water Square cloudburst (source: <http://www.urbanisten.nl/wp/?portfolio=waterplein-benthemplein>)
- Figure 23: Benthemplein Water Square water pressure generated art (source: <http://www.urbanisten.nl/wp/?portfolio=waterplein-benthemplein>)
- Figure 24: Prithula Prosun's LIFT House project in Bangladesh (source: [www.lifthouse.org](http://www.lifthouse.org))
- Figure 25: LIFT House sectional diagram (source: [www.lifthouse.org](http://www.lifthouse.org))
- Figure 26: Water infrastructure catalouge collages
- Figure 27: Water and architecture catalouge
- Figure 28: Combining terracing and roof water collectors
- Figure 29: Combining canals and amphibious architecture
- Figure 30: Combining water plazas and underwater structure
- Figure 31: Map of Blue Ring overlapping with informal settlements in Mexico City
- Figure 32: Map of Mexico City highlighting the surrounding mountains, overlaid Lake Texcoco, and Grand Canal
- Figure 33: Rainy/mountainous strategy
- Figure 34: Rainy/urban strategy
- Figure 35: Dry/urban strategy
- Figure 36: Rainy/rural strategy
- Figure 37: Dry/mountainous strategy
- Figure 38: Dry/rural strategy
- Figure 39: Map of Blue Ring overlapping with informal settlements in Mexico City locating northern site
- Figure 40: Map of Infiltration Efficiency locating northern site (source: De Urbanisten)
- Figure 41: Map of Flash Flooding locating northern site (source: De Urbanisten)
- Figure 42: Map of Evapotranspiration locating northern site (source: De Urbanisten)
- Figure 43: Map of Mexico City highlighting the overlaid Lake Texcoco, and Grand Canal, and Ecatepec de Morelos
- Figure 44: Grand Canal open sewage system (source: San Miguel Times, 2017)
- Figure 45: La Presa neighborhood of Ecatepec de Morelos (source: The Guardian, 2017)
- Figure 46: La Presa in relation to the Grand Canal
- Figure 47: Concept paintings of procession up the mountains
- Figure 48: Concept collage of incorporating self-built community stairs into water management strategies
- Figure 49: Map of La Presa hihglighting 6 water havens and pilgrimage path
- Figure 50: Lookout icon
- Figure 51: Chapel icon
- Figure 52: Bodega icon
- Figure 53: Mercado icon
- Figure 54: Zocalo icon
- Figure 55: Pavilion icon

Figure 56: Site section collage through the six water havens + contributions to aquifer recharge  
Figure 57: Initial sketches for the pavilion  
Figure 58: Neighborhood application of lessons learned from the pavilion  
Figure 59: Pavilion site plan  
Figure 60: Pavilion section  
Figure 61: Pavilion looking towards zocalo  
Figure 62: Initial sketches for the zocalo  
Figure 63: Neighborhood application of lessons learned from the zocalo  
Figure 64: Zocalo site plan  
Figure 65: Zocalo section  
Figure 66: Zocalo looking towards mercado  
Figure 67: Initial sketches for the mercado  
Figure 68: Neighborhood application of lessons learned from the mercado  
Figure 69: Mercado site plan  
Figure 70: Mercado section  
Figure 71: Mercado looking uphill towards neighborhood public high school  
Figure 72: Initial sketches for the bodega  
Figure 73: Neighborhood application of lessons learned from the bodega  
Figure 74: Bodega site plan  
Figure 75: Bodega section  
Figure 76: Bodega looking towards chapel  
Figure 77: Initial sketches for the chapel  
Figure 78: Neighborhood application of lessons learned from the chapel  
Figure 79: Chapel site plan  
Figure 80: Chapel section  
Figure 81: Chapel looking towards lookout  
Figure 82: Initial sketches for the lookout  
Figure 83: Neighborhood application of lessons learned from the lookout  
Figure 84: Lookout site plan  
Figure 85: Lookout section  
Figure 86: Lookout looking towards pilgrimage path and the city

