

THE
POROUS
LANDSCAPE

Design studies, sketch book
Viviana Avila

The porous landscape

A man-made landscape with porous qualities
that create multi-purpose spaces to
contribute to relieving the storm flood in
Santa Marta, Colombia

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International Master of Landscape Architecture

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What is this book about?

This is a book of design studies through the diploma project. It shows the design process with hand sketches, physical models in clay, paper lace, digital diagrams, renders, written ideas, and 3d prints.

The document is organized chronologically from the very first attempt of looking for a site, until the detailed final design solution presented for the diploma submission.

Content

- 6-29 Before 1st interim review
- 30-39 Before 2nd interim review
- 40-59 Design for Second interim review
- 60-139 Diploma final design

Before

1st interim review

Paper lace

First study of Manzanares river watershed

Before 1st interim review

8



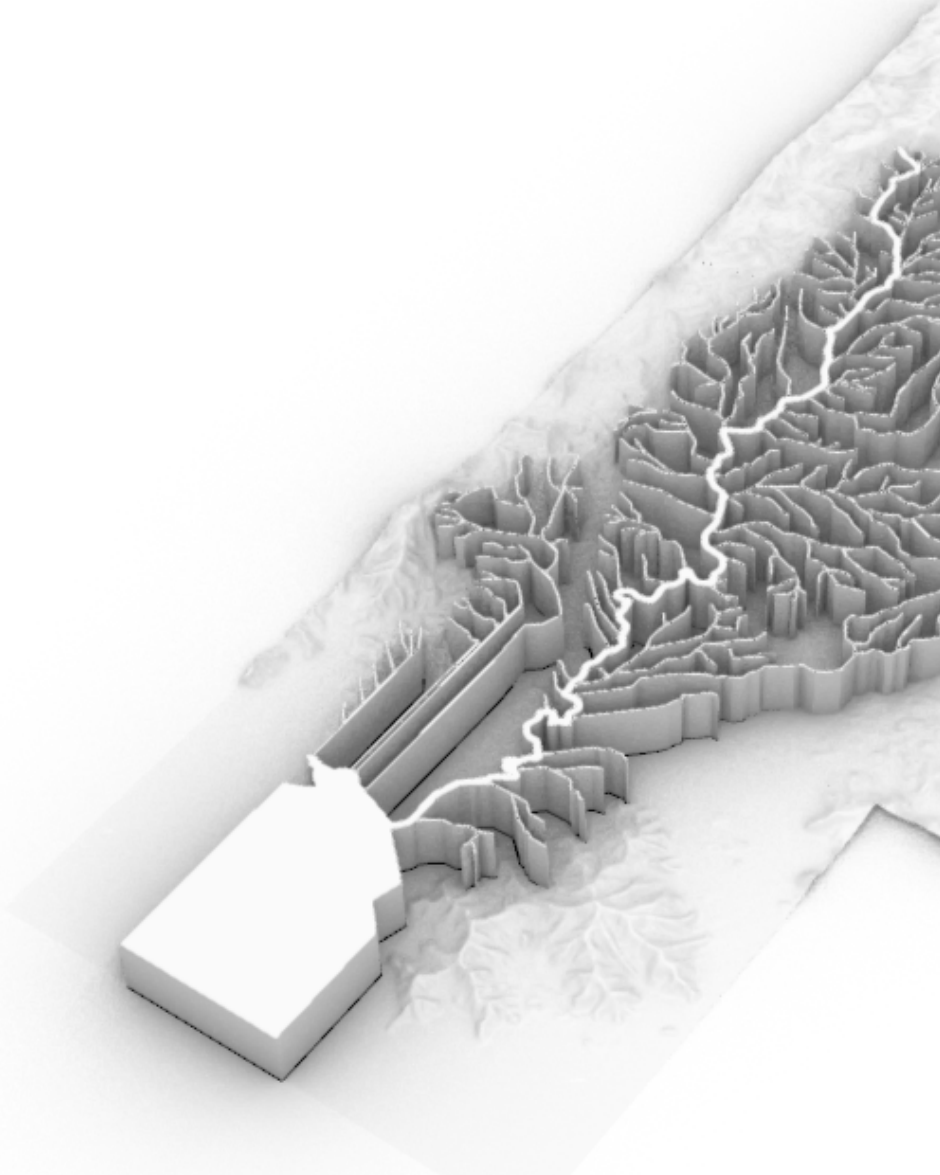


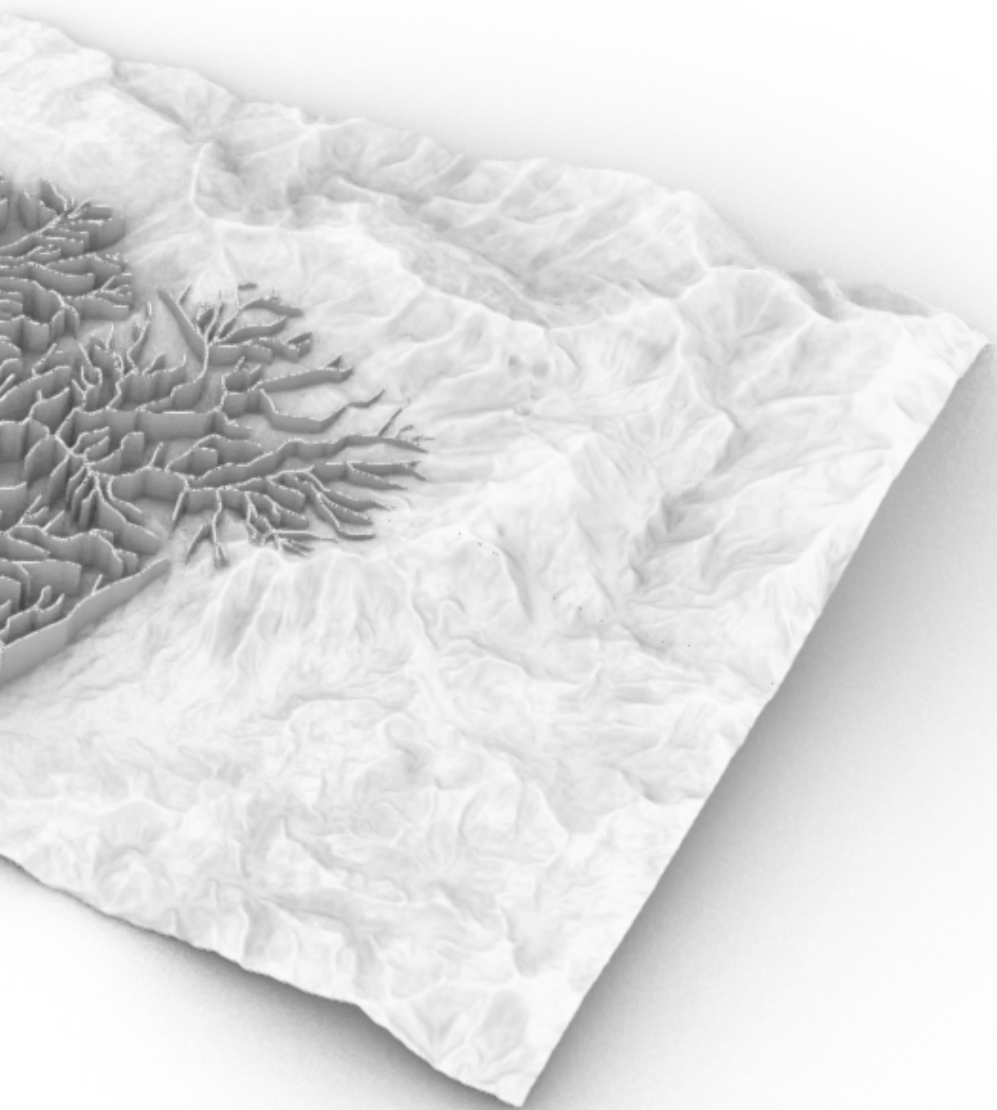
3d model of the watershed

First study of Manzanares river watershed

Before 1st interim review

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Miro board

Looking for a site

Before 1st interim review



How is this project structured - are there different levels, parts, cells etc.?



Photo credit: [Photograph of a sports complex in San Diego, California](#)

Photo credit: [Aerial view of a sports complex in San Diego, California](#)



Miro board

Looking for a site

Before 1st interim review



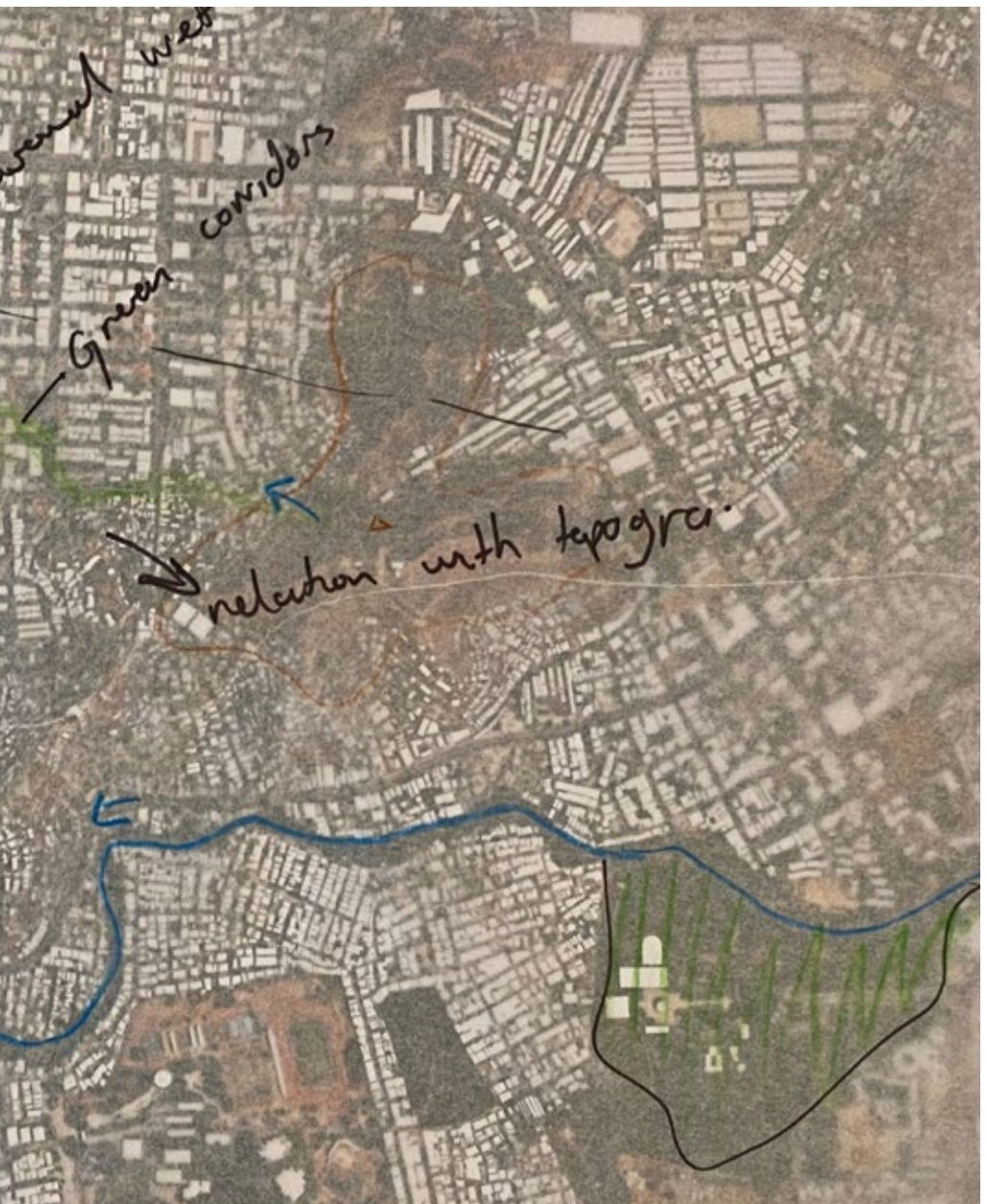
Handsketch

Looking for connections

Before 1st interim review

14



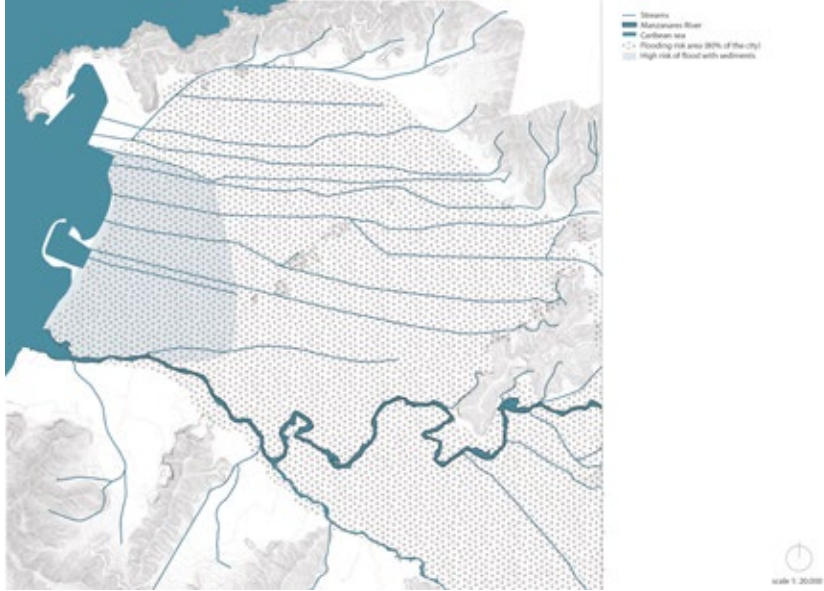


Digital diagrams

First study of City Porous system

Before 1st interim review

Flooding in the city

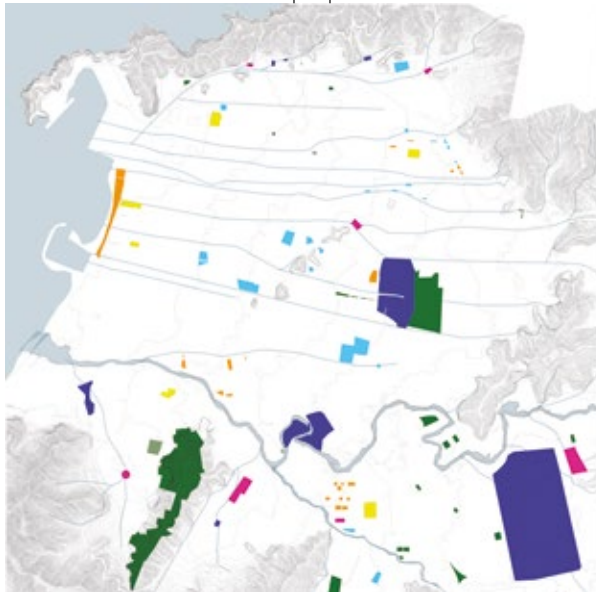


16

Public spaces in the city



Runoff reduction elements proposal



17

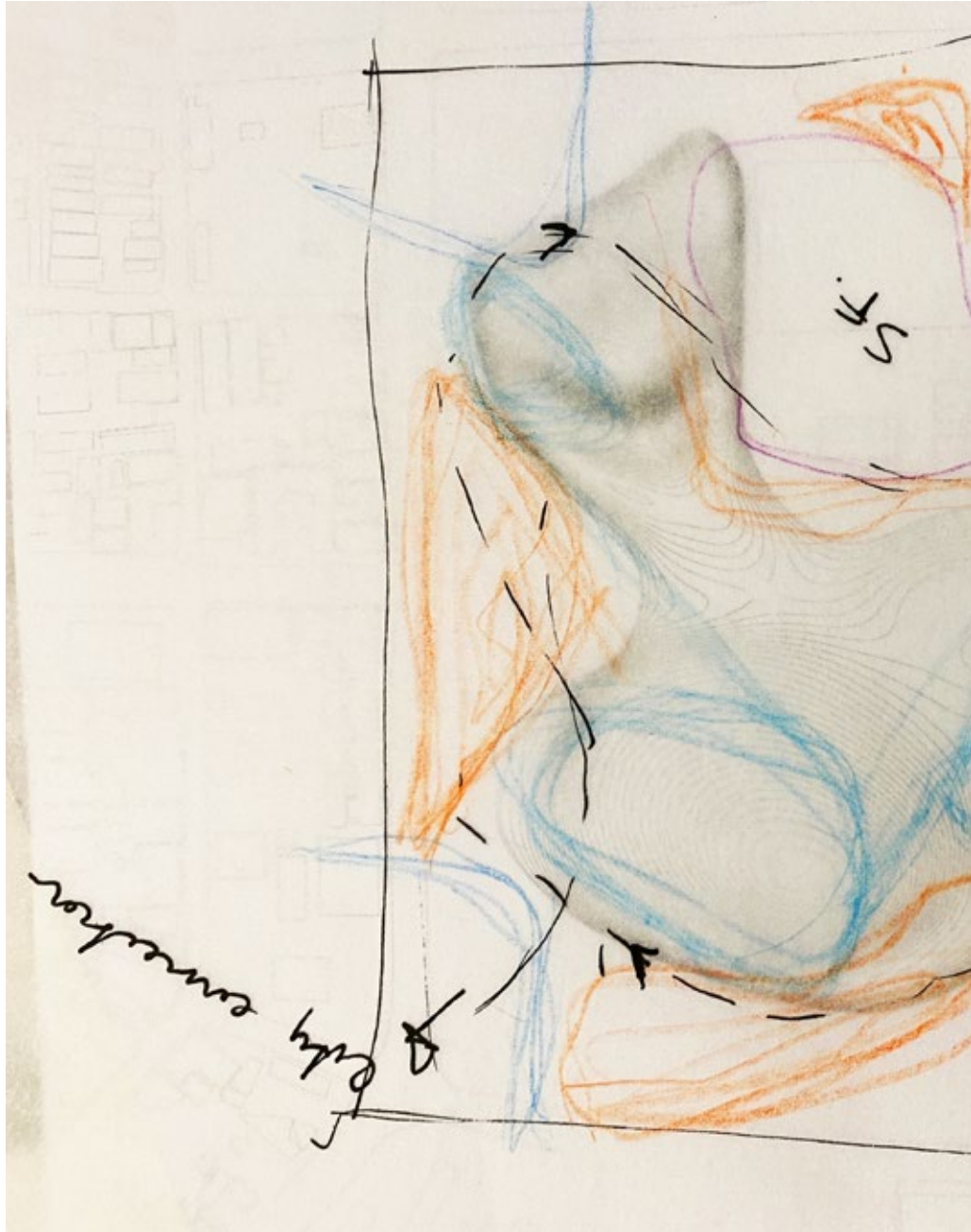
Study of porous system

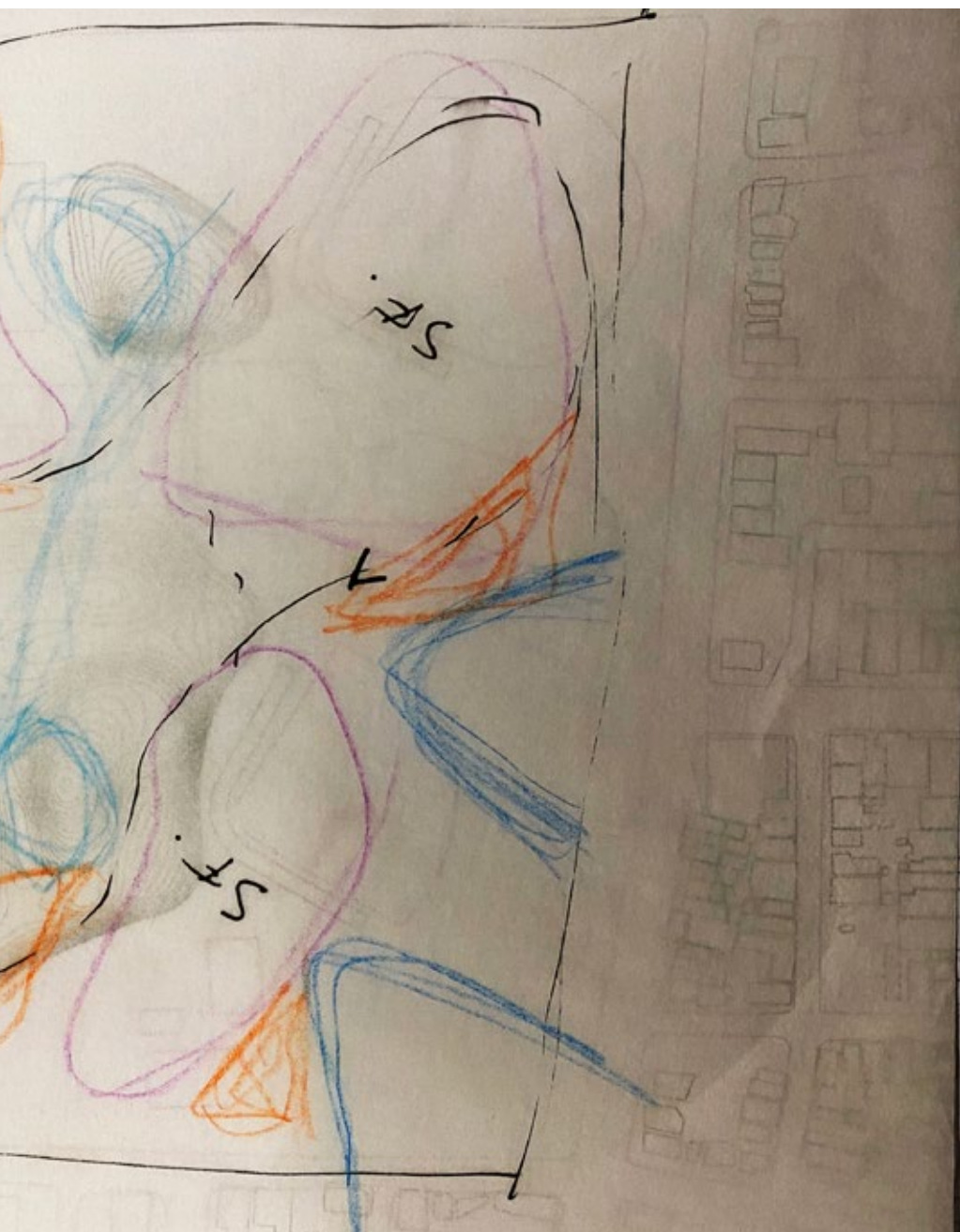


Idea handsketch, intentions

First study of local intervention

Before 1st interim review





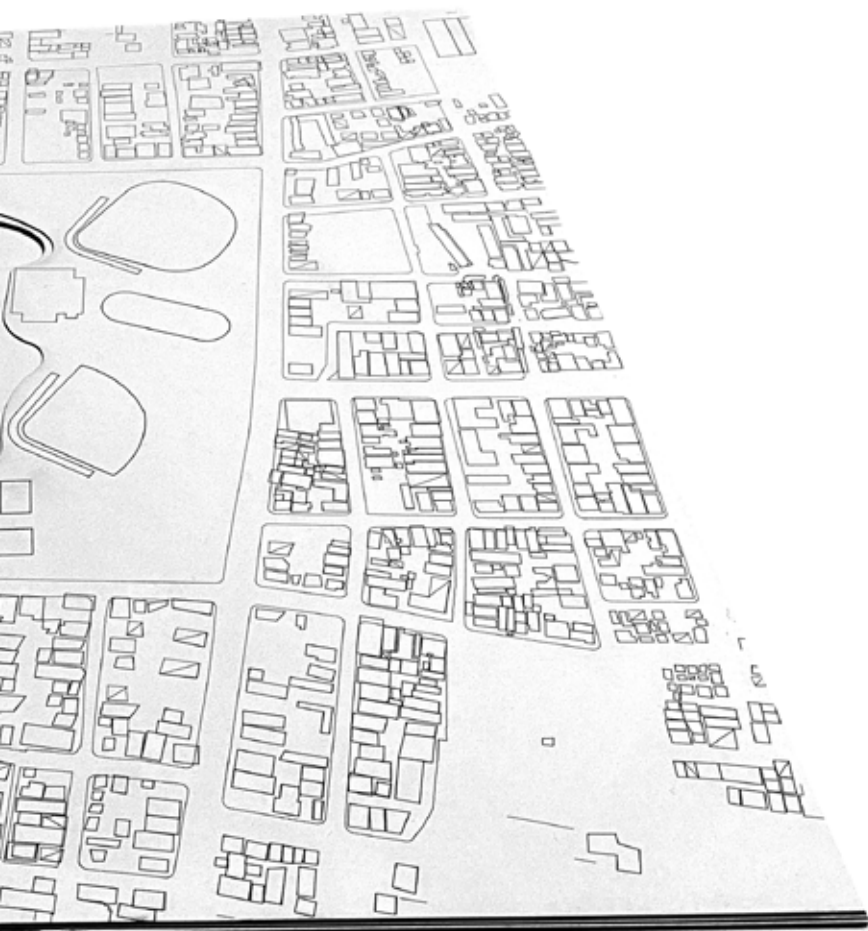
Physical model scale 1:2.000

First study of local intervention

Before 1st interim review

Cut and fill technique to landscape creation





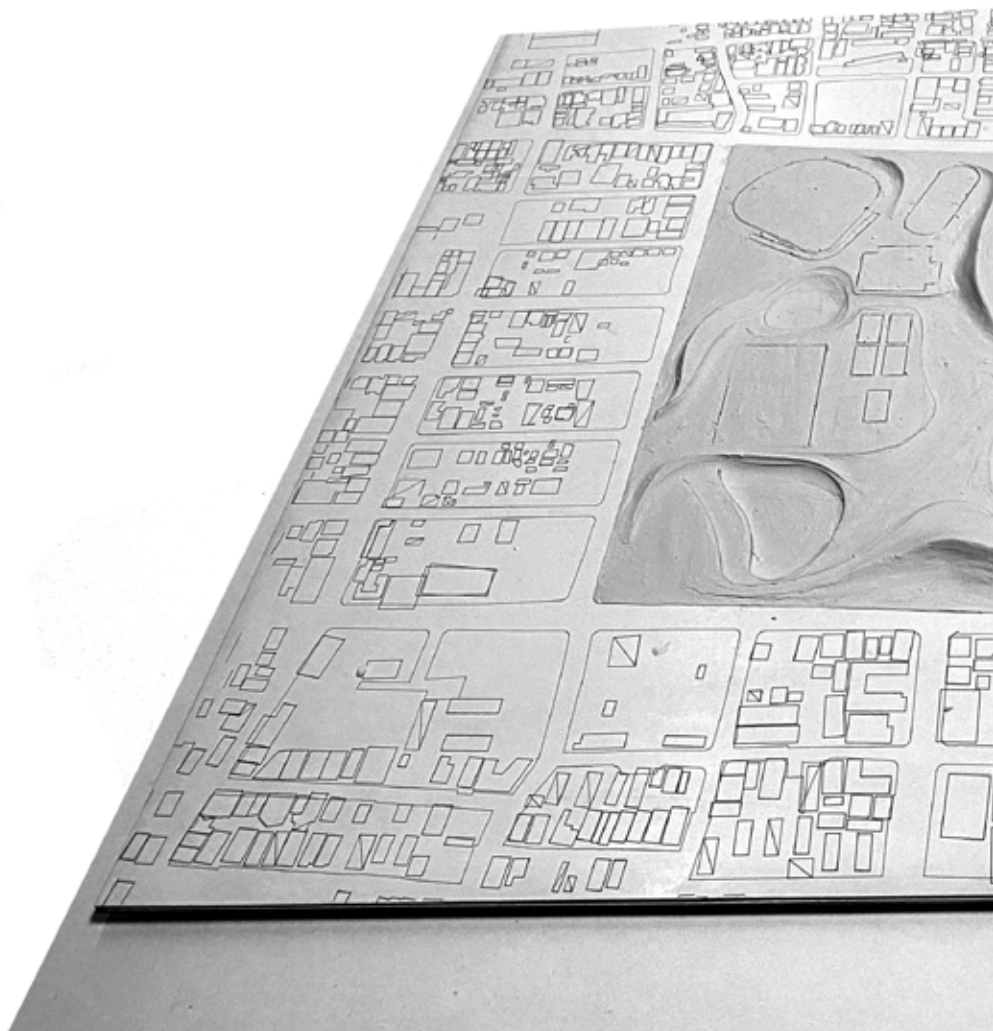
Physical model scale 1:2.000

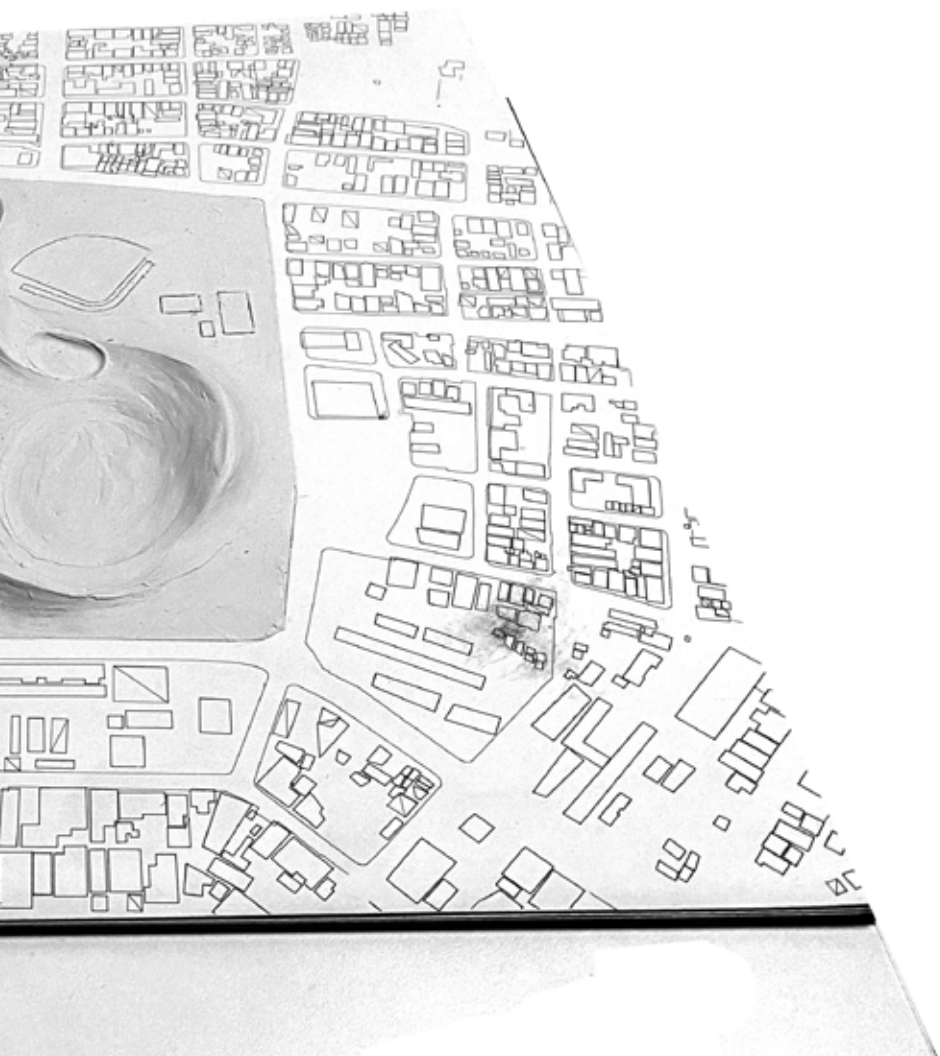
First study of local intervention

Before 1st interim review

Cut and fill technique to landscape creation. Shaping the world. Clay and board

22

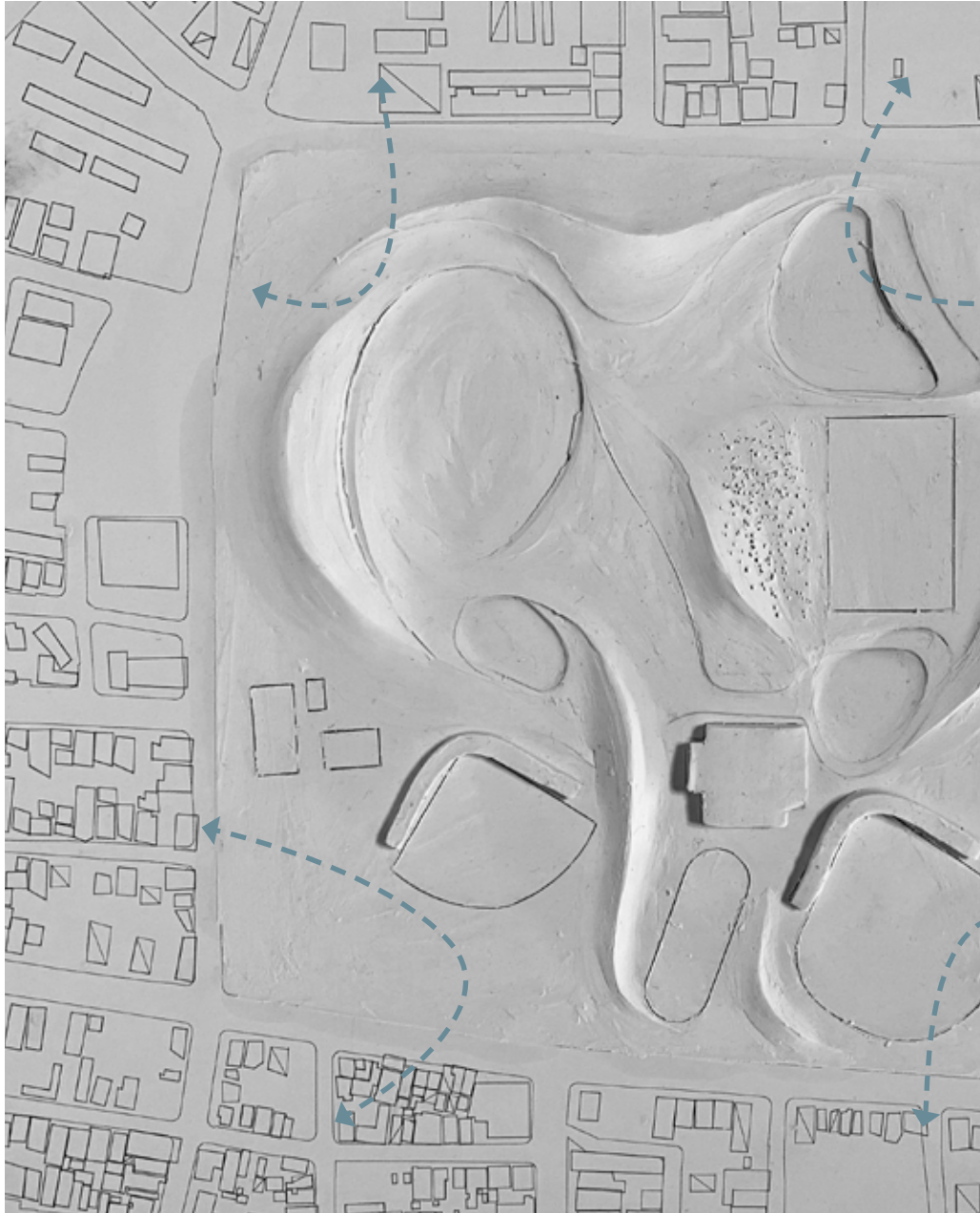




Physical model scale 1:2.000, clay and cardboard

First study of local intervention

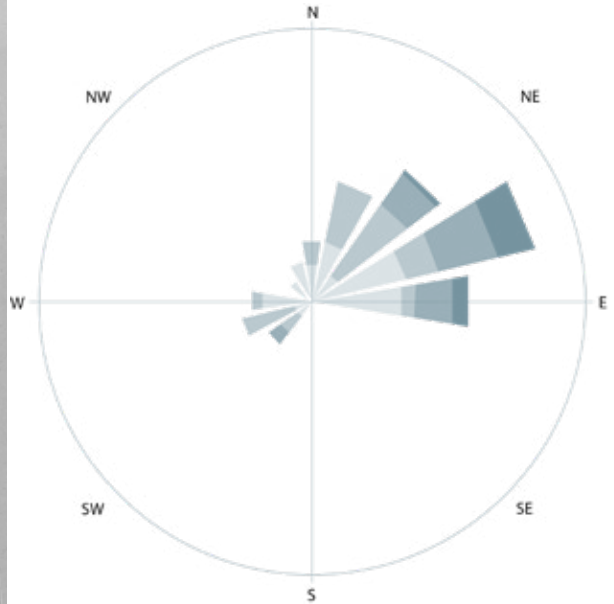
Before 1st interim review





New Topography to protect from the wind.

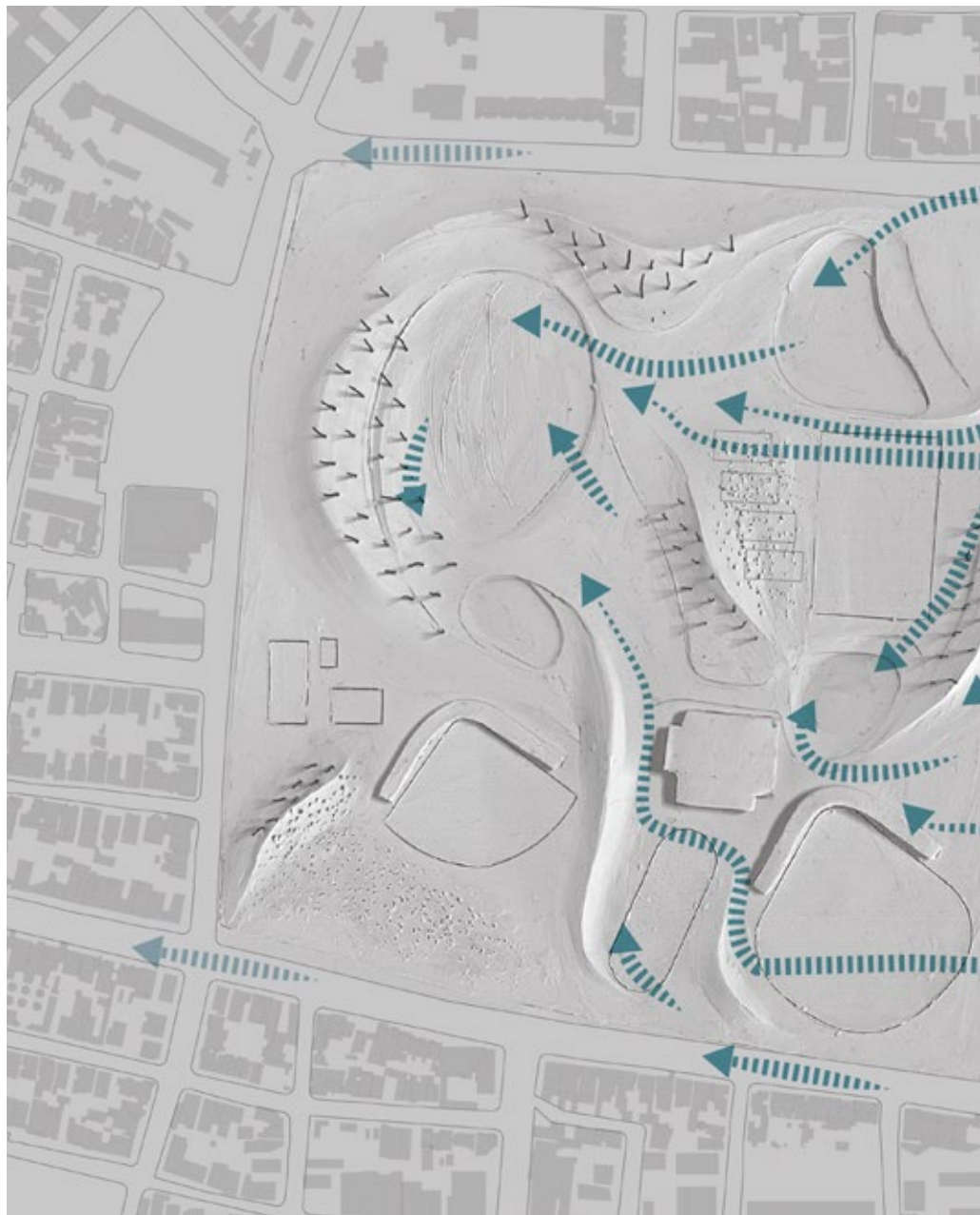
Intentions of urban connections and access plazas



Physical model scale 1:2.000, clay and cardboard

First study of local intervention

Before 1st interim review





Water flow, mix of physical model and digital representation.

First study of planting and vegetated areas



Physical model scale 1:2,000, clay and cardboard

First study of local intervention

Before 1st interim review

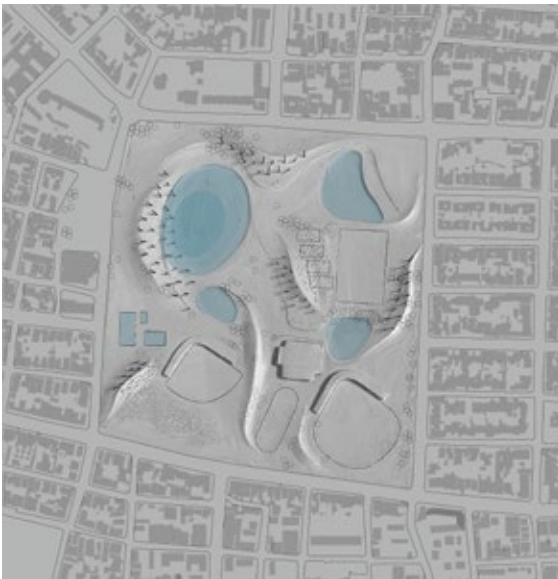
The performance of the landscape, adaptive to floods

28



THE POROUS PLAYSCAPES

- Water basin, filtration + storage + ecosystem
- Flood water filtration basins
- Contour lines every 20 cm
- Existing trees
- Manmade topography
- Emergency flood connecting level
- New trees in ecosystem wet areas
- Porous ground cover



THE POROUS PLAYSCAPES

- Water basin, filtration + storage + ecosystem
- Flood water filtration basins
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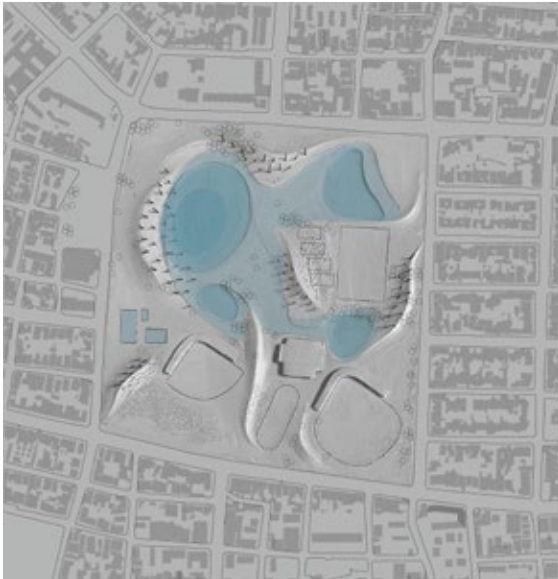


Physical model scale 1:2.000, clay and cardboard

First study of local intervention

Before 1st interim review

The performance of the landscape, adaptive to floods



THE POROUS PLAYSAPES

- Wet basin, filtration + storage + ecosystem
- First wet filtration basins
- Contour lines every 20 cm
- Existing trees
- Manned topography
- Emergency flood connecting level
- New trees in ecosystem wet area
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scale 1:2.000

Before
2nd interim review

Digital diagrams

Second study of City Porous system

Before 2nd interim review

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1. Create a flooding buffer area (relocate illegal housing at safe areas)

Digital diagrams

Second study of City Porous system

Before 2nd interim review



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2. Recover all the tributaries

Digital diagrams

Second study of City Porous system

Before 2nd interim review

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3. Insert wet basins to filter the water

Digital diagrams

Second study of City Porous system

Before 2nd interim review



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4. Porous system

Intervention diagrams

Second study of local intervention

Before 2nd interim review

Giving space to water - opening the stream -
Cut and fill

Reorganization of sport facilities

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— New topography

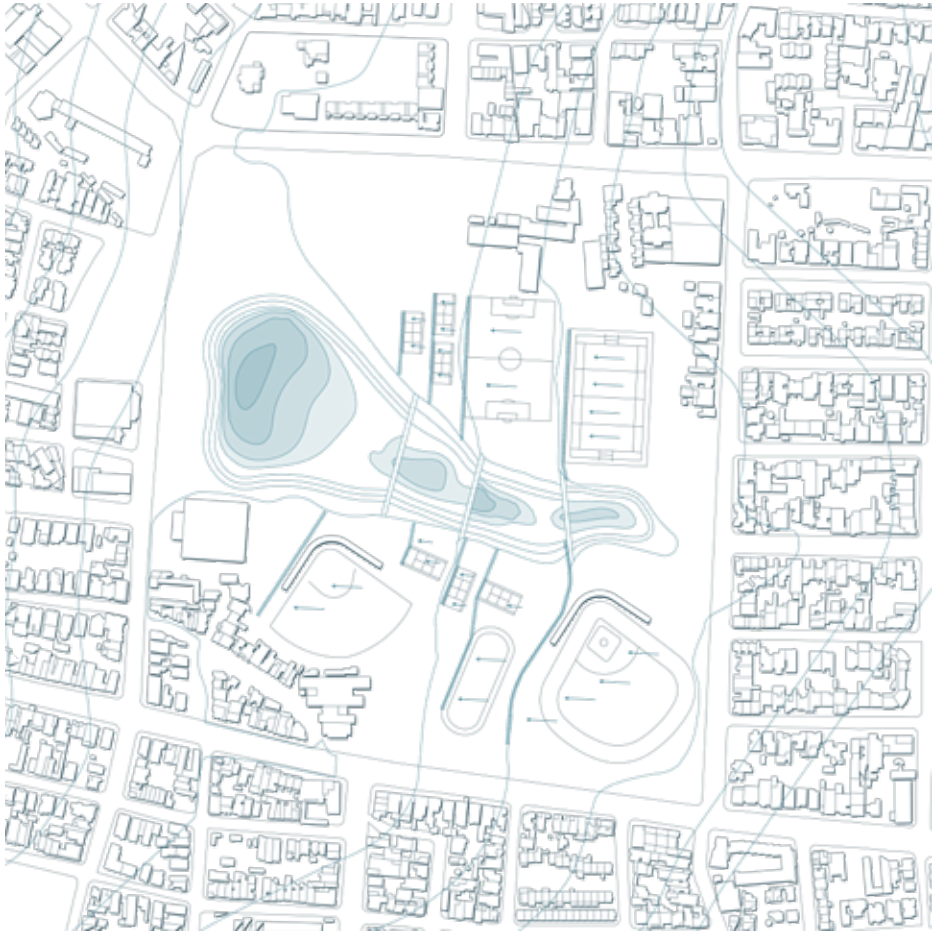


Intervention diagrams

Second study of local intervention

Before 2nd interim review

Wet basins and water direction



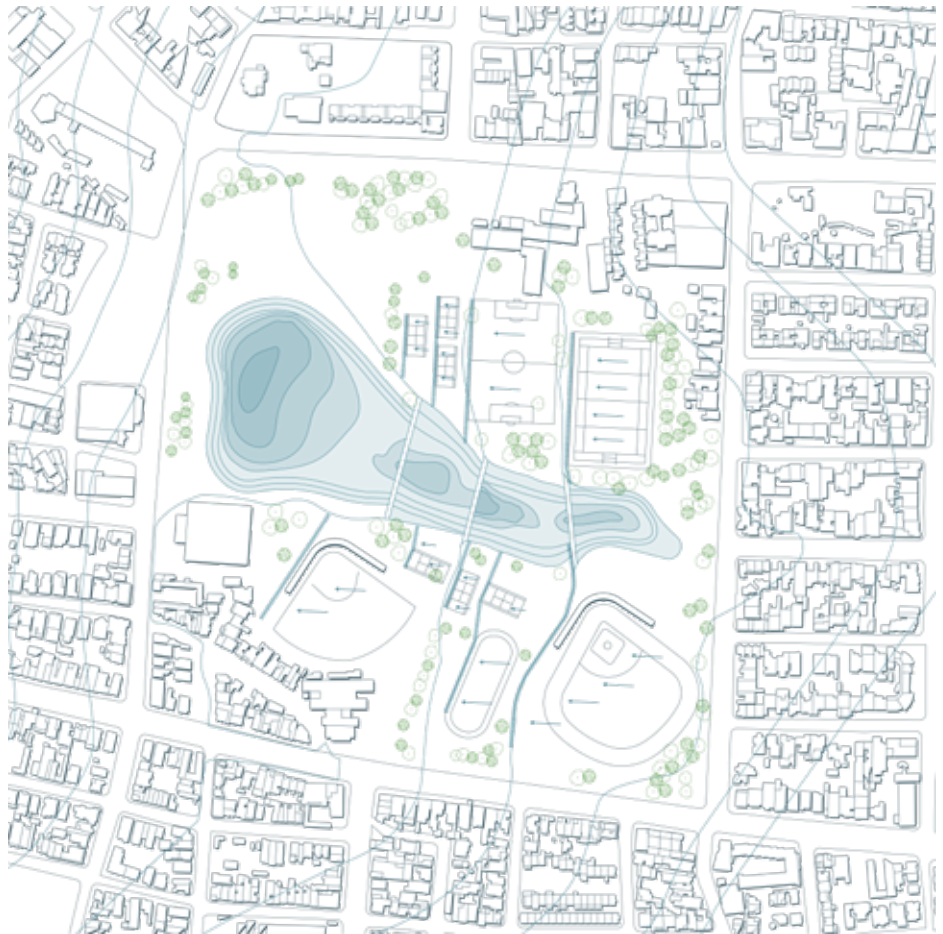
Intervention diagrams

Second study of local intervention

Before 2nd interim review

Flood condition

38



Longitudinal section

Second study of local intervention

Before 2nd interim review



Design for 2nd interim review

Third study of the Porous park

2nd interim review

Reorganization of sport facilities



Digital diagrams

Third study of the Porous park

2nd interim review

Giving space to water



Third study of the Porous park

2nd interim review

Cut and fill technique to create spread space for the water

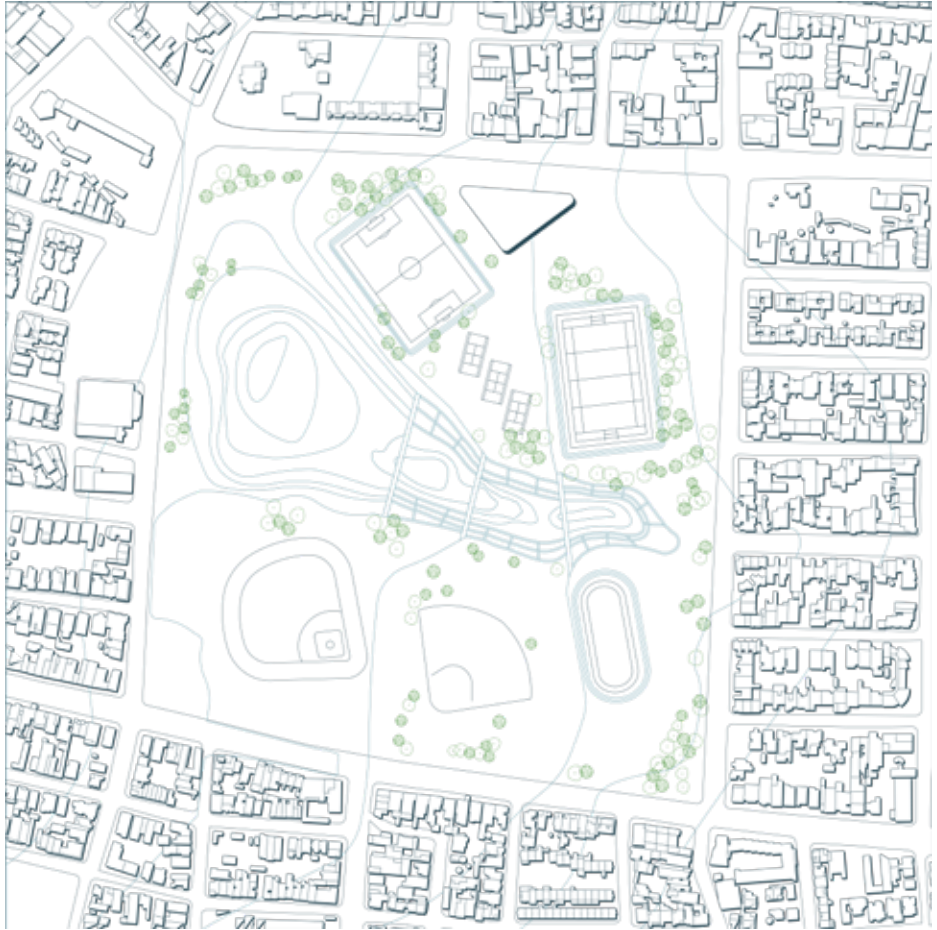


Digital diagrams

Third study of the Porous park

2nd interim review

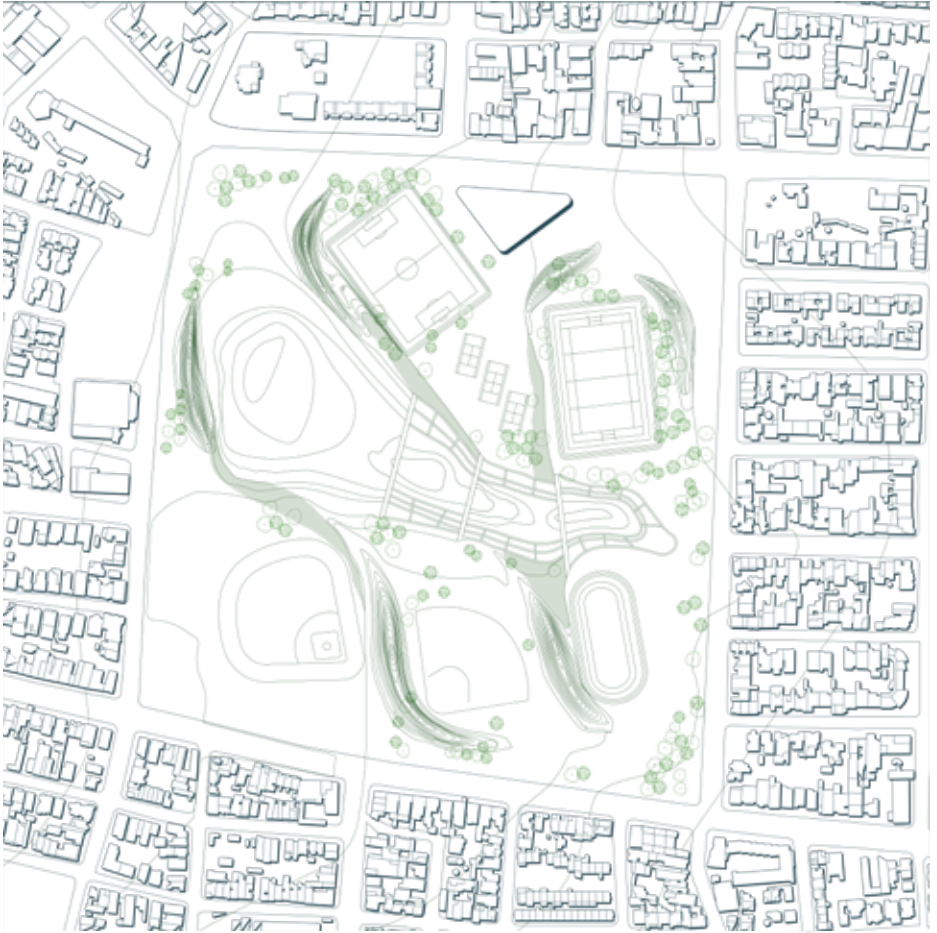
Filtrating terraces



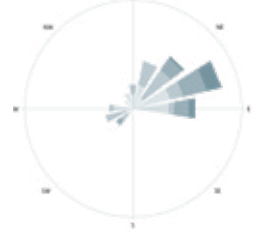
Third study of the Porous park

2nd interim review

Microtopography



46



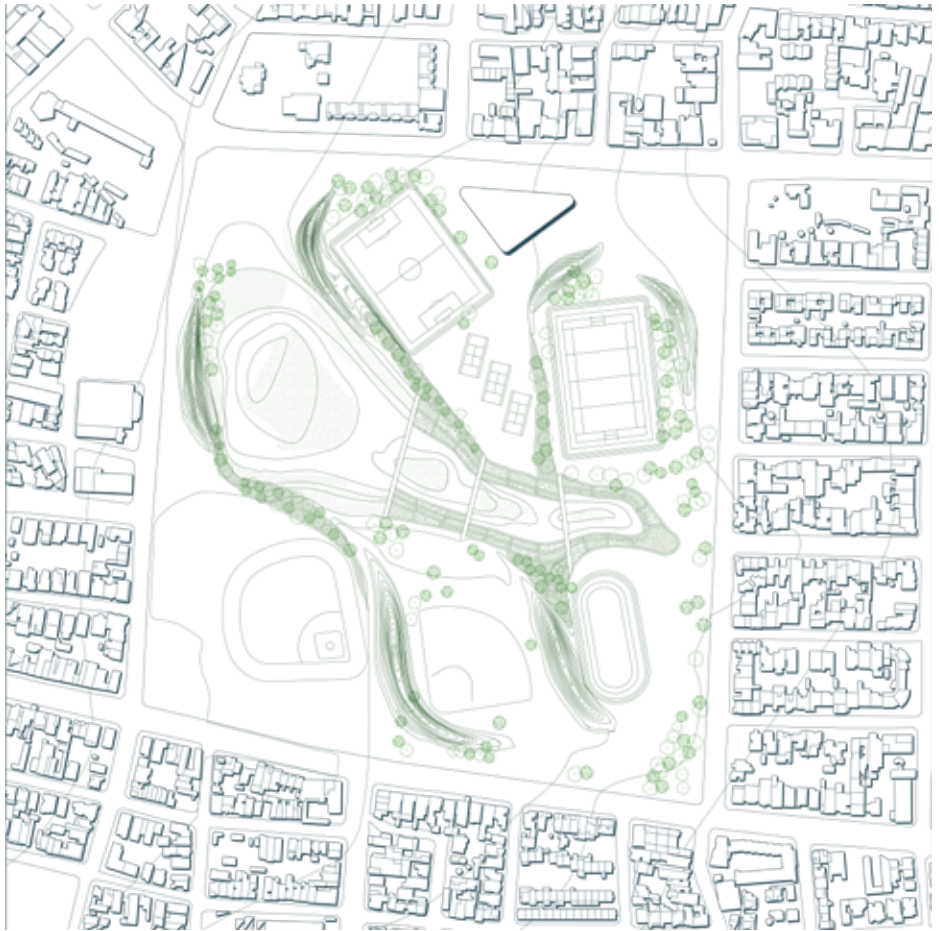
Wind rose

Digital diagrams

Third study of the Porous park

2nd interim review

Planting plan, vegetated water gardens and filtration terraces



Physical model scale 1:1.00, 3d print + clay + board

Third study of the Porous park

2nd interim review





Third study of the Porous park

2nd interim review

Planting plan

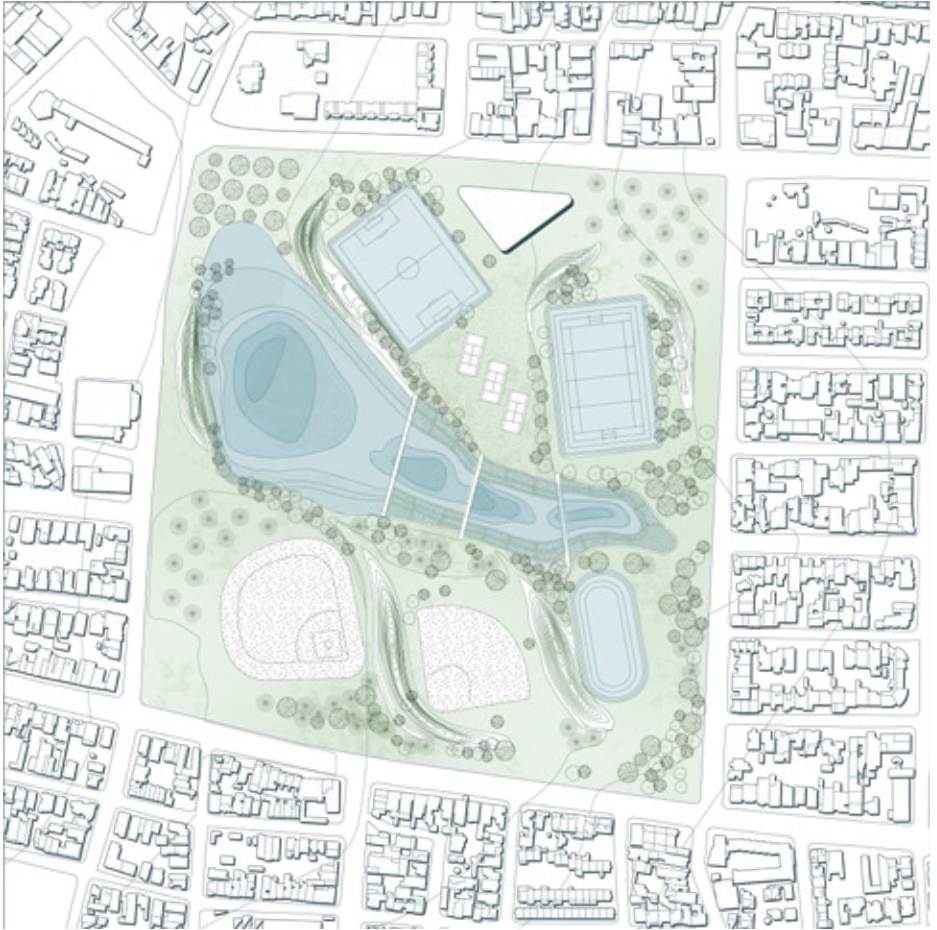


Digital diagrams

Third study of the Porous park

2nd interim review

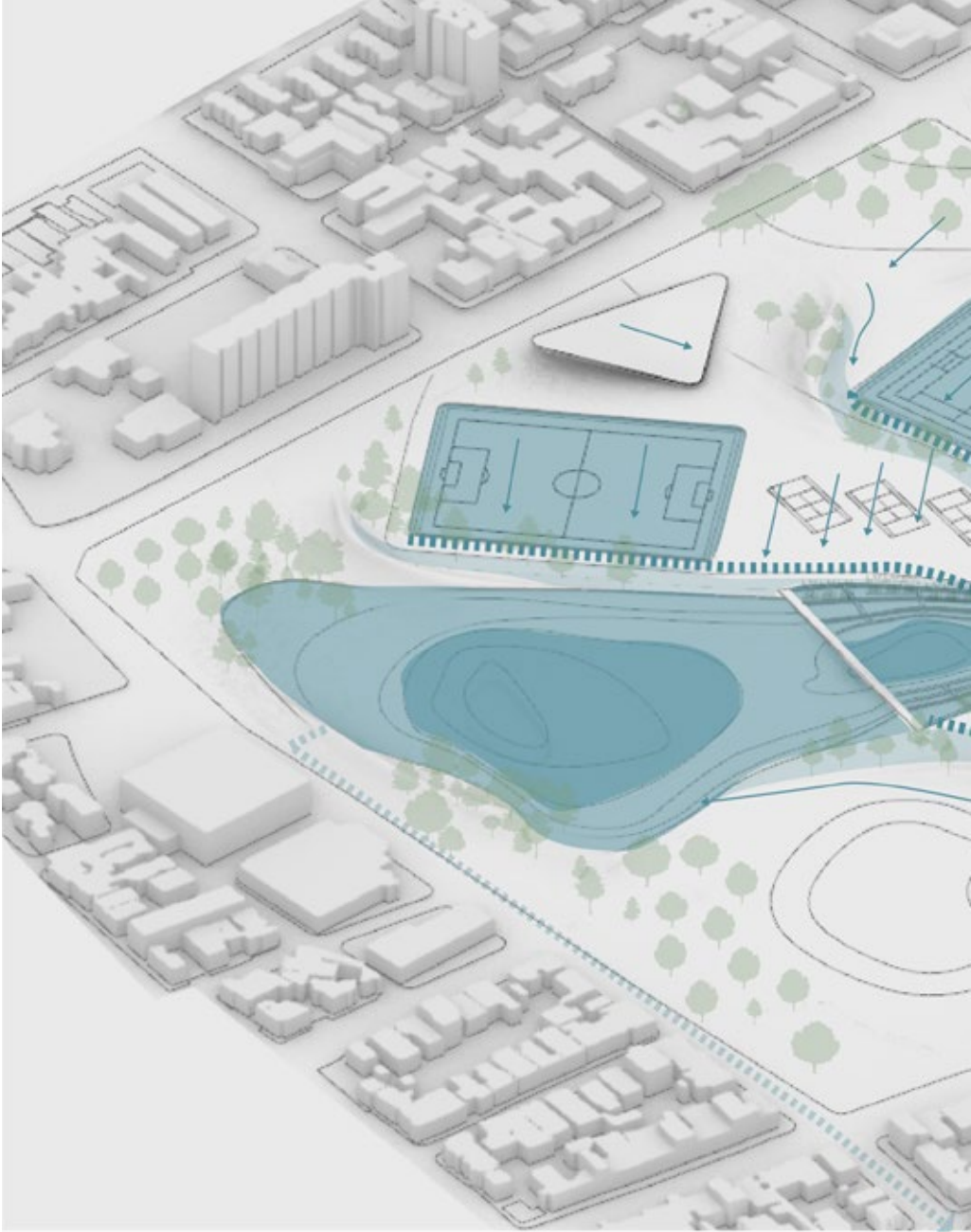
Max flood capacity

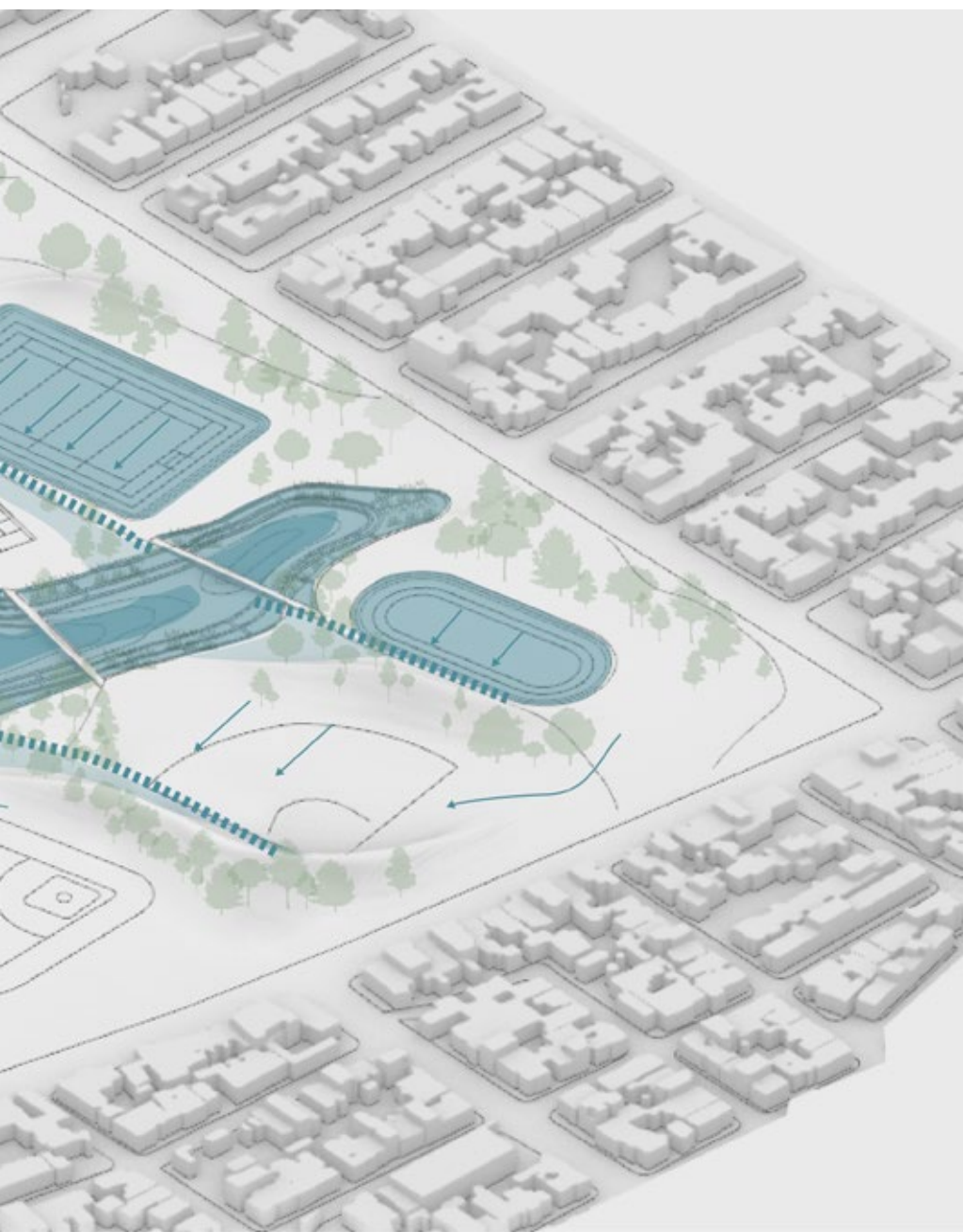


Digital diagrams

Third study of the Porous park water flow

2nd interim review



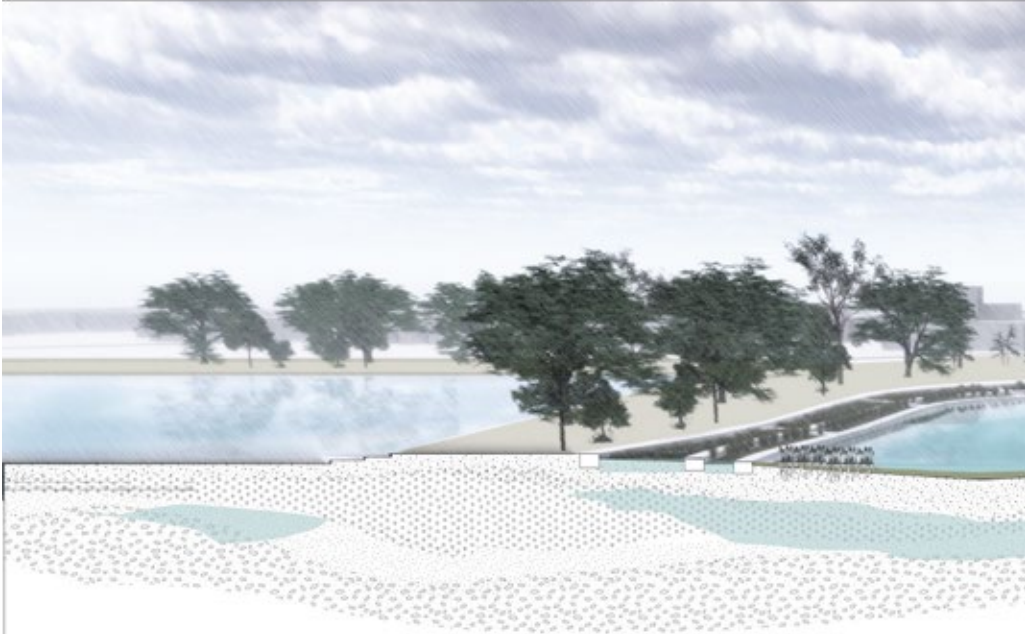


Sectional perspectives

Third study of the Porous park water flow

2nd interim review

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Render

Third study of the Porous park the feeling of the space

2nd interim review





Render

Third study of the Porous park the feeling of the space

2nd interim review





Diploma

Final design

Paper lace watershed

Final design

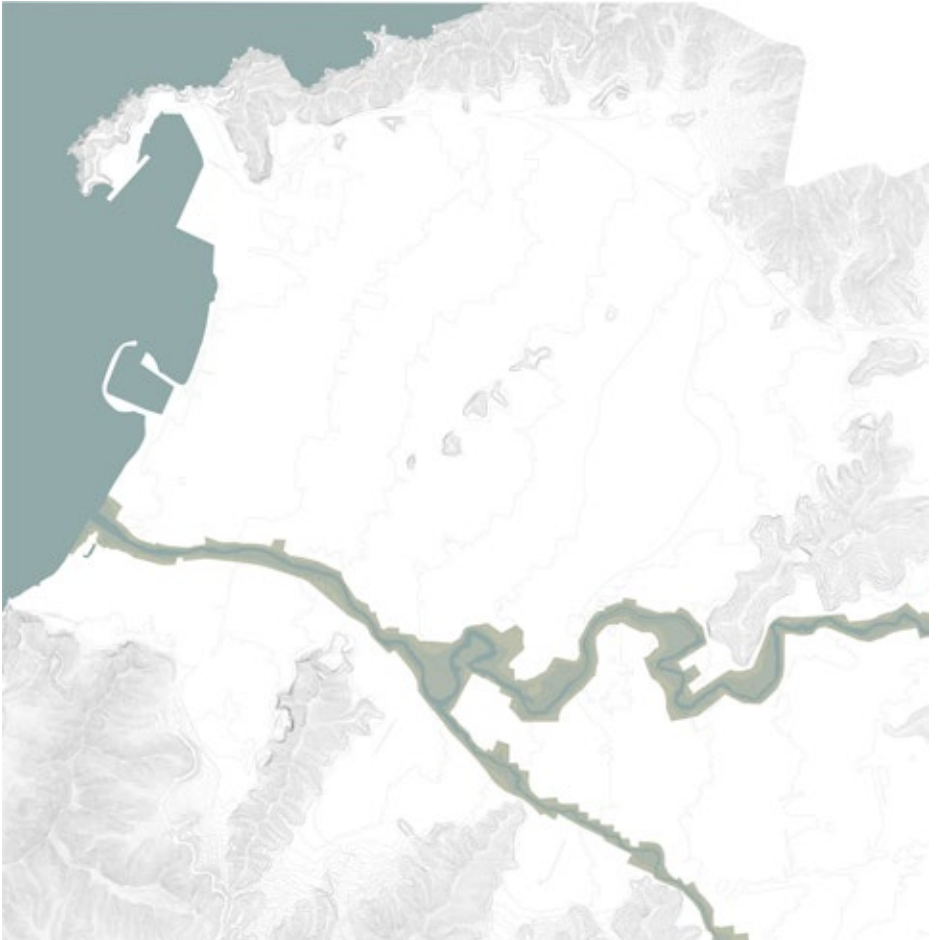
Diploma submission

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Paper lace of Manzanarez river watershed scale 1:100,000





1. Create a flooding buffer area (relocate illegal housing at safe areas) and give space to the river to grow during monsoon season in a safe area



2. Recover all the tributaries. Give space to the natural streams on the surface. Make visible the natural working of the water



3. Insert wet basins to filter and storage storm water and dry basins to increase system capacity at extreme flooding events.

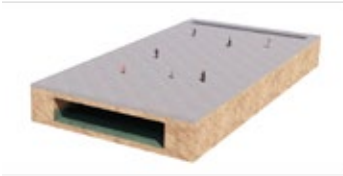


4. Porous system based on runoff reduction elements incorporated on public spaces that work to relieve the flood in the city, creates identity, new ecosystems and integrates communities.

Diploma
Toolbox of runoff reduction elements

Catchment elements

Porous pavement with detention tank



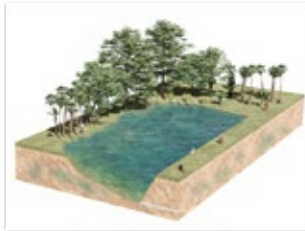
Porous ground, allow aquifer recharge



Green roofs



Storage elements



Dry pond, detention basin. Located where 2 afluents meet



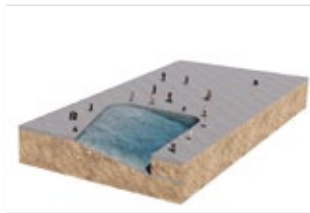
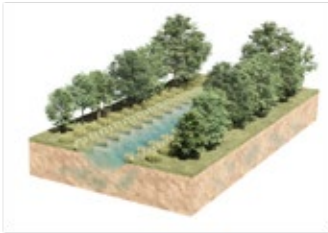
Wet pond, retention basin. Located in the course of a stream

Connecting the system

Bioswale

Open water channel

Pipe



Rain garden, located along the highways

Water feature. Located in plazas

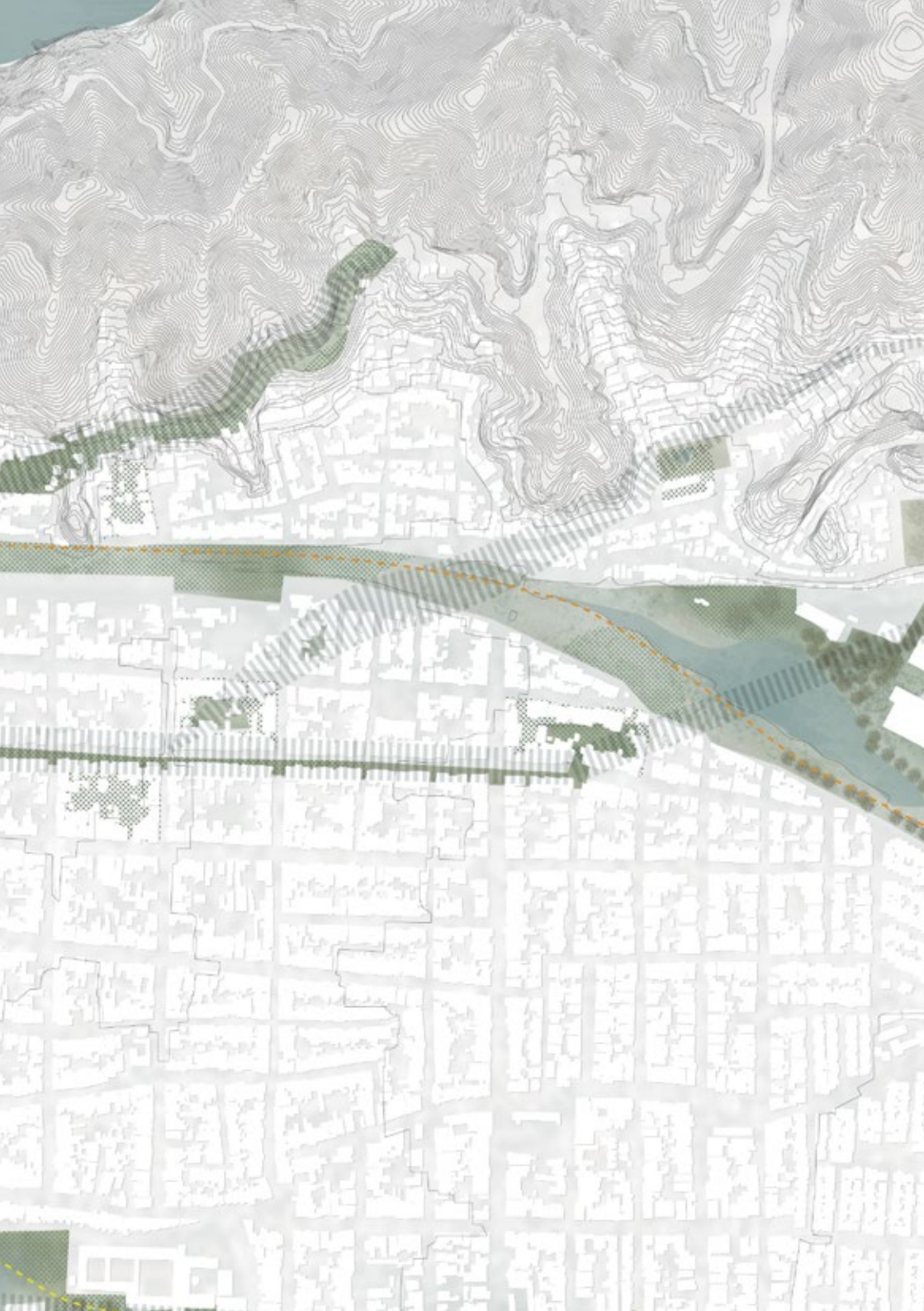
A project by itself won't solve the flood problems in the city, but a porous city system will help to relieve the flood in the most critical areas.

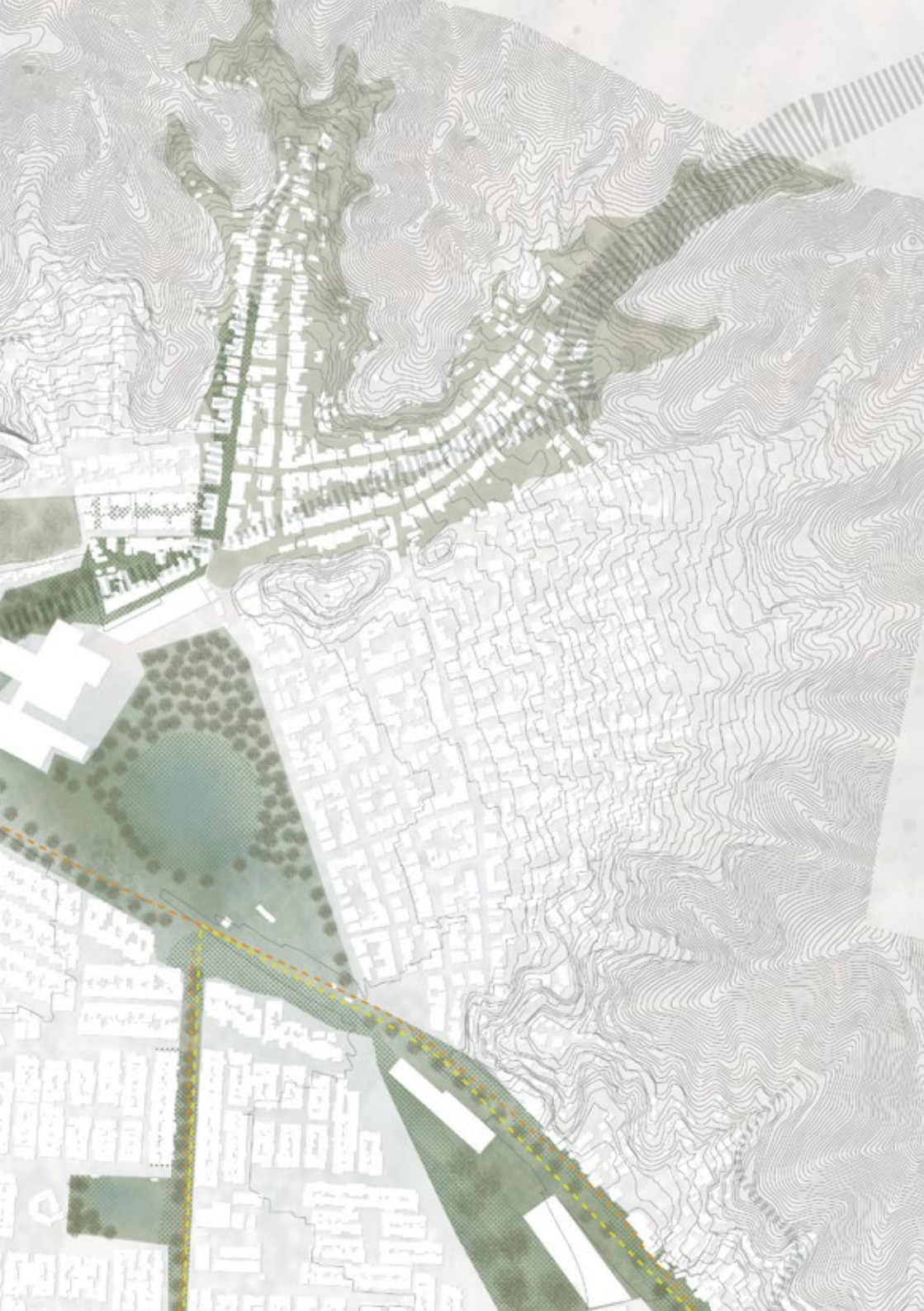
The system needs different elements to work, located across the city are catchment elements, connecting elements, and basins, these elements are interconnected and work together to allow control floods on public spaces in spread areas.

They work together to transform the city into a sponge, a permeable and porous city that works down the principle of a decentralized system.









Diploma

Santa Marta Vision 2050- Detail design of the whole porous system, urban connections





Diploma

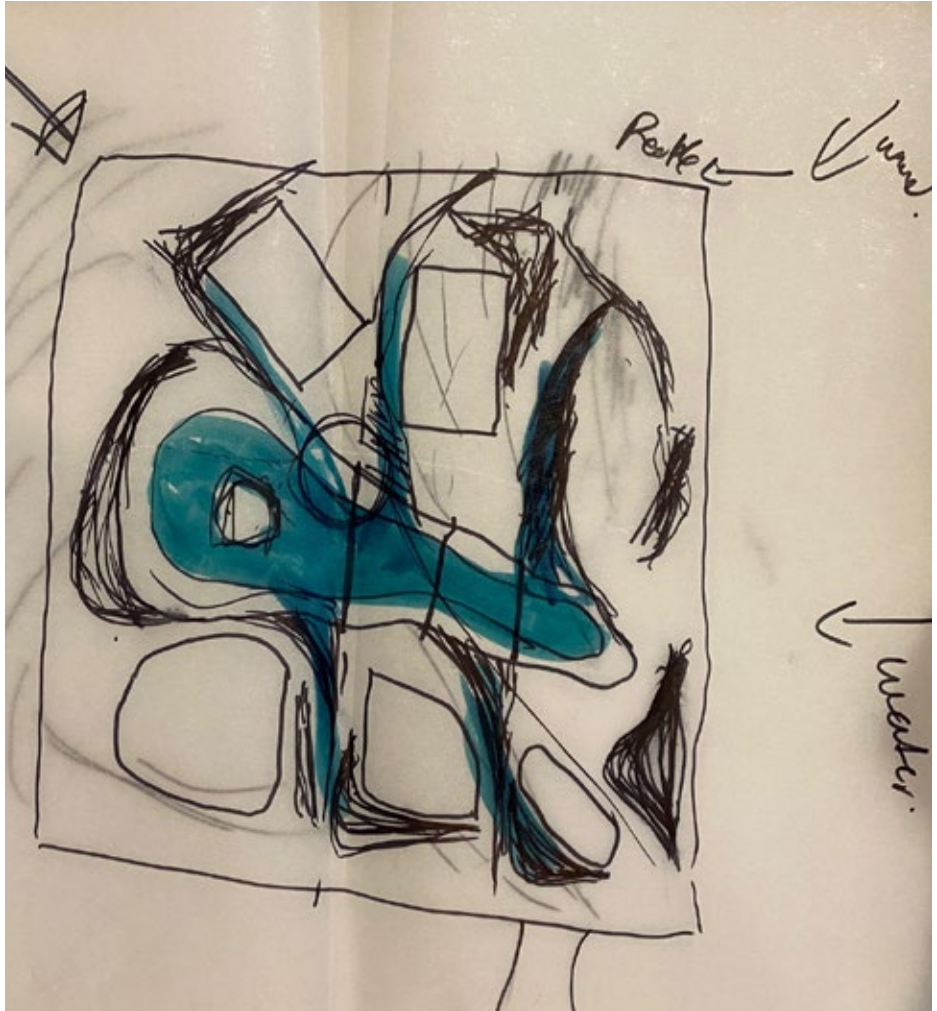
Santa Marta Vision 2050- Detail design of the whole porous system, urban connections





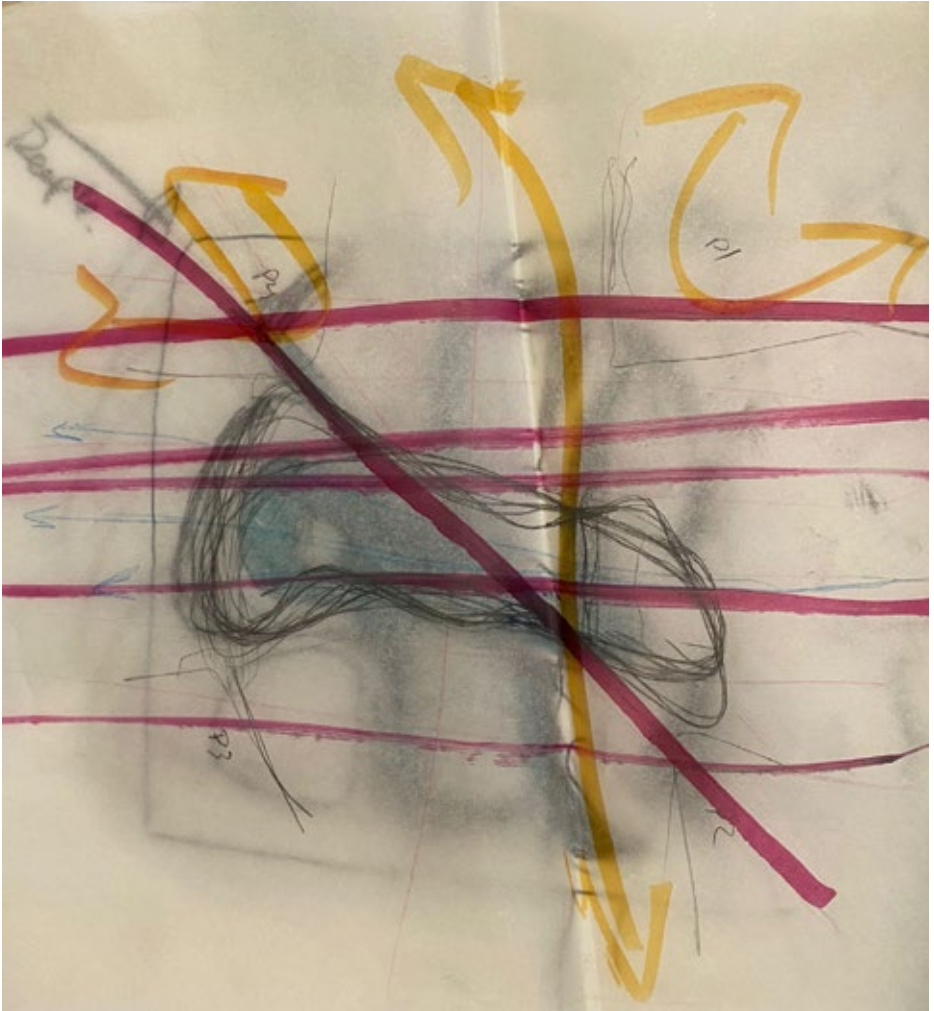
Hand sketch
Final design
Diploma submission

Sharpening ideas



Hand sketch
Final design
Diploma submission

Looking for axis



Diploma
Intermediate scale, urban connection



80 Flood 100 Tr



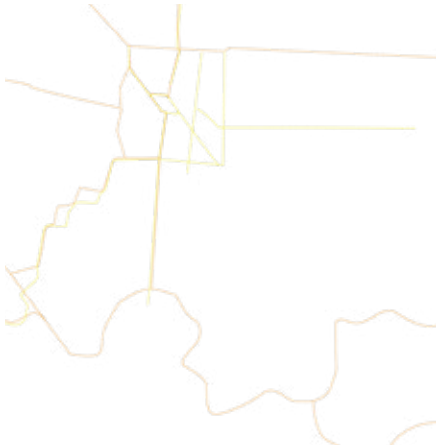
Topography



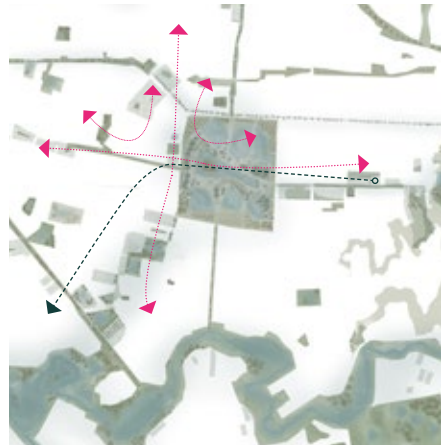
Green structure



Spread spaces for water



Slow movement network



Urban connections

The porous park

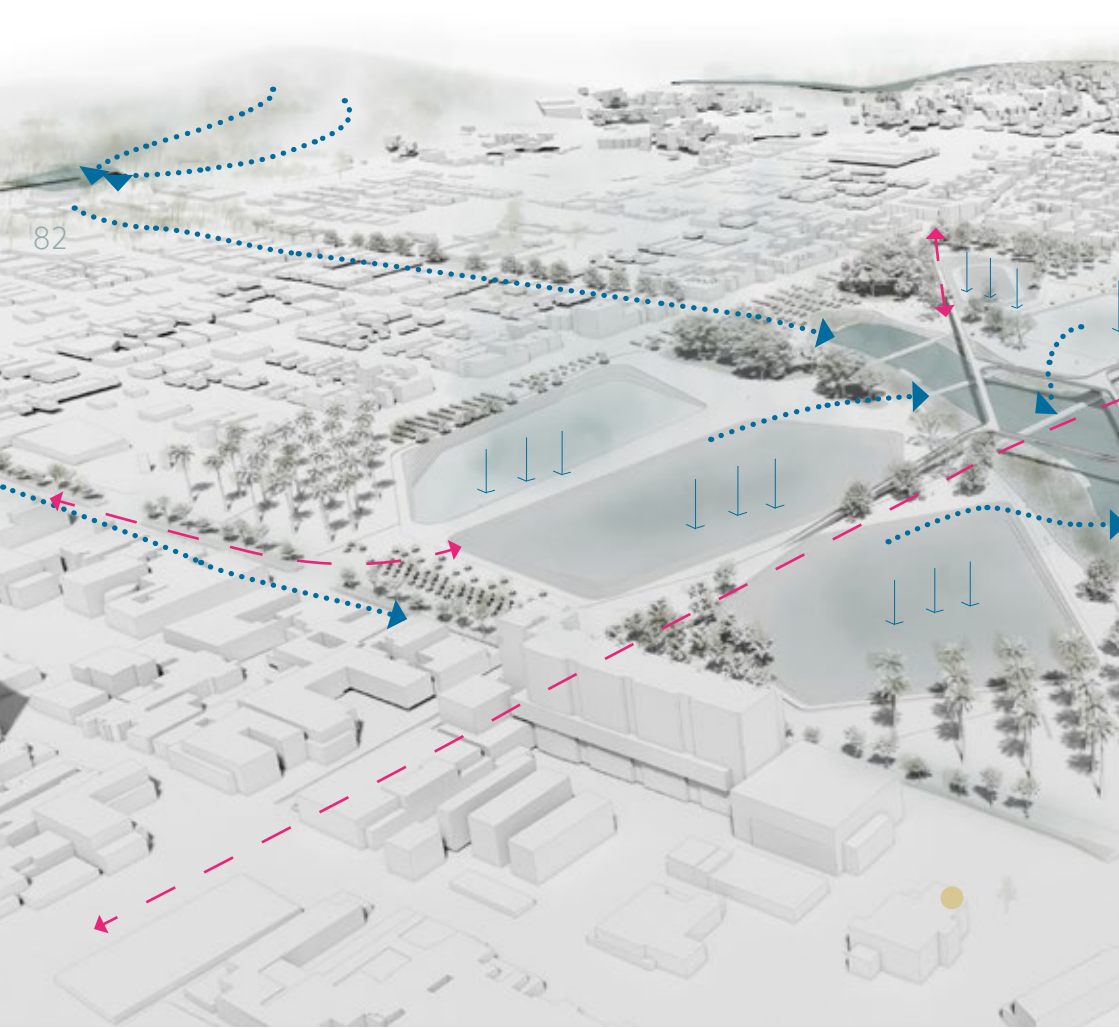
The park integrates into the porous city network, its objective is to be a multipurpose space, to create recreational spaces, and at the same time to regulate water. Reduces the flood in the historical center by managing the water on site.

The inflow comes from the stream running from the hill at the east, the water flows through terraces with native submerged aquatics and emerging plants from the wet ground that clean the water before it arrives at the wet basin.




Intermediate scale, urban connection

In moments of high floods, the system increases its flooding capacity with a combination of dry and wet basins.

Dry basins work as sports fields in dry conditions, in addition, 80% of the park is located 0.20 m lower than the pedestrian ecotone, which allows flooding the whole area in an extreme flood event. A pedestrian bridge connects the ecotone and allows the normal flow of people, even when the whole park is under an extreme flood condition.

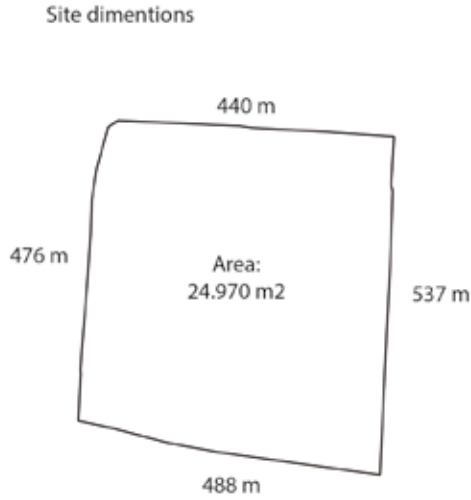









-  Pedestrian connections (urban porosity)
-  Water Flow
-  Bus stops

The porous park, local intervention

Actual situation



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-  Stream
-  Flooding 100 TR
-  Contourlines 0,2 m
-  Residential and commercial buildings
-  Existing trees

Sport facilities

1. Stadium Eduardo Santos
2. Besiball stadium
3. Sport center
4. Softball stadium
5. Rugby field
6. Tennis court
7. Skate ring
8. Olimpic pool
9. Sport arena

The porous park, local intervention

Actual situation



The porous park, local intervention

Actual situation



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The stadium has been abandoned, the structure is failing and falling apart. There are plans to demolish it.

The space in between the other sports facilities is deserts, arid, and don't give any identity to the city, do not connect with the green or blue structure and is not attractor for people.



Diploma

The porous park, local intervention

Actual situation



Diploma

The porous park, local intervention

Inspiration

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Inspired on ancestral communities, specially its building techniques, materiality and quality of the space the project will use terracing in a different scale and not going up as the picture shows but in contrast of it, will do a negative terracing on the ground to make space for the water, at the same time that introduces stone as the construction material of the terraces.



The porous park, local intervention

Intervention steps

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Reorganize sport facilities



Giving space to water - opening the stream - Cut and fill



Introduce wet basins and filtering terraces



Microtopography to directionates the water, protect the sport facilities from the wind



Introduce a 0.20m low level to work under emergency events



Pedestrian ecotone and urban connections

The porous park

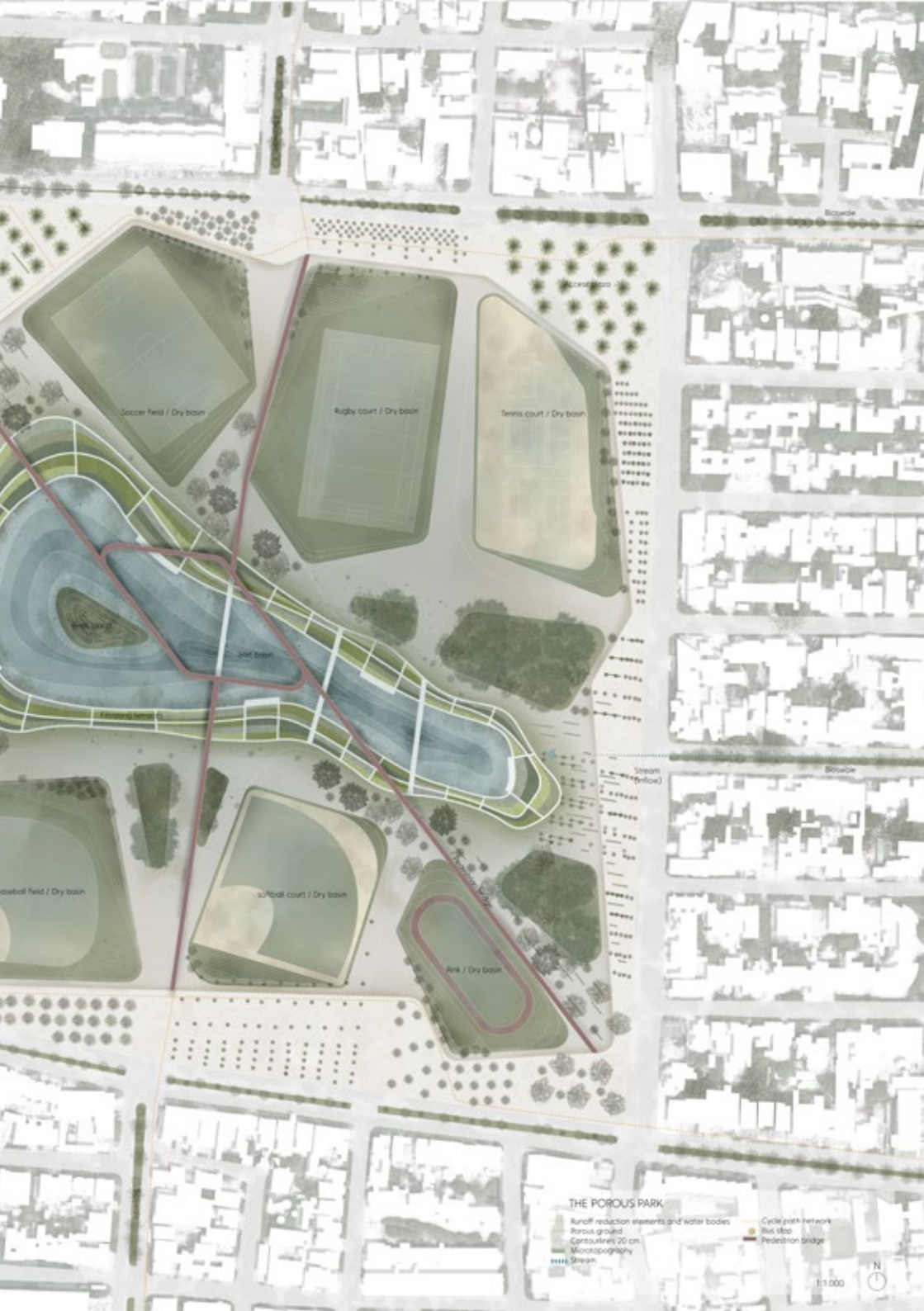
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The inflow comes from the stream running from the hill at the east, the water flows through terraces with native submerged aquatics and emerging plants from the wet ground that clean the water before it arrives at the wet basin.

Diploma
The porous park, local intervention
Site Plan

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Soccer field / Dry basin

Rugby court / Dry basin

Tennis court / Dry basin

Stream bed

Wet basin

Rue de la République

Basketball field / Dry basin

Softball court / Dry basin

Birk / Dry basin

Stream (surface)

Boulevard

THE PORCOUS PARK

- Runoff reduction elements and water bodies
- Runoff gradient
- Contourlines (20 cm)
- Microtopography
- Stream
- Cycle path network
- Bus stop
- Pedestrian bridge

1:1,000



Diploma

The porous park, local intervention

Site Plan zoom



Birds island

Wet basin

Filtrating terraces



Diploma

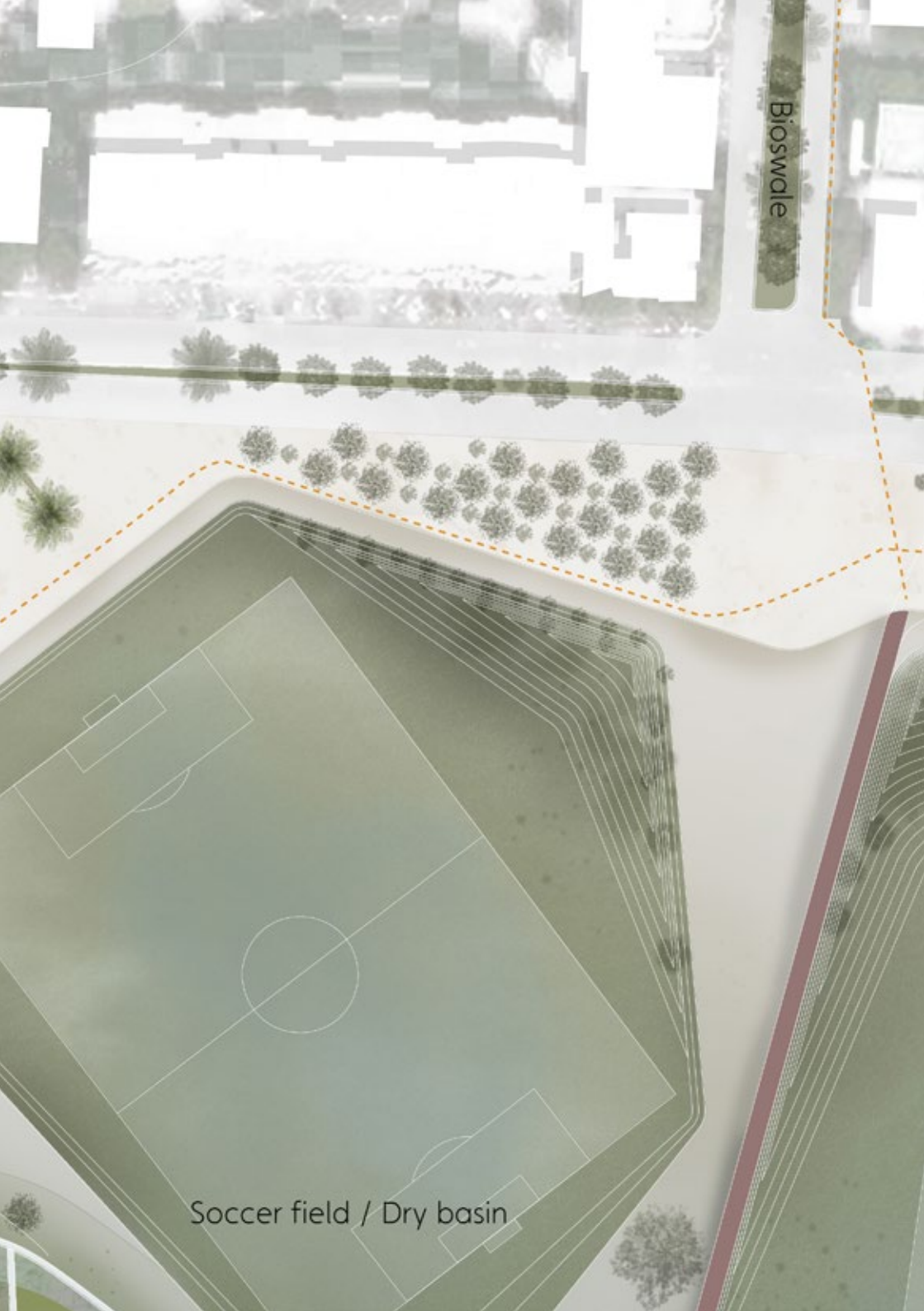
The porous park, local intervention

Site Plan zoom access plaza and sport facilities



Access plaza

Bioswale

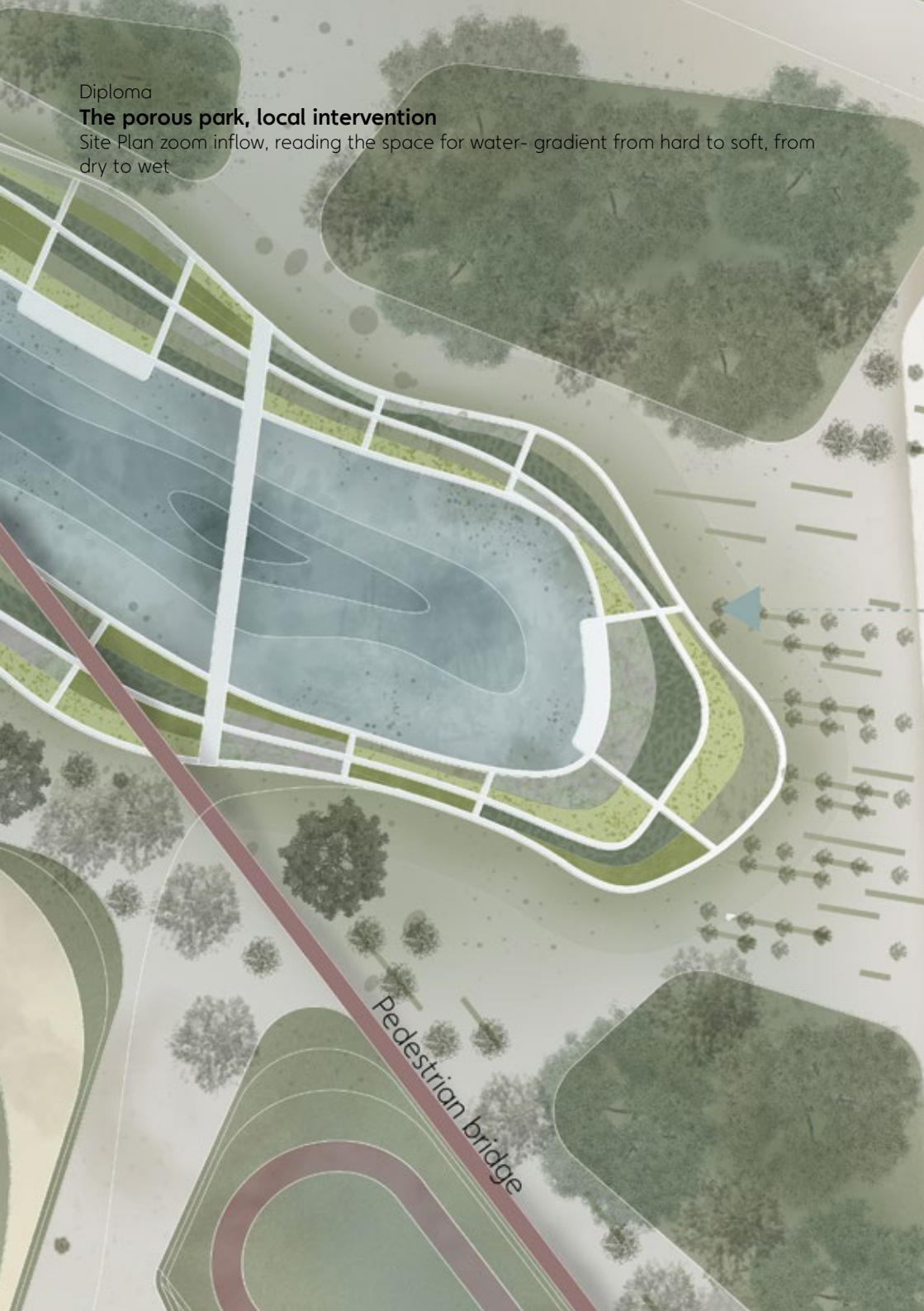


Soccer field / Dry basin

Diploma

The porous park, local intervention

Site Plan zoom inflow, reading the space for water- gradient from hard to soft, from dry to wet





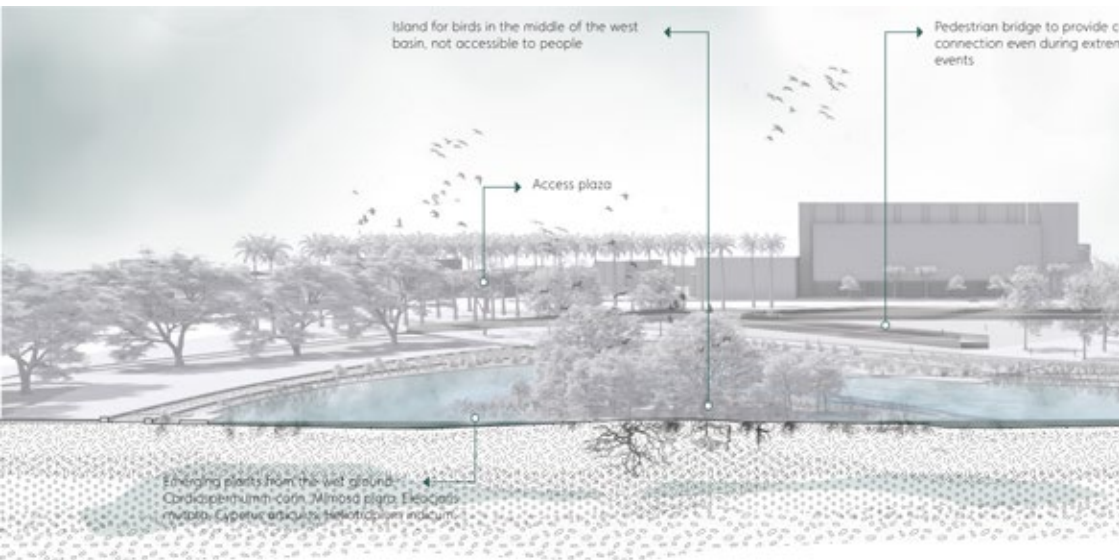
Stream
(inflow)

Bios

Diploma

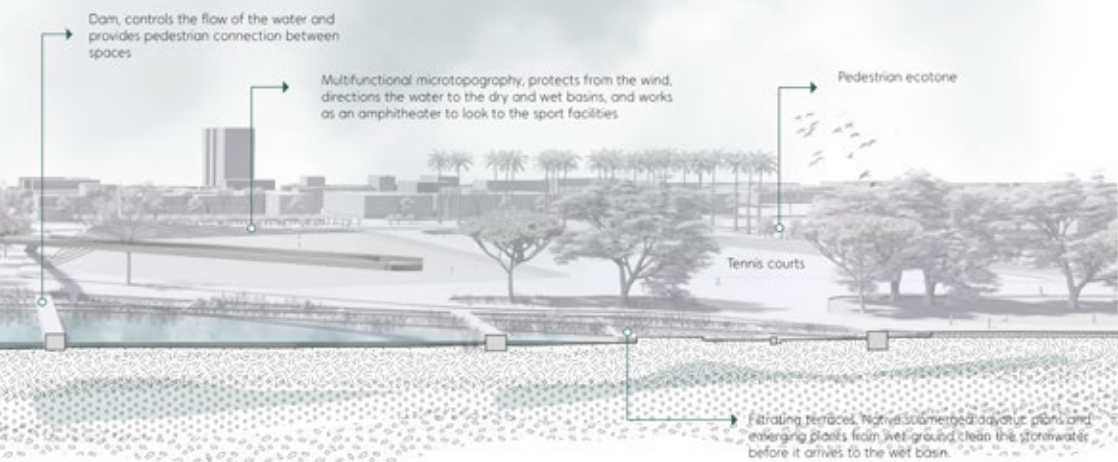
The porous park, local intervention

Longitudinal sectional perspective



Wet basins are designed to store water in a spread way instead of a deep way. The spread management of the water allows to fertilize the soil and to keep safe deep of the water bodies.

continuous
the flooding



The porous park, local intervention

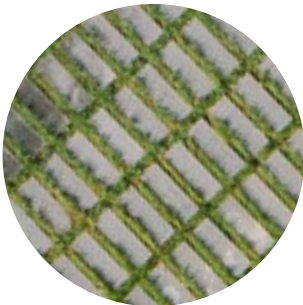
Material palette



Pavers 100% density



Pavers 75% density with pebbles



Pavers 75% density with grass



Crushed brick (recycled material)



Tree bark



Sand

Diploma

The porous park, local intervention

Material palette

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The material selection is based on getting the most permeable materials possible to have a permeable ground to allow aquifer recharge.

In addition, all pavers are with local stone and go with different densities, from 100% density on the pedestrian ecotone to a 75% density mix with pebbles and grass, then transition from hard to soft, from dry to wet, from the exterior to the interior of the park.

Flooding on site



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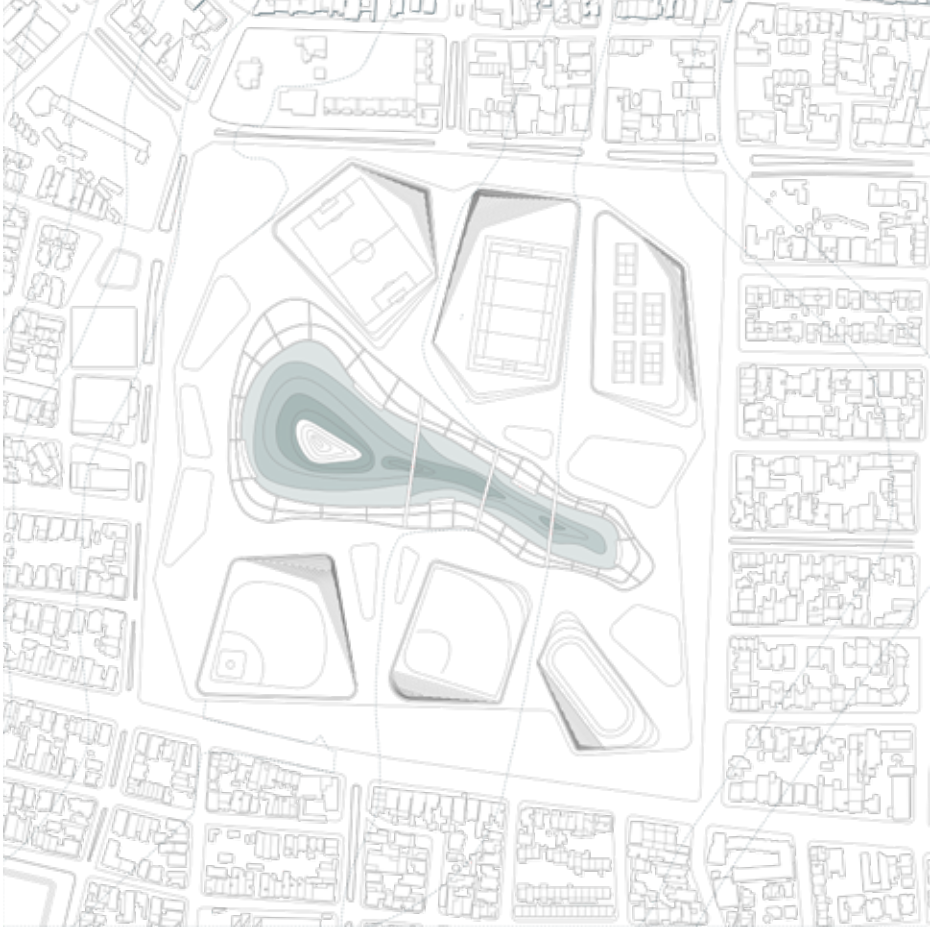
Actual situation

Diploma

The porous park, local intervention

Flooding sequence

Flooding in an adaptive landscape



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Dry condition



The porous park, local intervention

Flooding sequence

Flooding in an adaptive landscape



Moderate flood condition

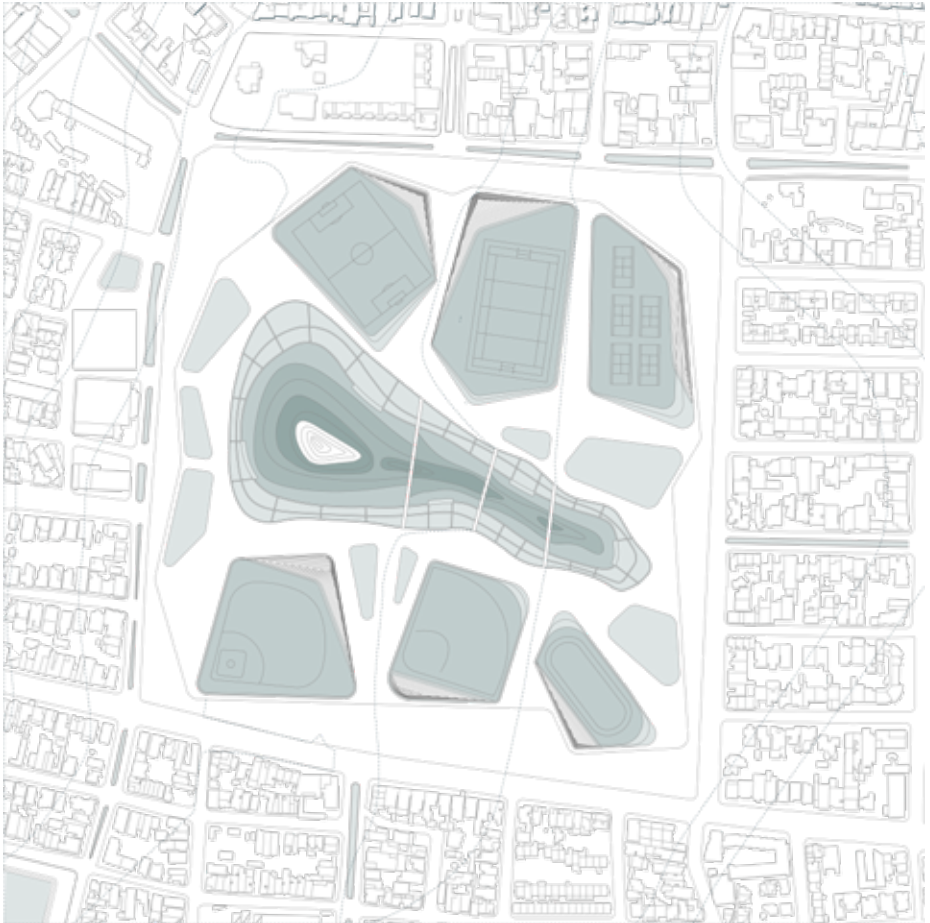
- Ap
- Jn
- Jl
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Diploma

The porous park, local intervention

Flooding sequence

Flooding in an adaptive landscape



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High flood condition

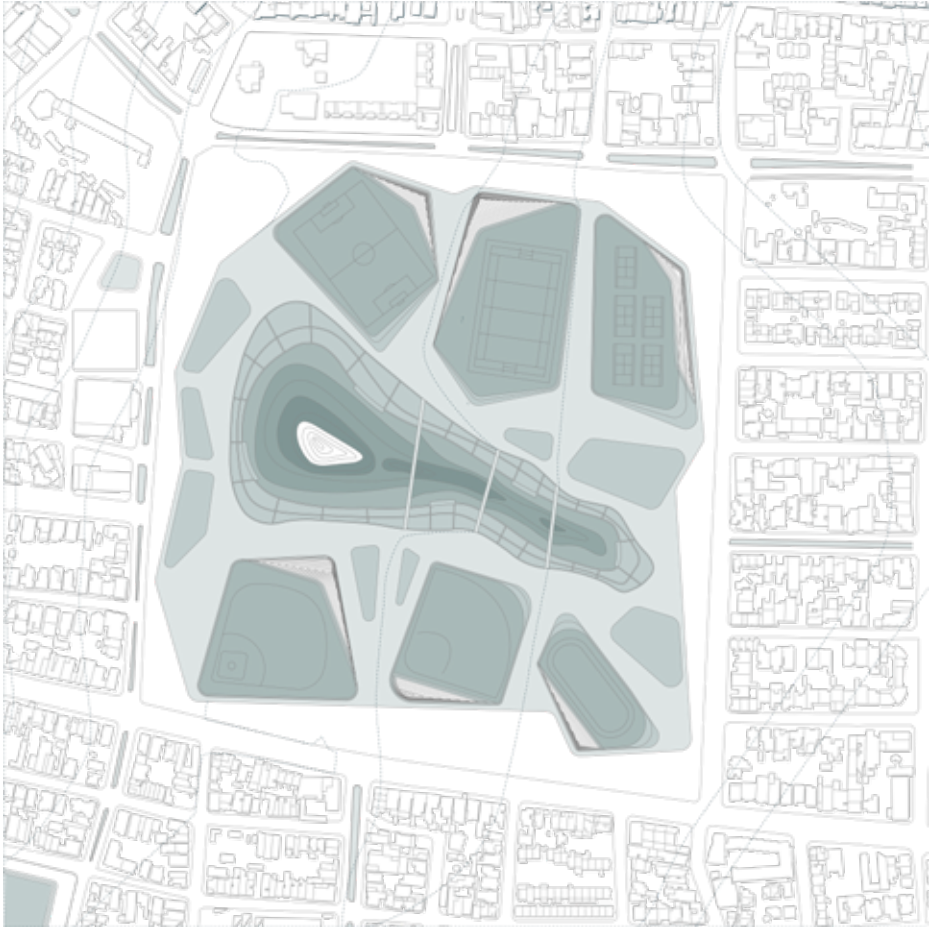


Diploma

The porous park, local intervention

Flooding sequence

Flooding in an adaptive landscape



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Extreme flood condition

The porous park, local intervention

Flooding sequence

The inflow comes from the stream running from the hill at the east, the water flows through terraces with native submerged aquatics and emerging plants from the wet ground that clean the water before it arrives at the wet basin.

In moments of high floods, the system increases its flooding capacity with a combination of dry and wet basins. Dry basins work as sports fields in dry conditions, in addition, 80% of the park is located 0.20 m lower than the pedestrian ecotone, which allows flooding the whole area in an extreme flood event.

A pedestrian bridge connects the ecotone and allows the normal flow of people, even when the whole park is under an extreme flood condition.

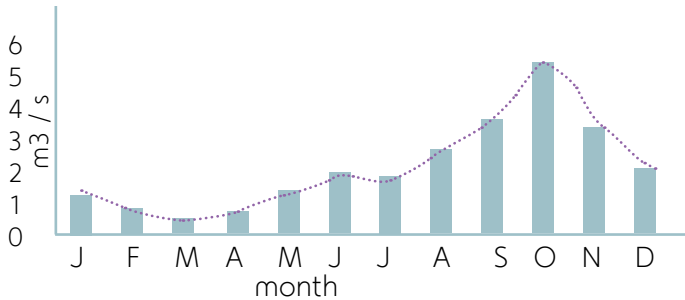
The porous park, local intervention

System capacity, Modified Rational Method

Data to determine the Unit Hydrograph of the Manzanares River Basin

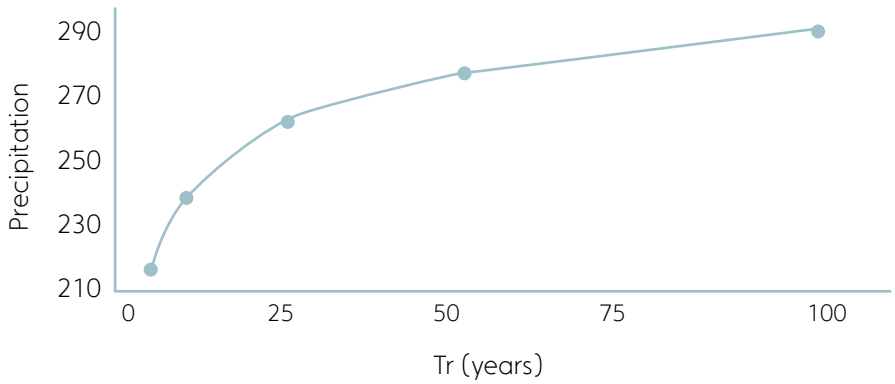
L	33,5 km
CN	73,66
J	0,079 m/m
A	174,54 km ²
Lc	29,19 km
Wc	5,98 km
Lc/wc	4,88
K	0,86 hrs
tp	2,20 hrs
tp/Km	2,57 hrs
n	12,14
B	300
Up	9,7m ³ /sec
to	2,86 hrs
t1	4,58 hrs

110



The porous park, local intervention

System capacity, Modified Rational Method



111

$$q \text{ max} = 0,86 * 1,25 * 5,5 \text{ (mm/h)} * 2,4970 \text{ (Ha)}$$

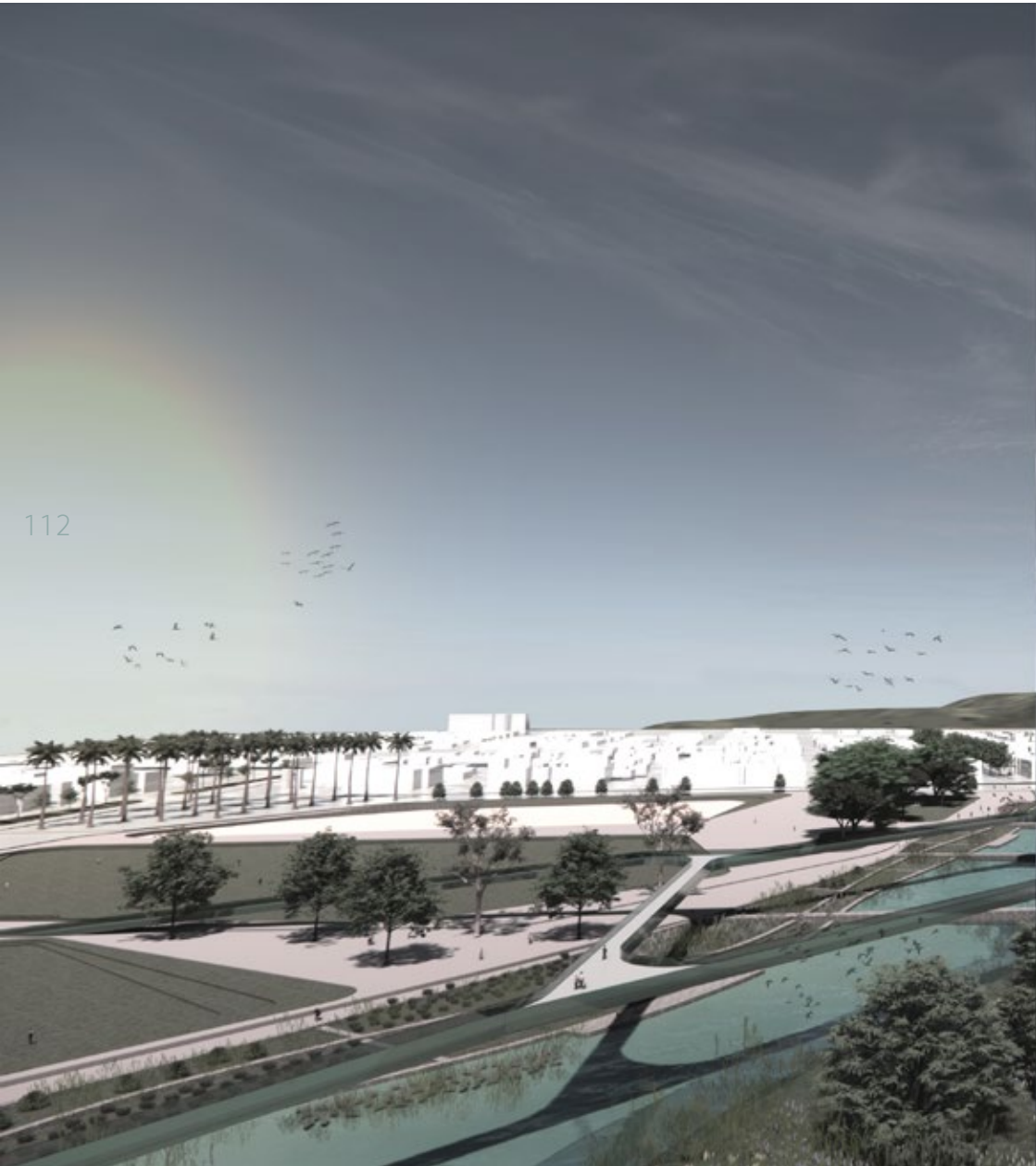
$$q \text{ max} = 14,19 \text{ m}^3/\text{s}$$

Diploma

The porous park, local intervention

An adaptive landscape

112



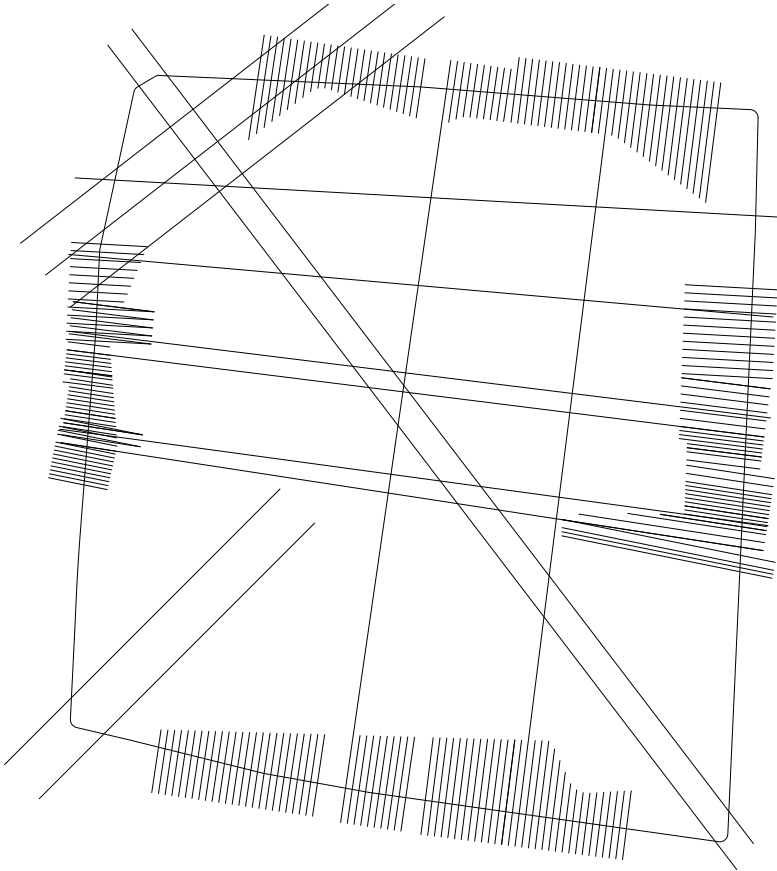


Diploma

The porous park, local intervention

Planting strategy

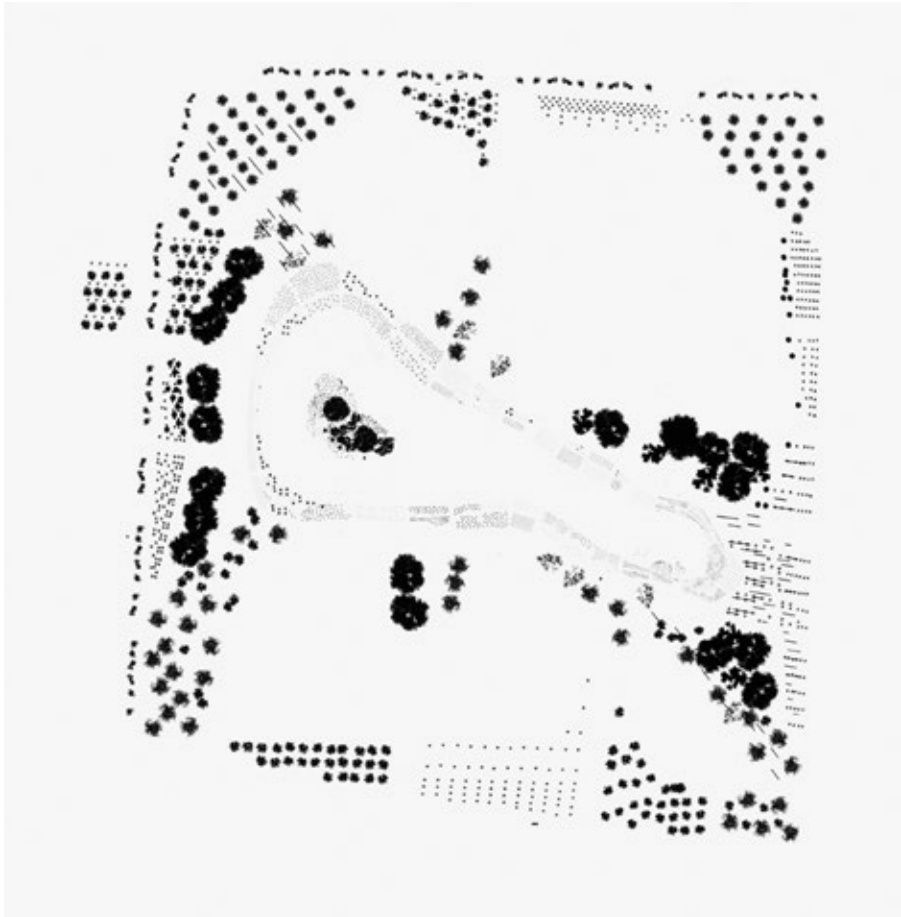
Planting grid, main axis



114

The location of the planting is defined by a series of grids, that look for a geometrical connection, relation, and tension with the urban fabric, the natural flow of the people, and the natural flow of the water.

Planting plan



At access plazas, the vegetation continues with the diagonality connecting with the principal people flow. At the border, the planting is related to the immediate context. On the east side, the vegetation recognizes the flow of the water and makes it evident with the strips of vegetation that lets water go in between.

The porous park, local intervention

Planting strategy

Planting Strategy Access plazas- Dry zone



116

The ecotone planting is characterized by 3 layers of vegetation. Tall trees, medium-sized trees, and low vegetation. The access plazas are a combination of palm trees that highlight the desertic zonobiome that surrounds the area, give a clear path to follow, and are combined with fruit trees that attract different bird species.

Diploma
The porous park, local intervention
 Planting strategy

Palms - Dry tropical type



<i>Astrocaryum mayba</i> Height: 3m Width: 2m	<i>Coccothraustes</i> Height: 30m Width: 10m	* <i>Albida rapides</i> Height: 10-30m Width: 14m	<i>Aspidosperma polymorpha</i> Height: 15m Width: 5m
---	--	---	--

attractive for birds - frutal



<i>Aichche</i> Height: 4m Width: 2m	<i>Anard</i> Height: 6m Width: 3m	<i>Aramo</i> Height: 3m Width: 5m	<i>Ipomoea carnea</i> Height: 2.5m Width: 1.5m
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Flowering plants



<i>Bromelia pinguin</i> Height: 2m Width: 3m	<i>Reurothallis</i> Height: 0.5m Width: 0.8m	<i>Cyperus arcticus</i> Height: 30m Width: 10m	* <i>Dichoanthera</i> Length: 0.5m Width: 0.1m
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* Native species



The porous park, local intervention

Planting strategy

Planting Strategy Shadow zone

Shadow cr



118

The average temperature in Santa Marta is 31 c with a max register of 41 c.

It is necessary to introduce native trees with high shadow production to provide climatic comfort for people, an promote all-day function of the park.

Diploma
The porous park, local intervention
Planting strategy

Selection trees



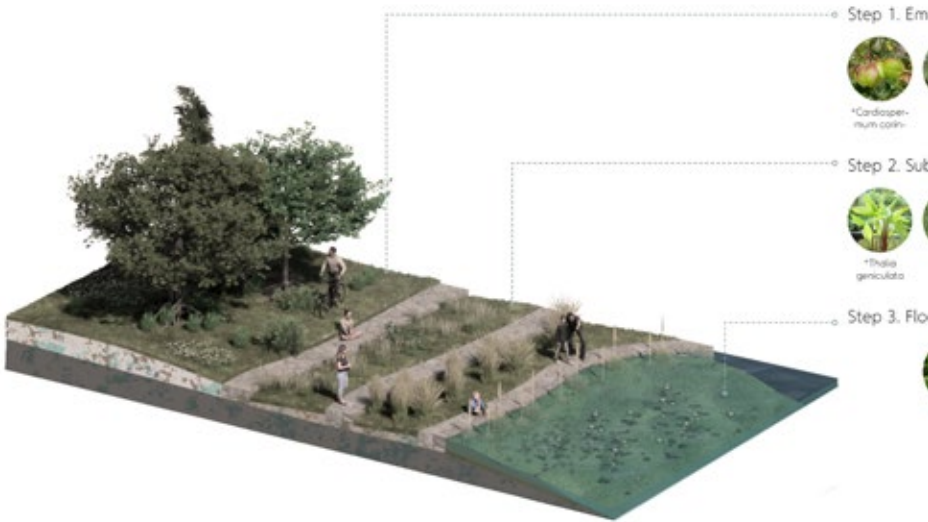
* Native species



The porous park, local intervention

Planting strategy

Planting Strategy Wet zone



120

A series of plants between emerging, submerged and flooring has been selected on a color range of green with purple flowering. These plants are located along with the permanent water bodies and have been chosen for their ability to clean the water of heavy minerals, they filter the water before it arrives at the basin and performs well even when the stormwater has been mixed with the sewage water.

Diploma
The porous park, local intervention
Planting strategy

Emerging plants of wet ground



Emerged Aquatics



Flowering leaved plants



* Native species



Diploma

The porous park, local intervention

Transversal sectional perspective

Species attracted by the fruit trees, the water, and the birds island



Pyrrhura V.



Chaetocor.



Coeligen.



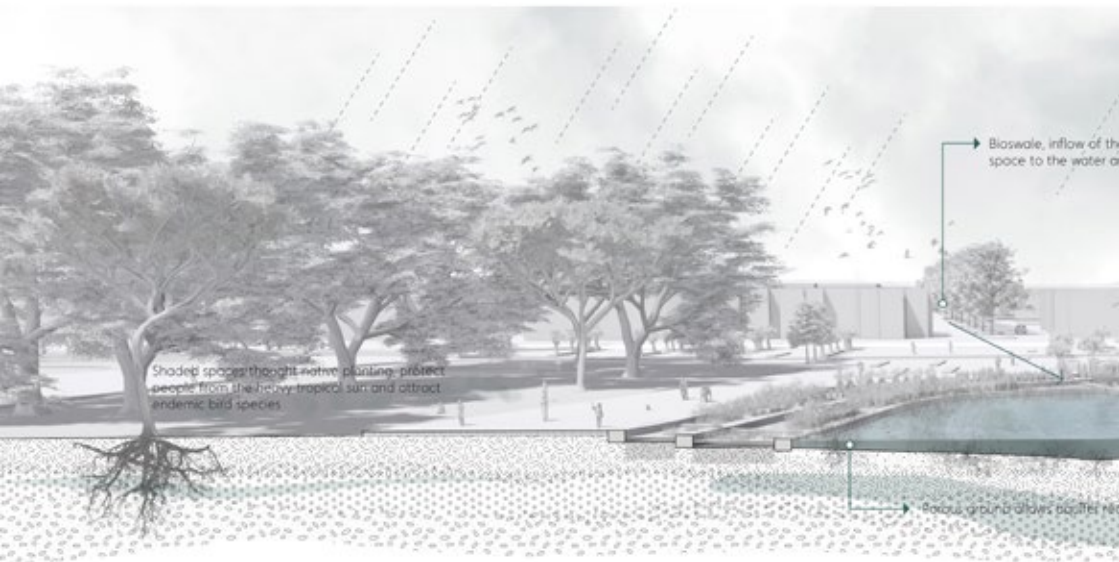
Anthocep.

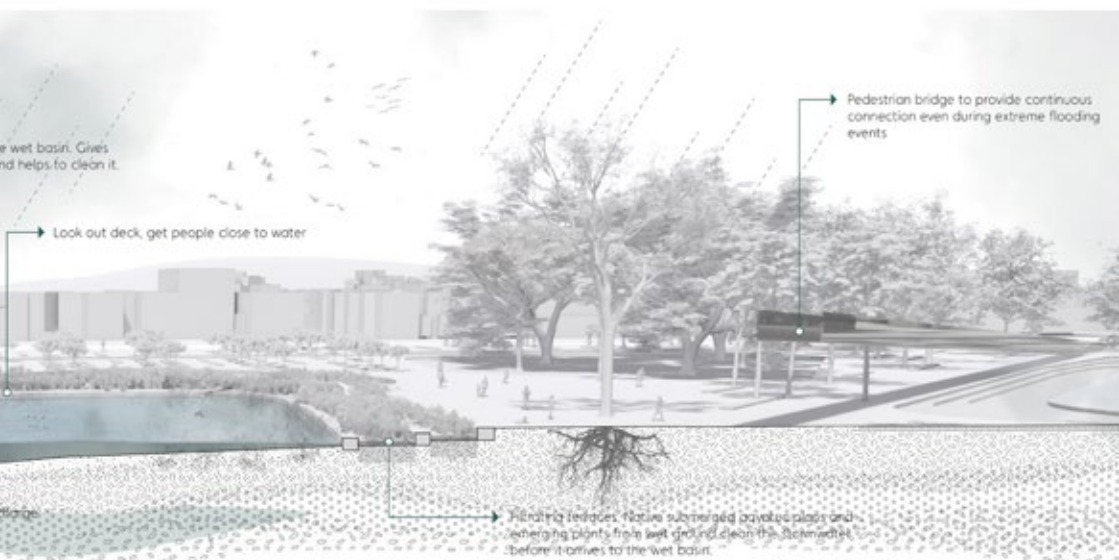


Cranial.



Cralloria B.





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The porous park, local intervention

The user experience, Dry condition



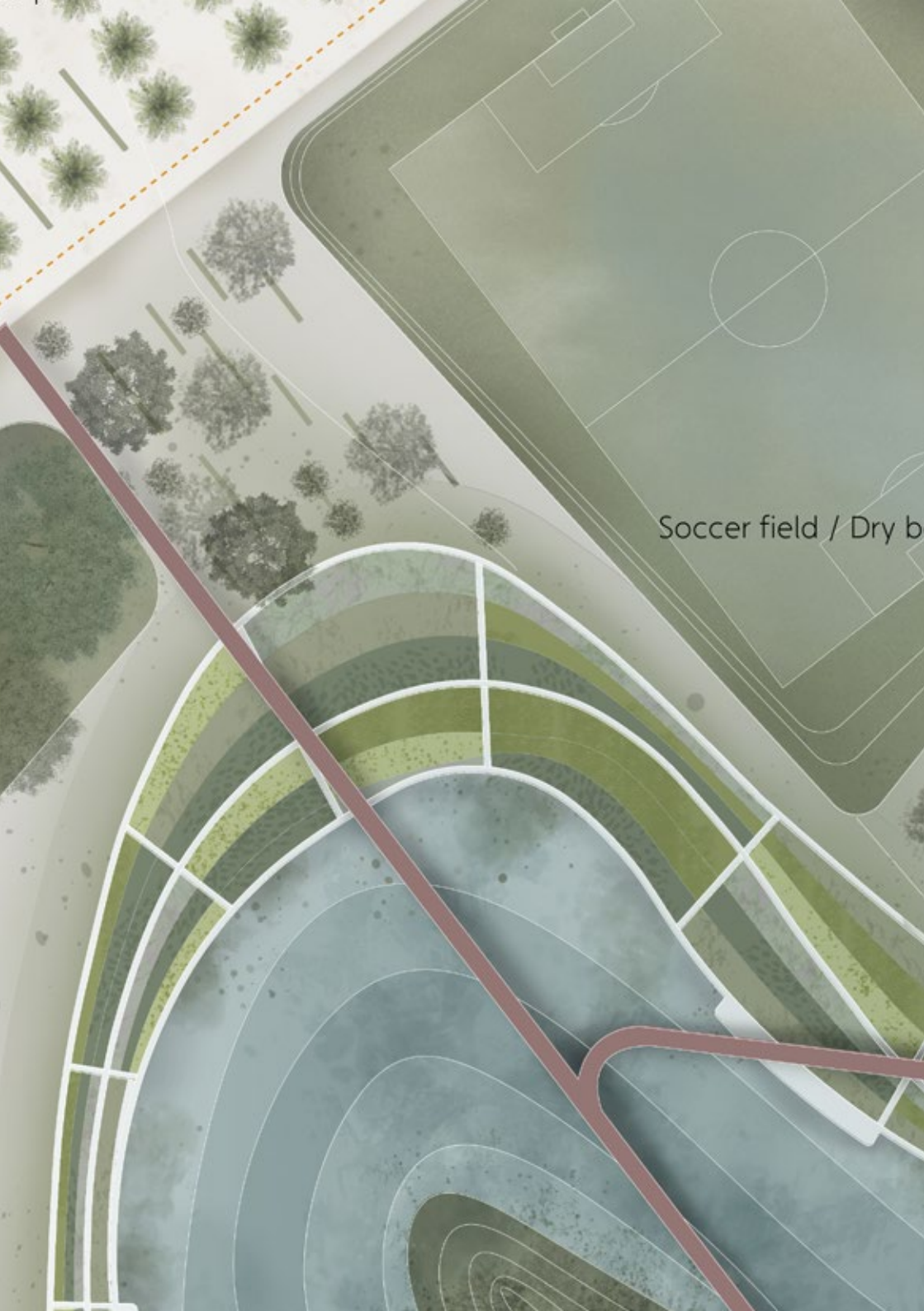


Diploma

The porous park, local intervention

Site Plan zoom, a park that connects with the whole system, extensions of the landscape on the city





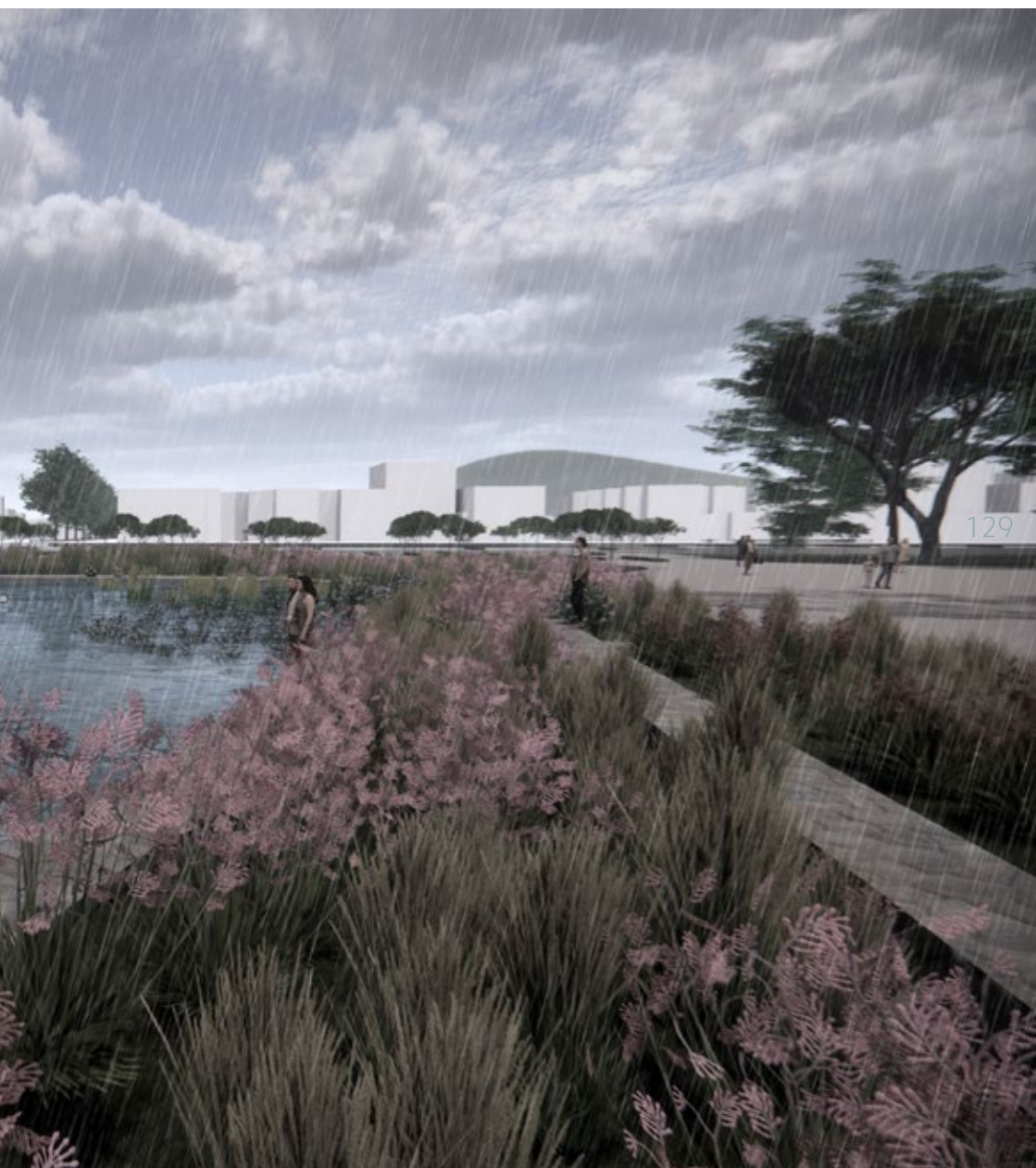
Soccer field / Dry ball court

Diploma

The porous park, local intervention

The user experience, Rain condition





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The porous park, local intervention

Physical model scale 1:1000





Diploma

The porous park, local intervention

Physical model scale 1:1000

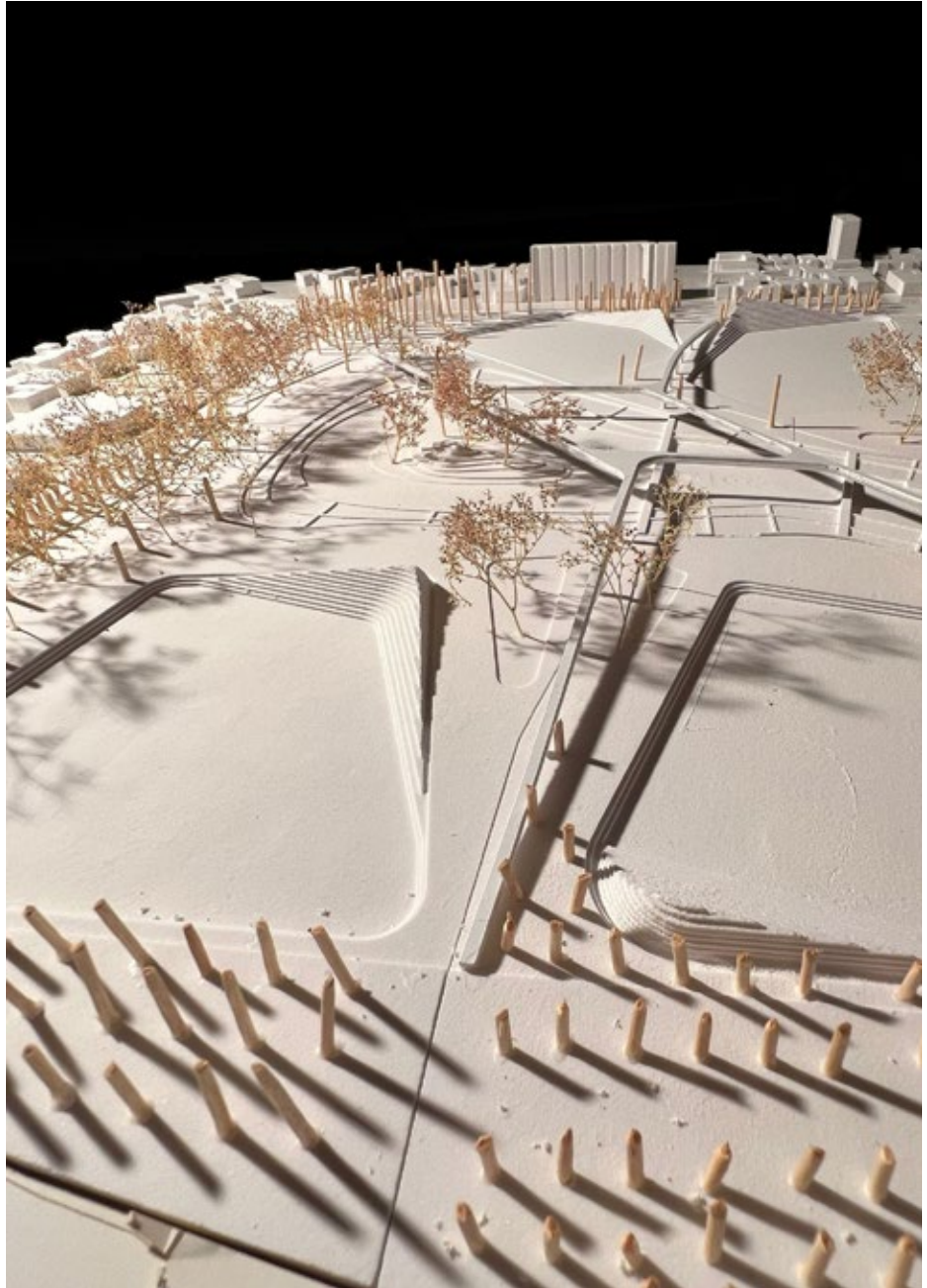


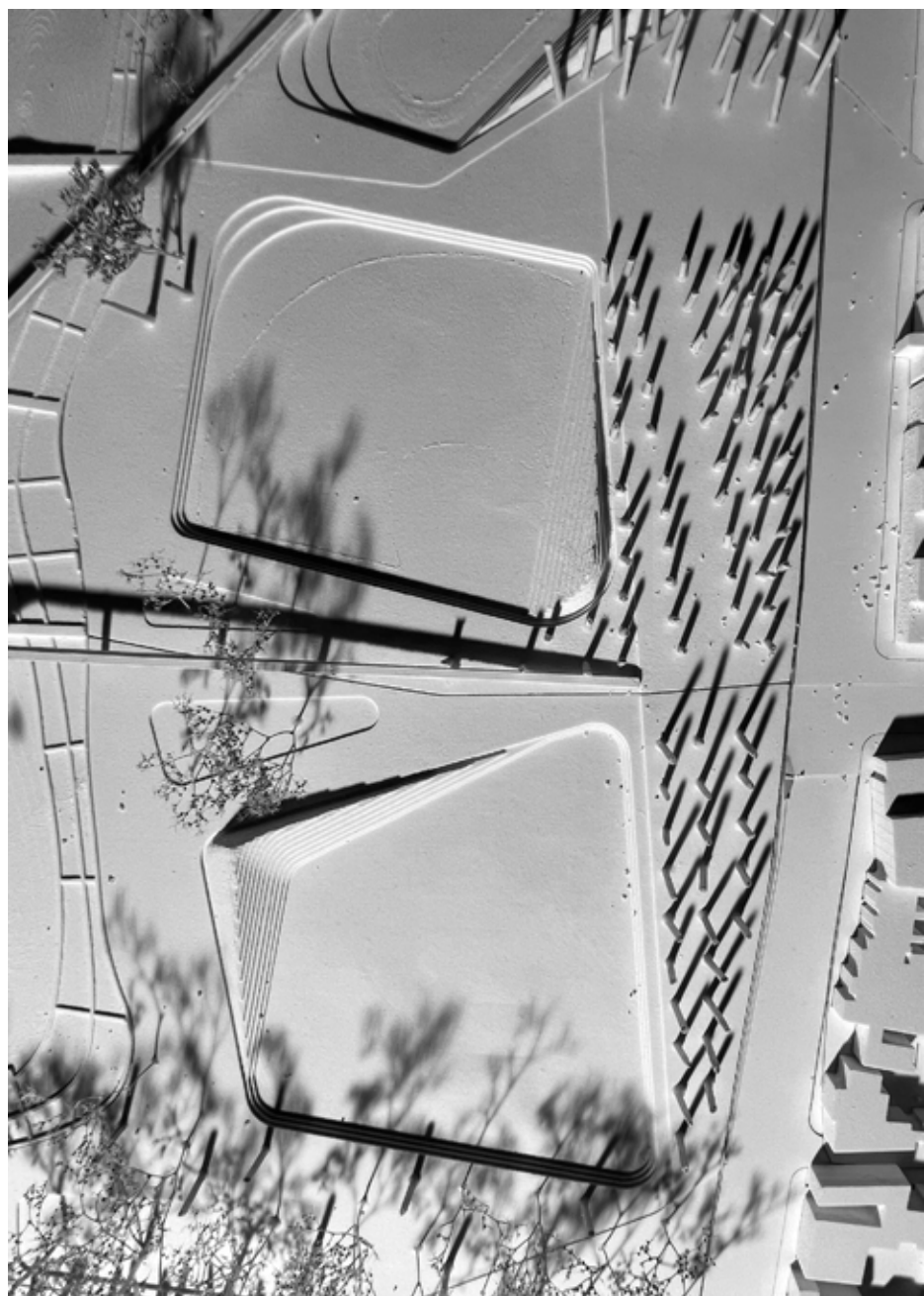


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The porous park, local intervention

Physical model scale 1:1000





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The porous park, local intervention

Physical model scale 1:1000





Diploma

The porous park, local intervention

Physical model scale 1:1000



