



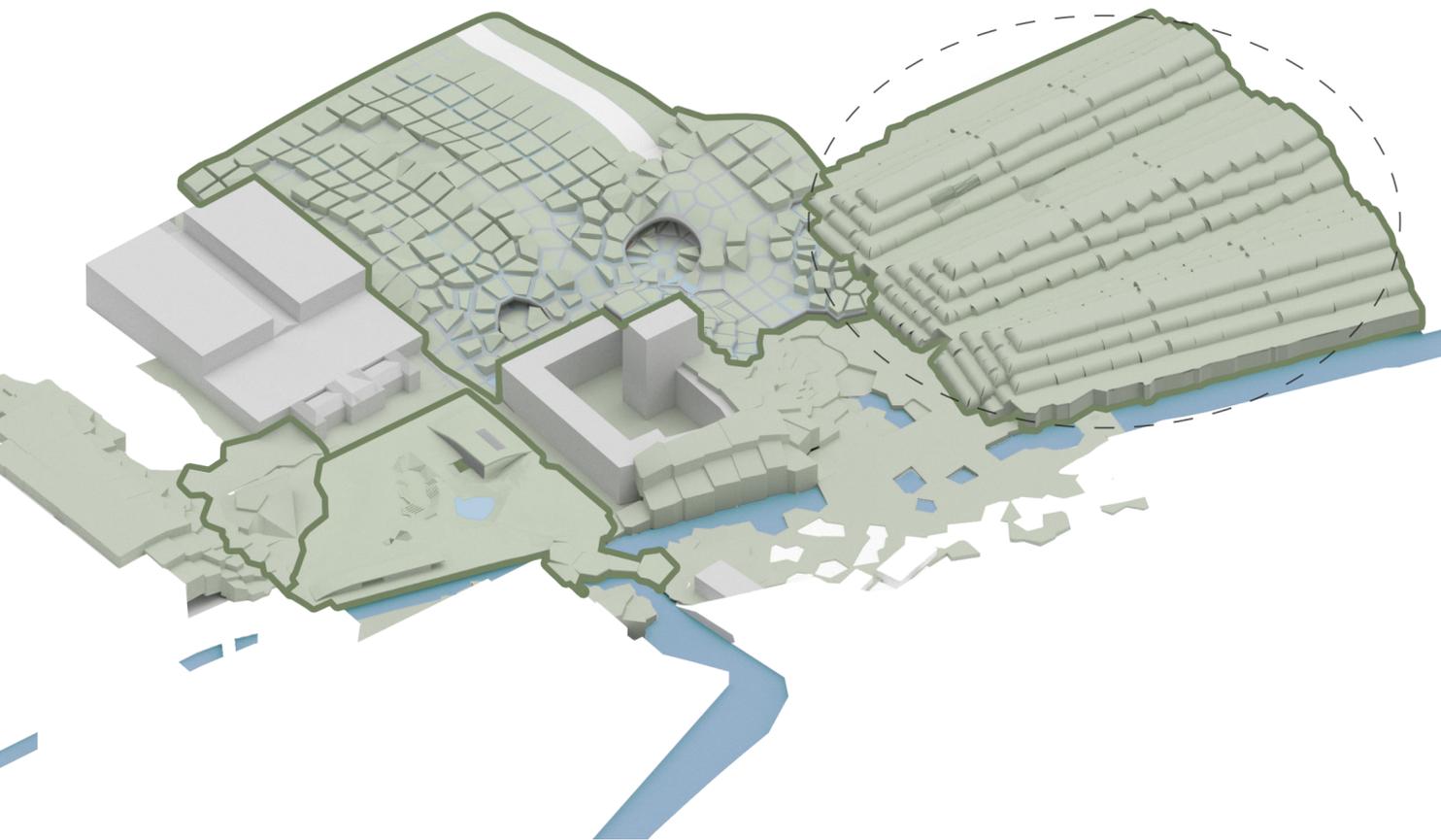
Housing units - life underground

Project Floodgate - exploring a terrain of extruded mass

Architecture and Urban Space Design

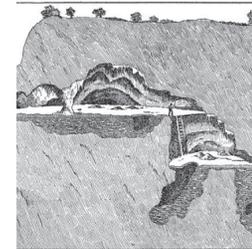
Sofia Lindell, Slussen

Detailing Area of study



In this area, all previous buildings have been removed, allowing for an entirely new type of building to emerge - one carved out from the terrain.

References



A vertical cave-like system



Spaces both with and without daylight



Old caves transformed to hotels



Openings as a result of demolition



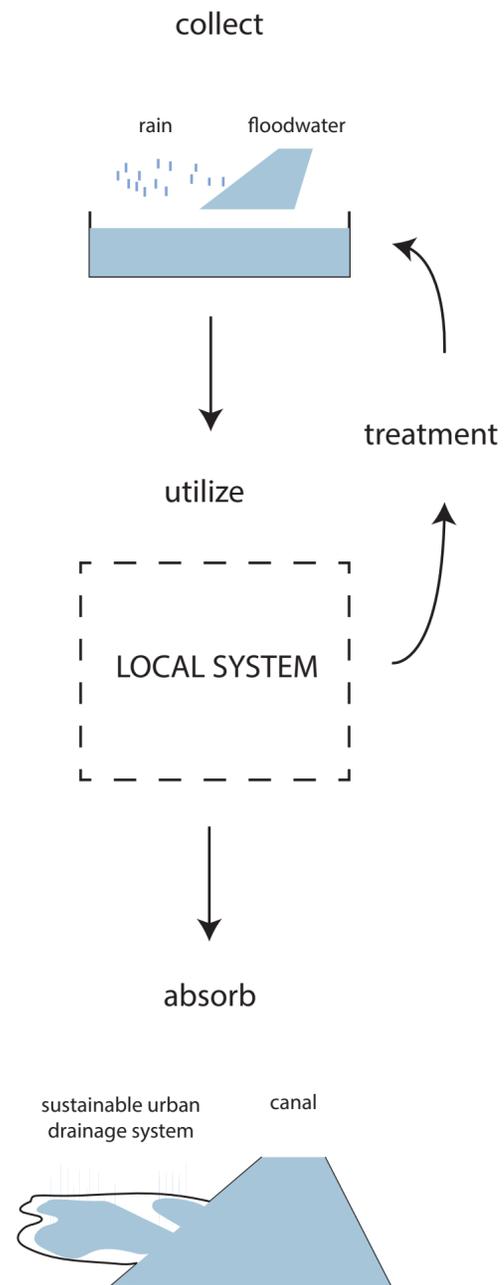
Modern cave house in Utah



Materiality of boulders

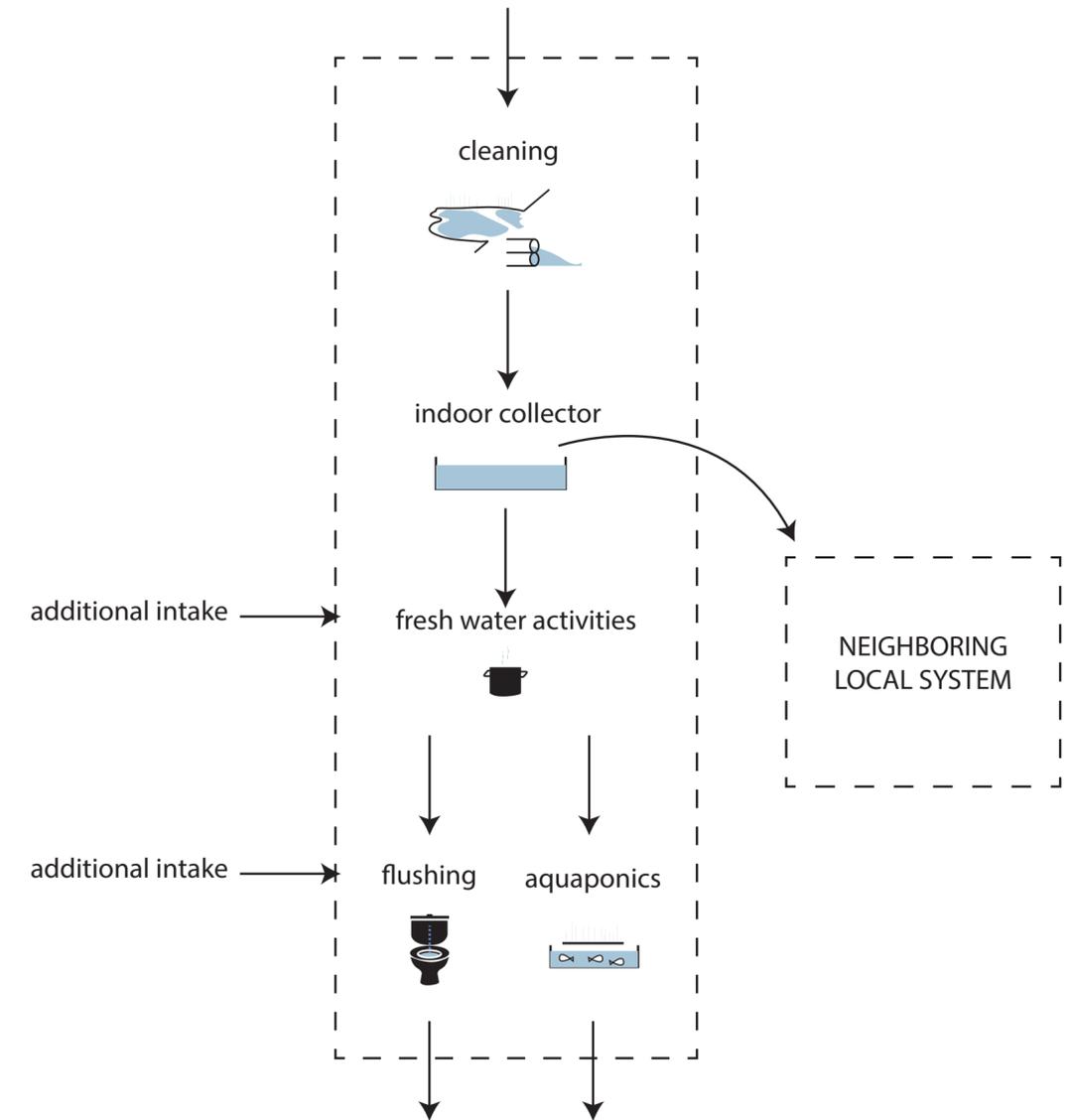
System Cascading water system

The hydrosocial system is divided in a global system, spreading over the entire terrain, and several specific local system.



System Local system

This is the local system of this focus area.



Local system Argument

Just like the global hydrosocial system, this local one is based on a **cascading water system** that centers around the experience, visibility, and use of water in different stages of the water chain. The housing part of the landscape functions as a sponge, guiding water down into its mass, making use of the stormwater that would otherwise have flooded the space.

Water flows through three **stages of cleanliness** within the system: fresh, semi-fresh and used. These meet in three different types of activities: fresh water activities, flushing and aquaponics.

Water enters the system from two inputs, **rainwater** and the existing water system of Gothenburg, the second one is only active when there is not enough rainwater to use. The system defines rainwater as semi-fresh water, contaminated by suspended particles and urban emissions, so it goes through a cleaning process before entering the **indoor collector**, where it's stored until it's needed and used for **fresh water activities**.

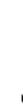
Semi-fresh water exits the fresh water activities and is used for either **flushing** or to feed the **aquaponics**. To avoid stagnant water over time, the collector has a maximum capacity and when it is exceeded, water flows down to the input of the next local system, mixing with its rainwater reserves.

After flushing, and potential drainage from the aquaponics system, the used water moves into the sewers, where it is properly cleaned and then it runs out into the canal.

Spatial requirements Water elements in the local systems

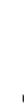
COLLECTING

Rainiest month in Gothenburg - August



Amount of people provided household water from solely rainwater capture per 12x12 m cell: **7 people**

Dryest month in Gothenburg - March



Amount of people provided household water from solely rainwater capture per 12x12 m cell: **3 people**

The entire quantification is available in the group booklet

AQUAPONICS

(i) **Fish Pond/Tank:** Area required for construction of the fish pond/tank is 80 m²; diameter of the circular tank is 7.2 m, having a volume of 60 m³ (60,000 litre), with effective water depth of 1.68 m and maximum depth of 2.13 m (centre of the pond/tank). The system is designed to handle more than 50 fish/m³ (total 3000 fish). Details of design of pond/tank are as follows:

Sl.No.	Particulars	Unit
1	Total Land Area required	Maximum of 150 m ²
2	Tank Area	80 m ²
3	Circular Tank Diameter	7.2 m
4	Tank Volume	60 m ³ (60,000 litre)
5	Effective Depth	1.68 m
6	Maximum Depth	2.13 m (centre of the pond)

= space needed per floor

= the height of one floor is enough

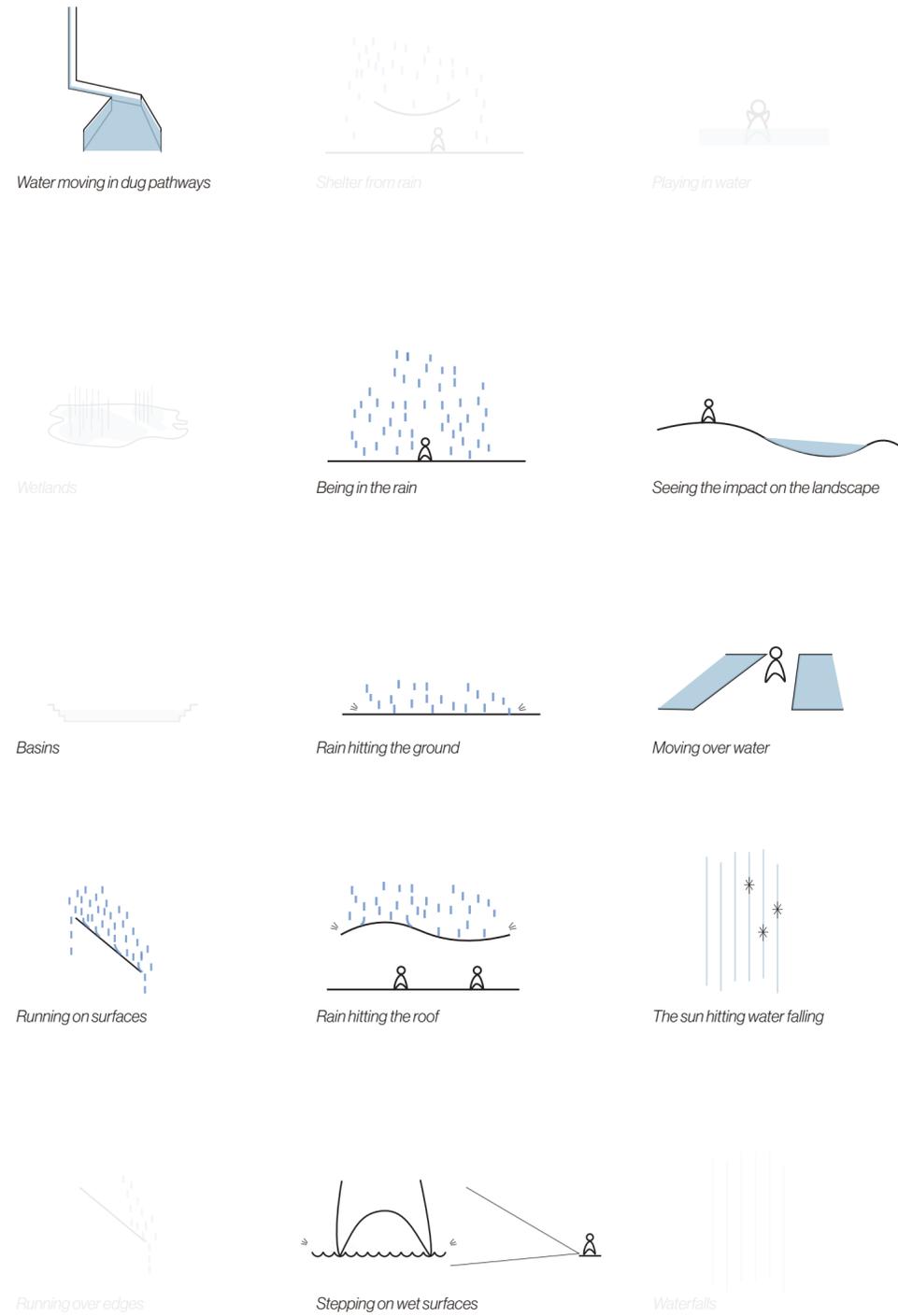
(ii) **Plant Grow-Beds:** Number of grow-beds in FRP Tanks 10, dimension of each grow-bed 6 x 2 x 1 ft (1.83 x 0.61 x 0.30 m); different kinds of solid media such as gravel or expanded clay pebbles (hydrotons) or lightweight expanded clay aggregate (LECA) are used to grow plants, through which water from fish tank passes. Design and layout of the fish tank and grow-beds is shown below:

Source: https://dof.gov.in/sites/default/files/2020-07/Aquaponics_System.pdf

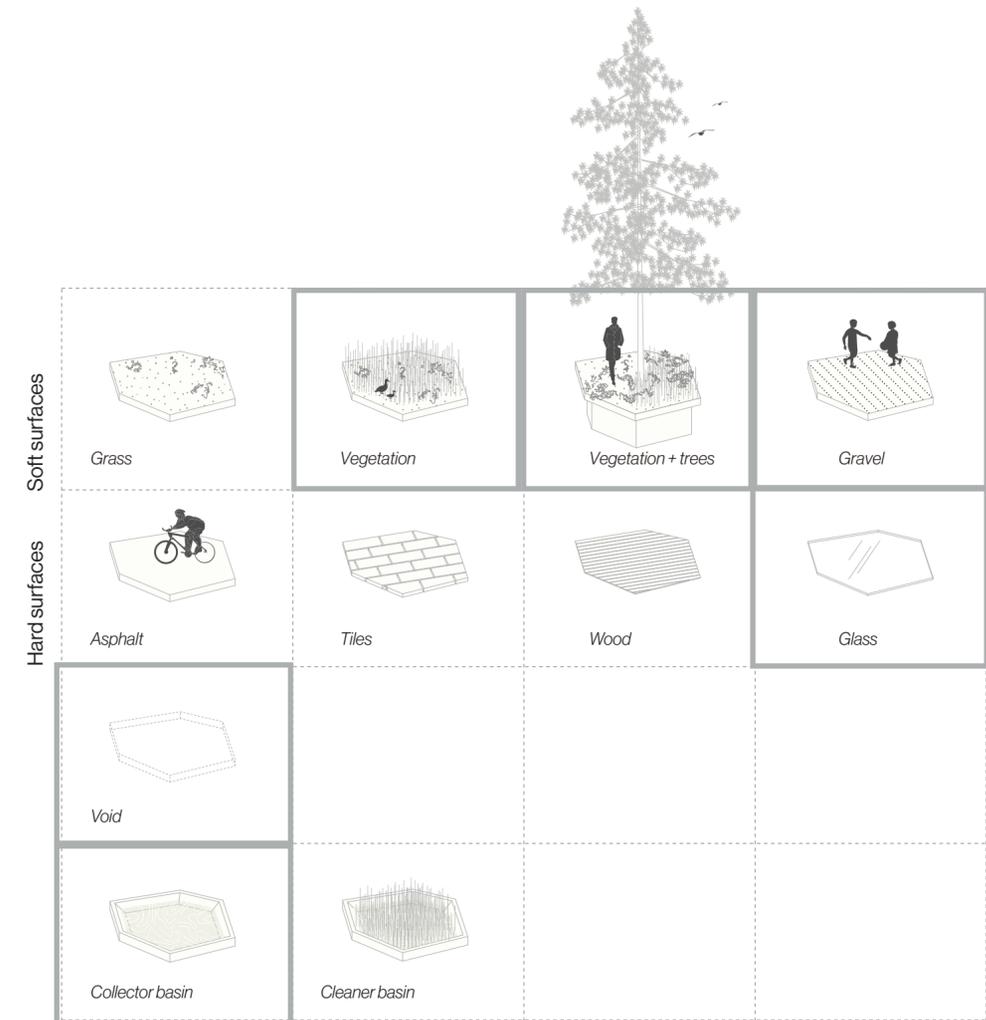
Conclusion: the cells of the hybrid landscape are approximately 12 x 12 m big, which is just enough to produce water for a maximum of 3 units per cell if one person is living in every unit. Hence, if the system is to be able to handle more than that it needs an additional intake.

The fish tanks need a little more than one floor of one cell. The plant part of the system needs less space than the fish part. The hybrid landscape have a lot of space vertically, so the system will be a two floor one with fish on the first and plants on the second floor. It will cover more than one cell since these measurements are for a "small-scale commercial system" which is an appropriate, closing in on too small, scale.

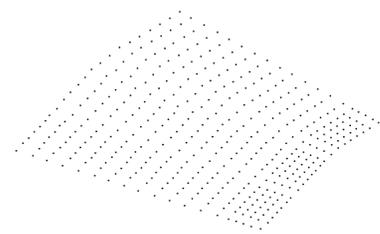
System Water experience to work with (from global system)



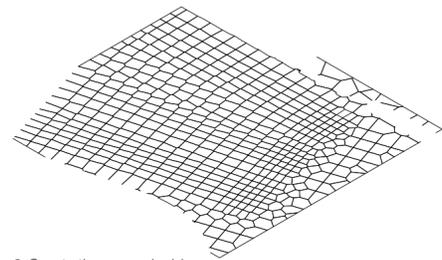
Terrain Toolbox of surfaces to work with (from global terrain)



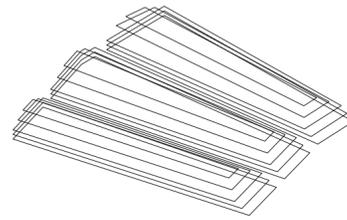
Detail Terrain Procedure



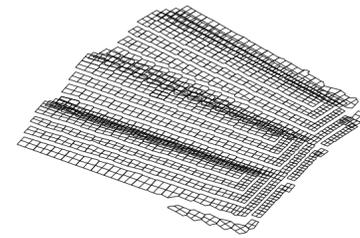
1. Adjust the grid of centre points



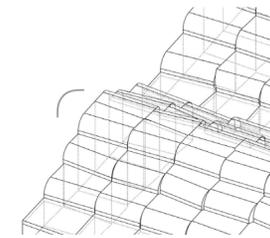
2. Create the voronoi grid



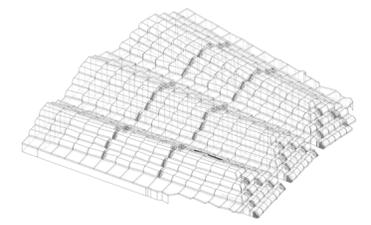
3. Determine height from wanted indoor spaces



4. Generate cell surfaces



5. Extrude down to ground and fillet edges to connect the horizontal and vertical planes



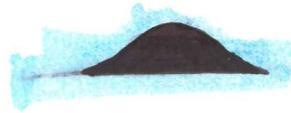
6. Offset cell boundaries and create pathways in offsets over the terrain

... and start carving out the interior spaces from the design strategies

Detail Problematisation



Working with a big landmass.



Preventing flooding.

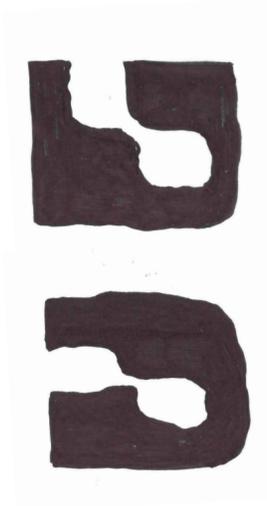


Getting light down into the mass.



Growing food in a dense urban space.

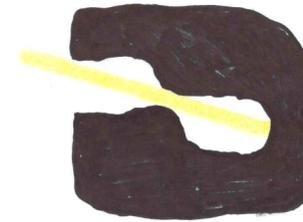
Detail Design strategies



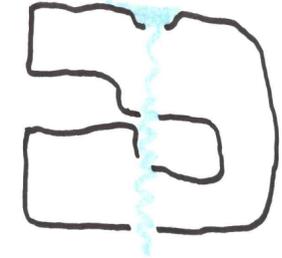
A duality of spaces: one connected to the outdoors and one deeper inside the mass.



Placing the food production in the most difficult part of the mass: the centre.

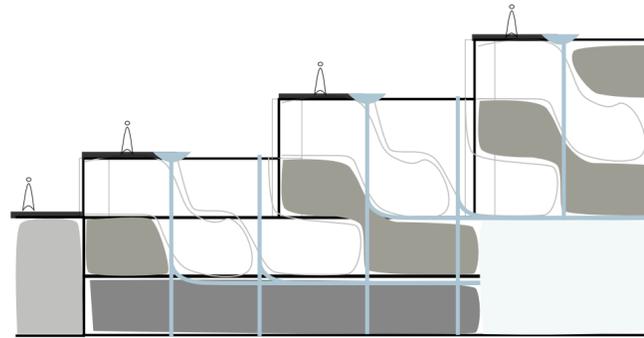


Connecting the spaces in a diagonal way to let light down into the darker space.



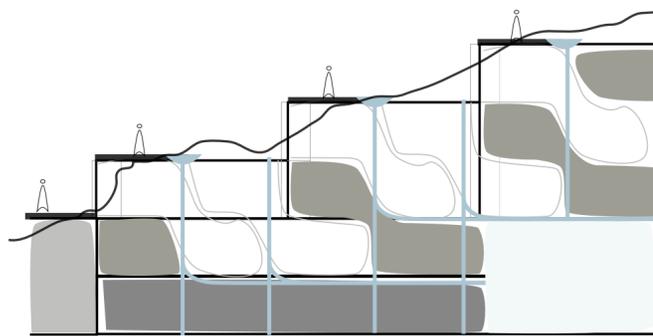
Interacting with the stormwater, connecting it to the local and global hydrosocial system.

Initial ideas Section

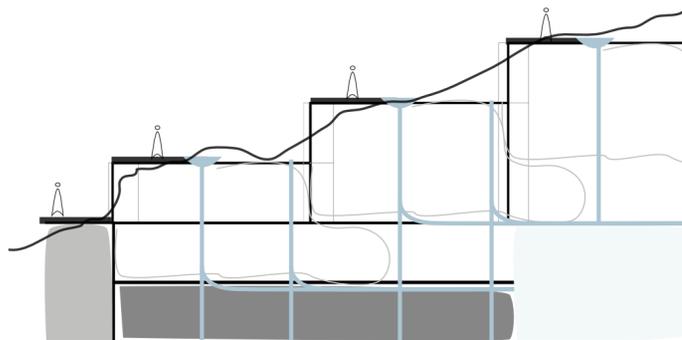


- Housing units
- Communal spaces
- Traffic
- Aquaponics
- Parking
- Walkable surfaces
- Water flowing through the local system

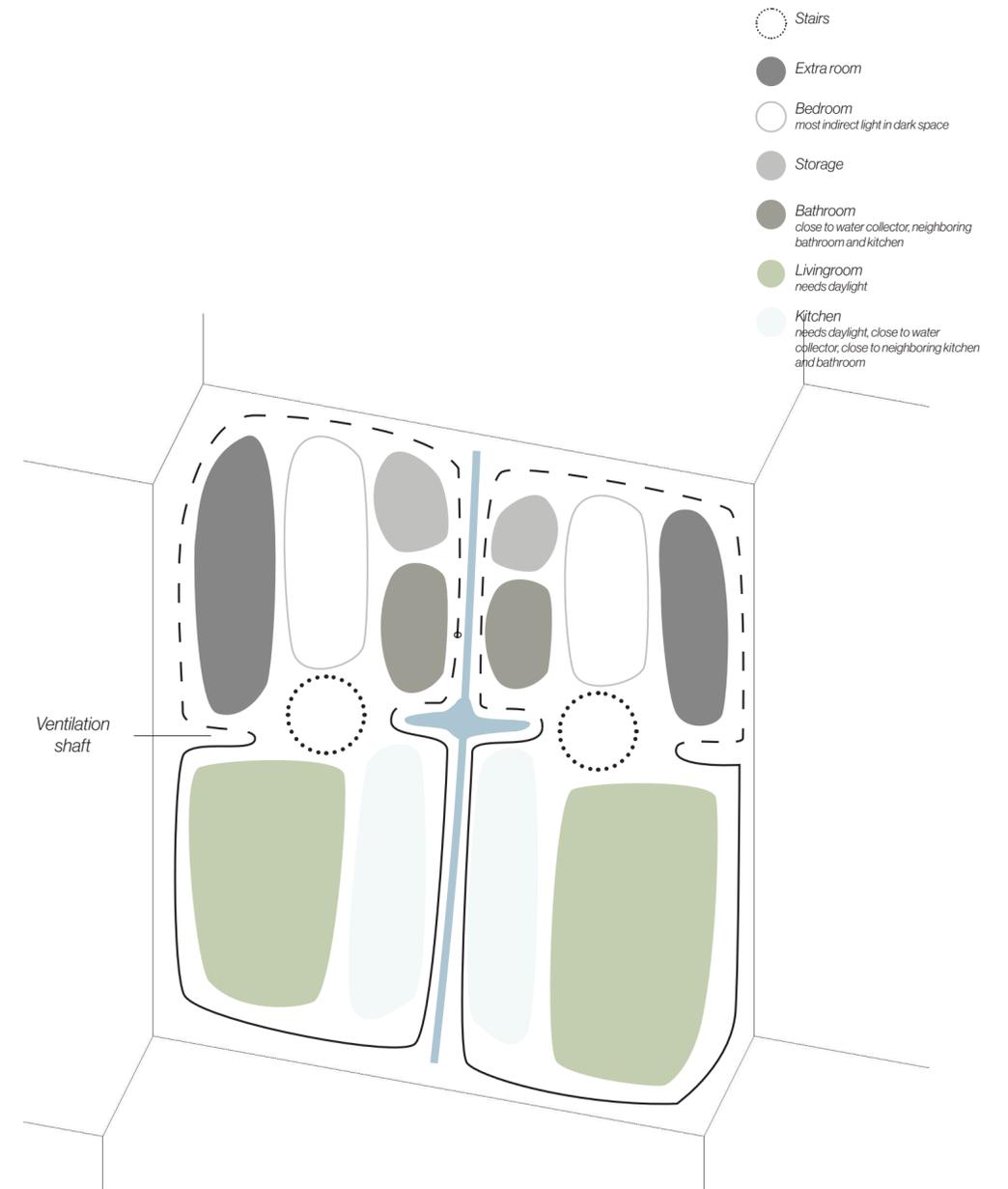
Round off the edges of the cells to connect the horizontal and vertical plane, allowing for exploration beyond the orthogonal grid.



Remove common spaces and make the units bigger to allow for better housing qualities and more daylight deeper into the unit.



Initial ideas Plan and daylight

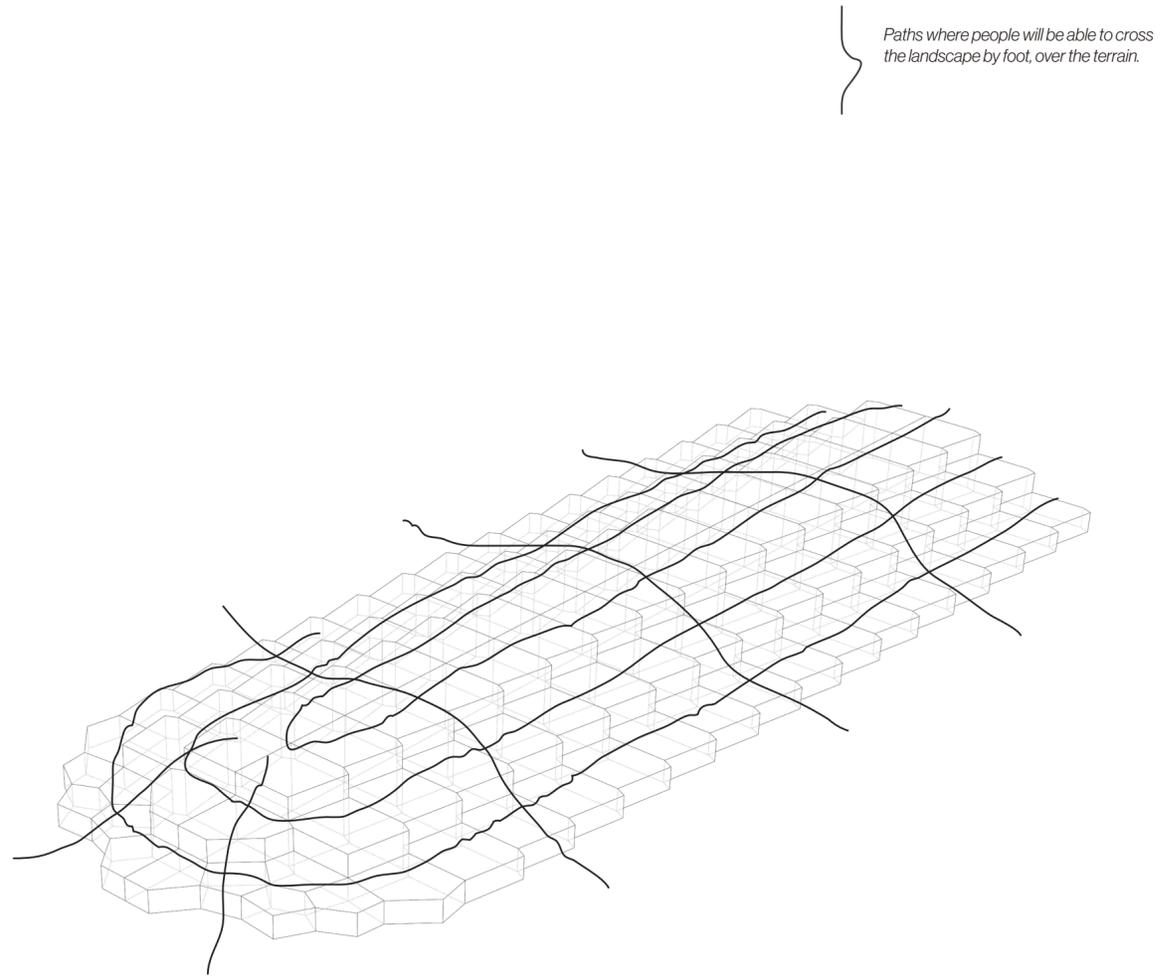


Initial ideas Axon



- Private spaces
for those living in the area
- Public spaces
places to sell food produced in aquaponics, cafés - a way for the private housing blocks to meet the public Akareplatsen
- 🌿 Vegetation
to amplify the barrier between public and private

Initial ideas Human flow



Paths where people will be able to cross the landscape by foot, over the terrain.

Analog modelling Finding the right material



Paper: Not solid enough.



Paper: Possible to shape into a good texture not difficult to attach without breaking the illusion of a boulder materiality.



Clay: Good materiality but difficult to get a hold of the right amount needed for the 1:50 model.



Plaster: Similar to boulders and easy to work with.



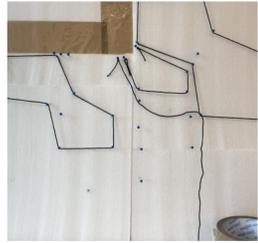
Styrofoam: Good materiality and easy to shape both exterior and interior.



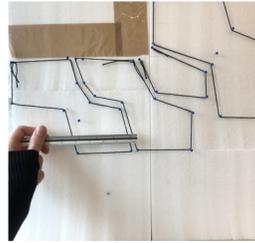
Styrofoam: Breaks the illusion of a boulder materiality.

Conclusion: continuing with styrofoam and finish it off with a coat of plaster

Analog modelling Process 1:50



Mapping out potential shapes.



Daylight studies in smaller models to find optimal shapes.



Transferring shapes to styrofoam.



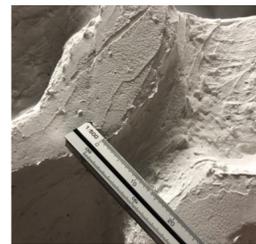
Start carving out the shapes.



Working externally as well.



Testing new ideas and openings.



Always measuring.

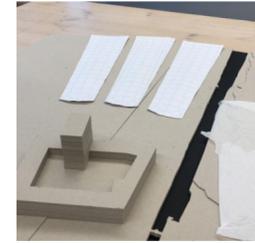


Adding plaster.

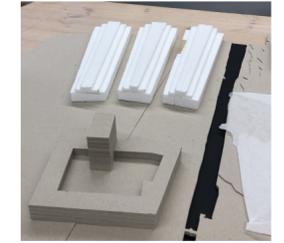
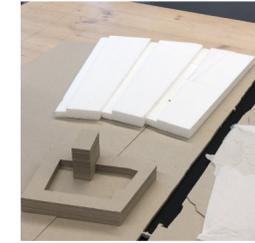


Adding colour.

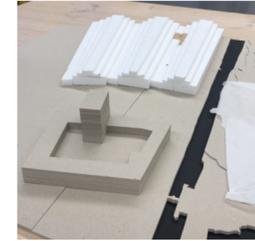
Analog modelling Process 1:500



Working in the site model.



Finding height and slope.



Adding the in-between spaces for infrastructure.



Adding plaster

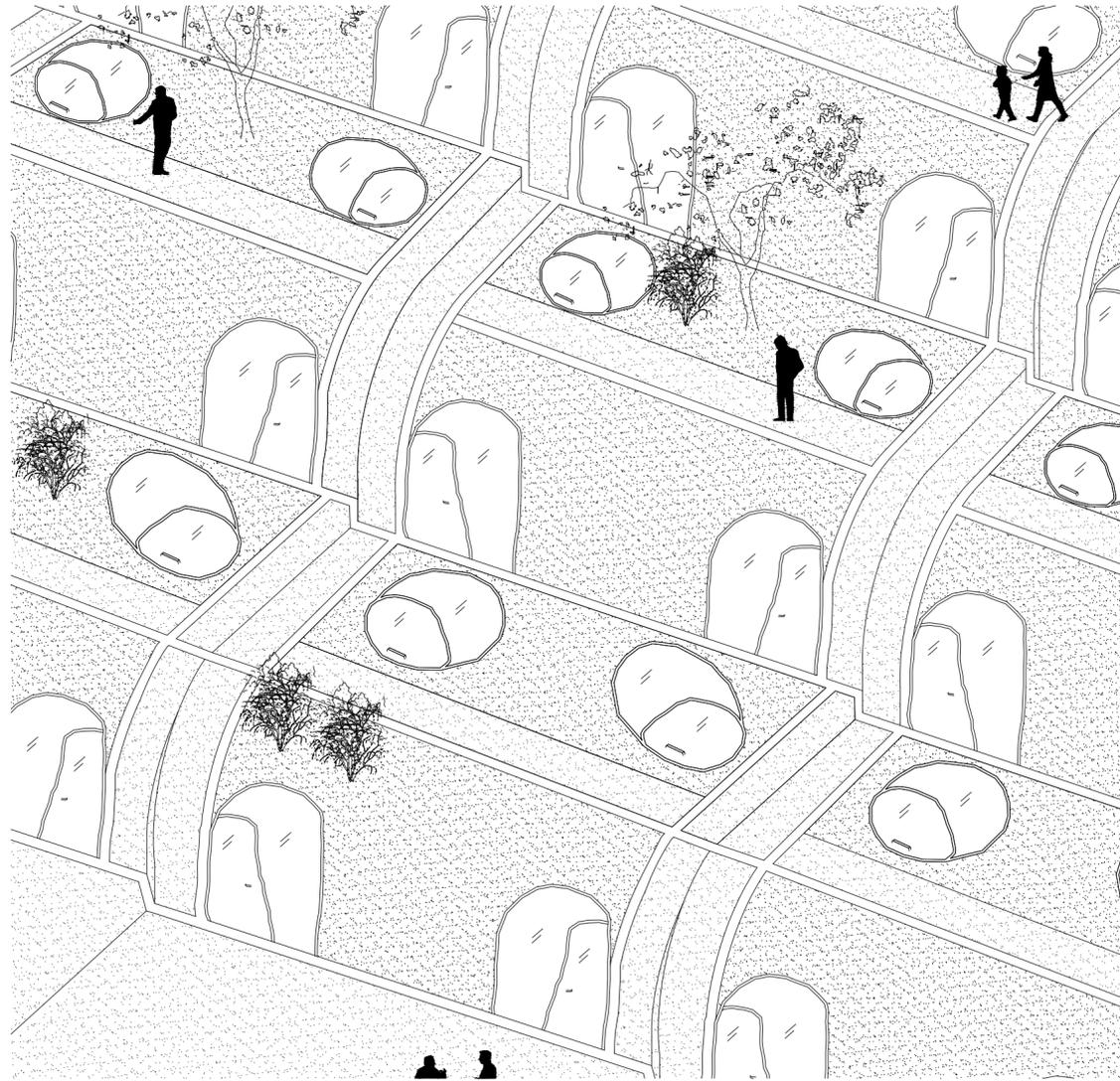


Analog model 1:50

THE FINAL DESIGN

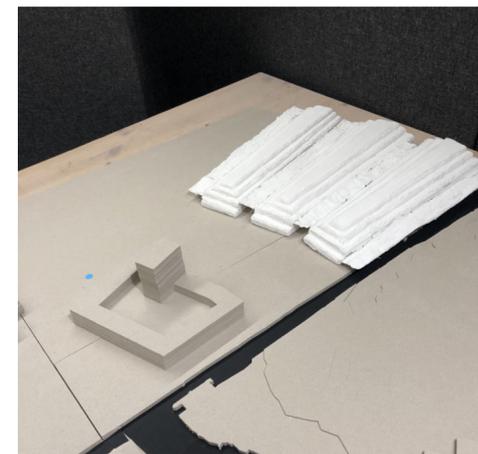
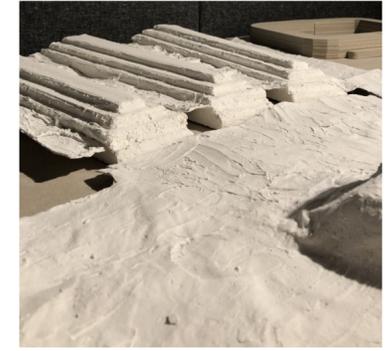


Axon 1:50

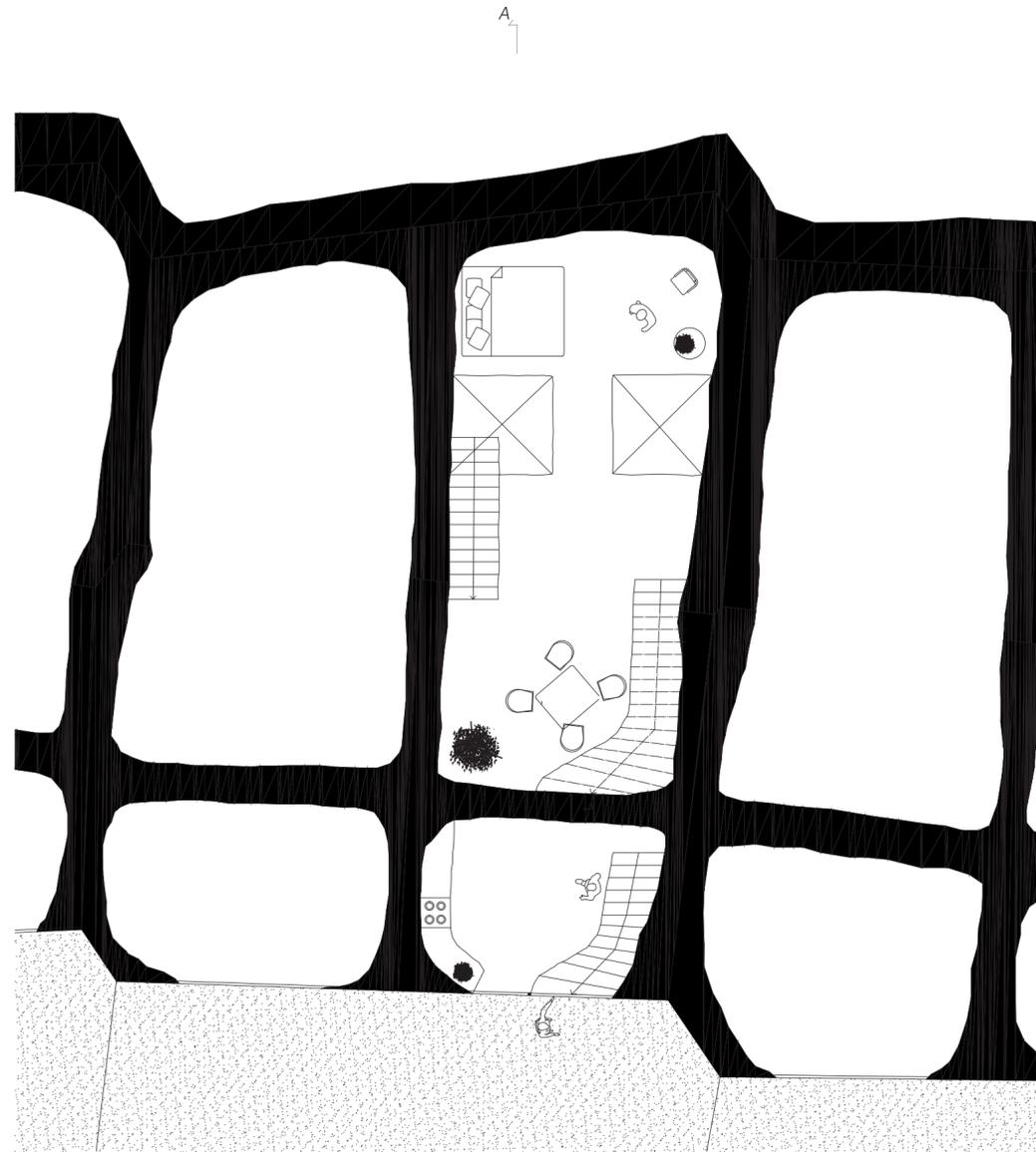


To connect the horizontal and vertical plane, and allow for movement inbetween the two, the edges of the voronoi cells are filleted and rounded off. This creates a softer landscape where both gardens, pathways for walking, and canals for collecting stormwater exist in all planes. Each voronoi cell has two units and each unit two doors - one vertical and one horizontal.

Analog model 1:500



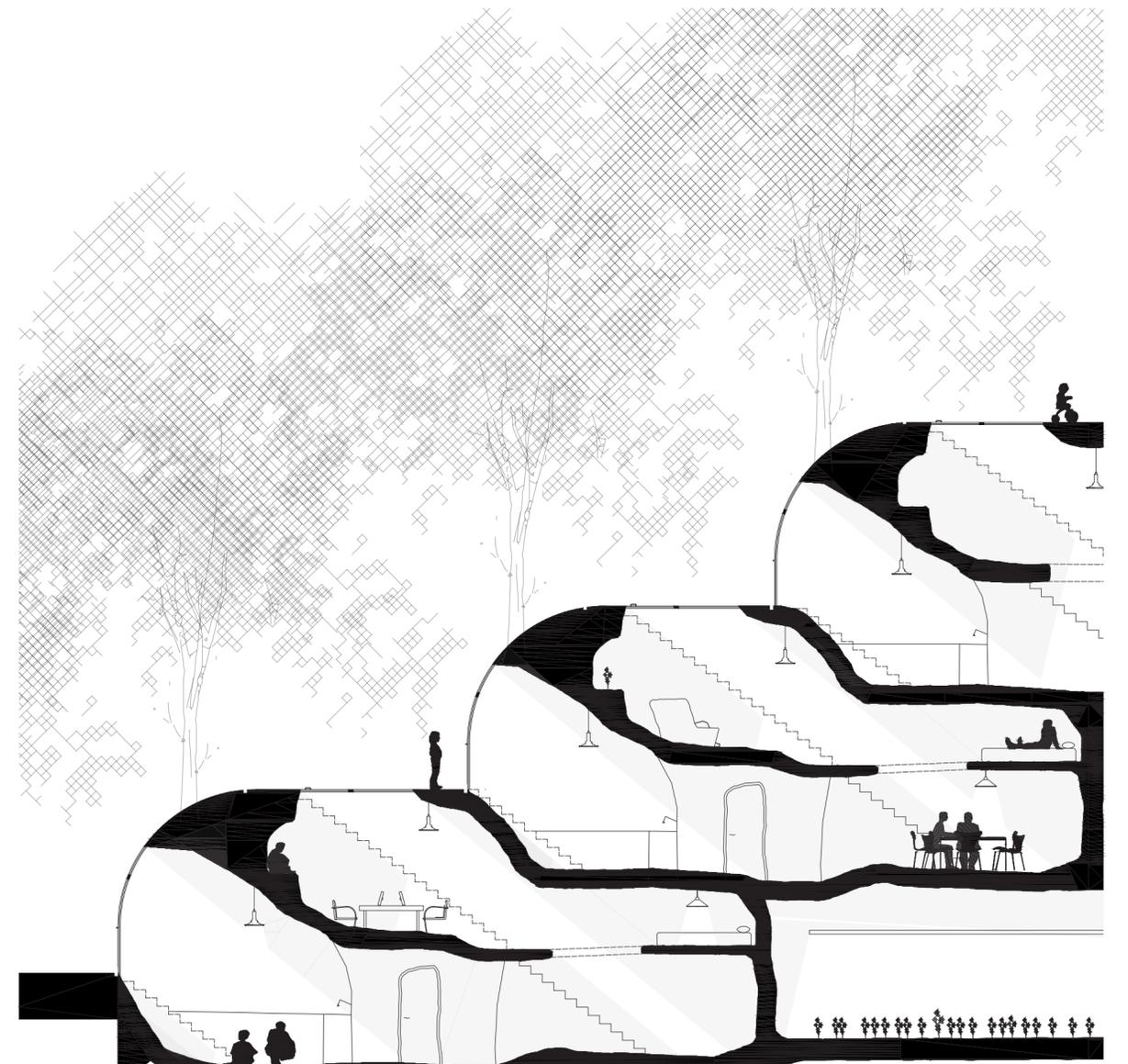
Plan 1:50 Housing Unit



There are two housing units per voroni cell. An important part of each unit is the ability to move inbetween the floors. This is done by stairs growing out from the walls. On the top floor, there are openings in the floor to allow daylight from the roof window to find its way down into the lower level.

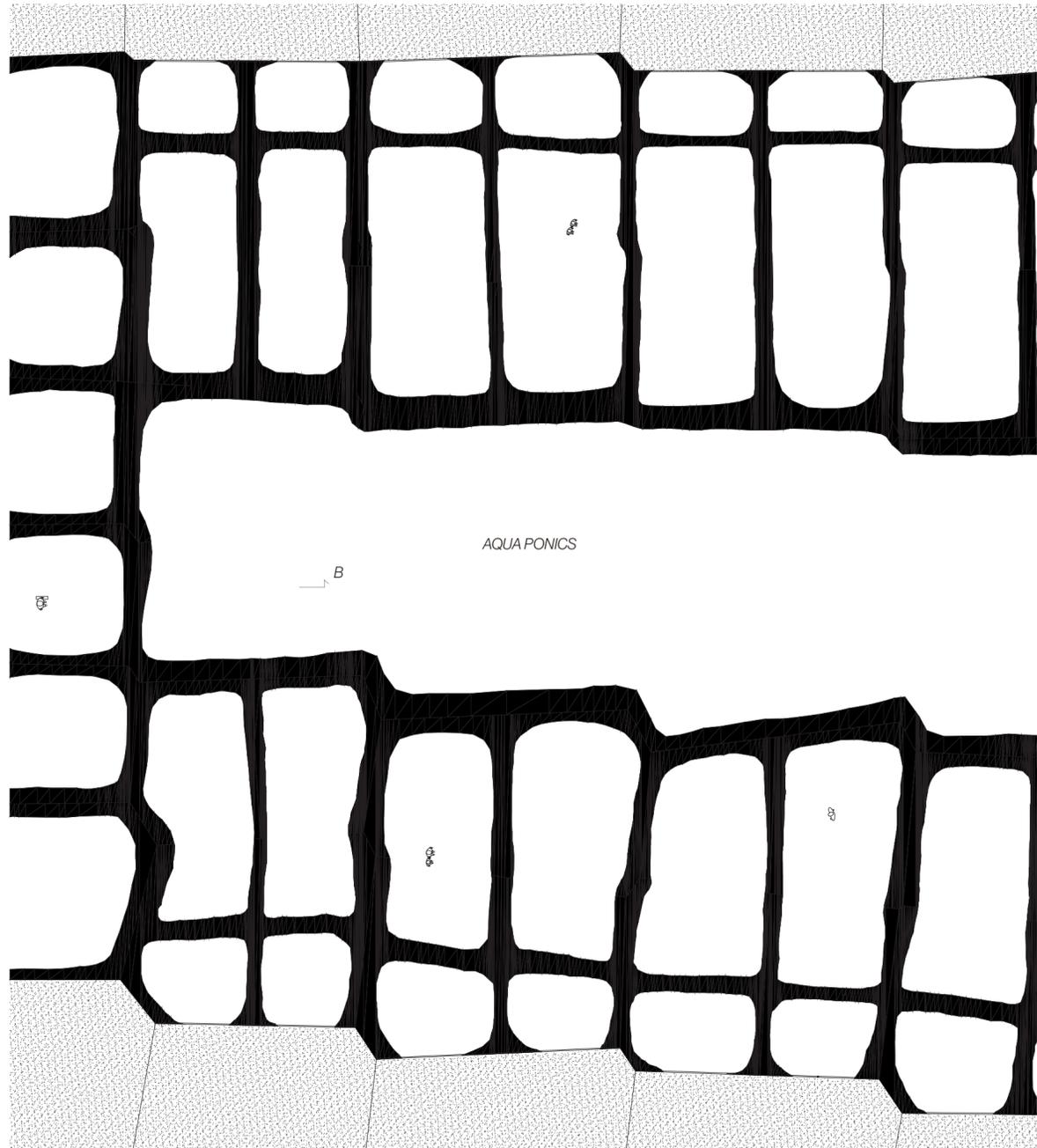


Section A-A 1:50 Housing Unit



Water flows down into the water system from the horizontal canals to vertical ones, connected to the bathroom and kitchen shaft. The housing units are shaped to allow daylight to enter in an effective way. There are two possible ways of entering the unit, both through a door in the wall and one in the roof. In the centre of each hill is an aquaponic system powered by plant lamps.

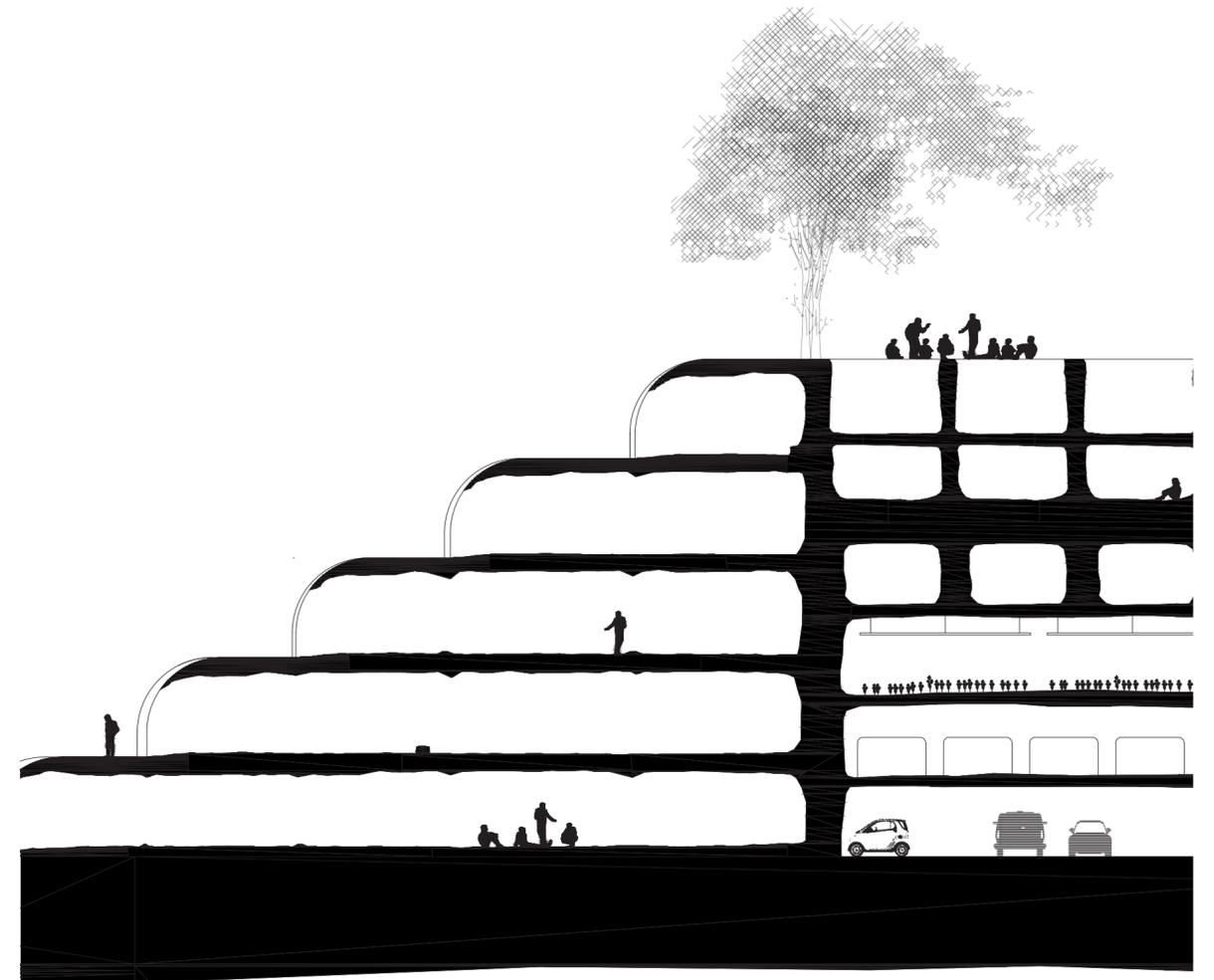
Plan 1:100 Aqua Ponics



In centre of each hill, the aquaponic system is located as it doesn't need any daylight. Around and on top of it are housing units and public spaces.

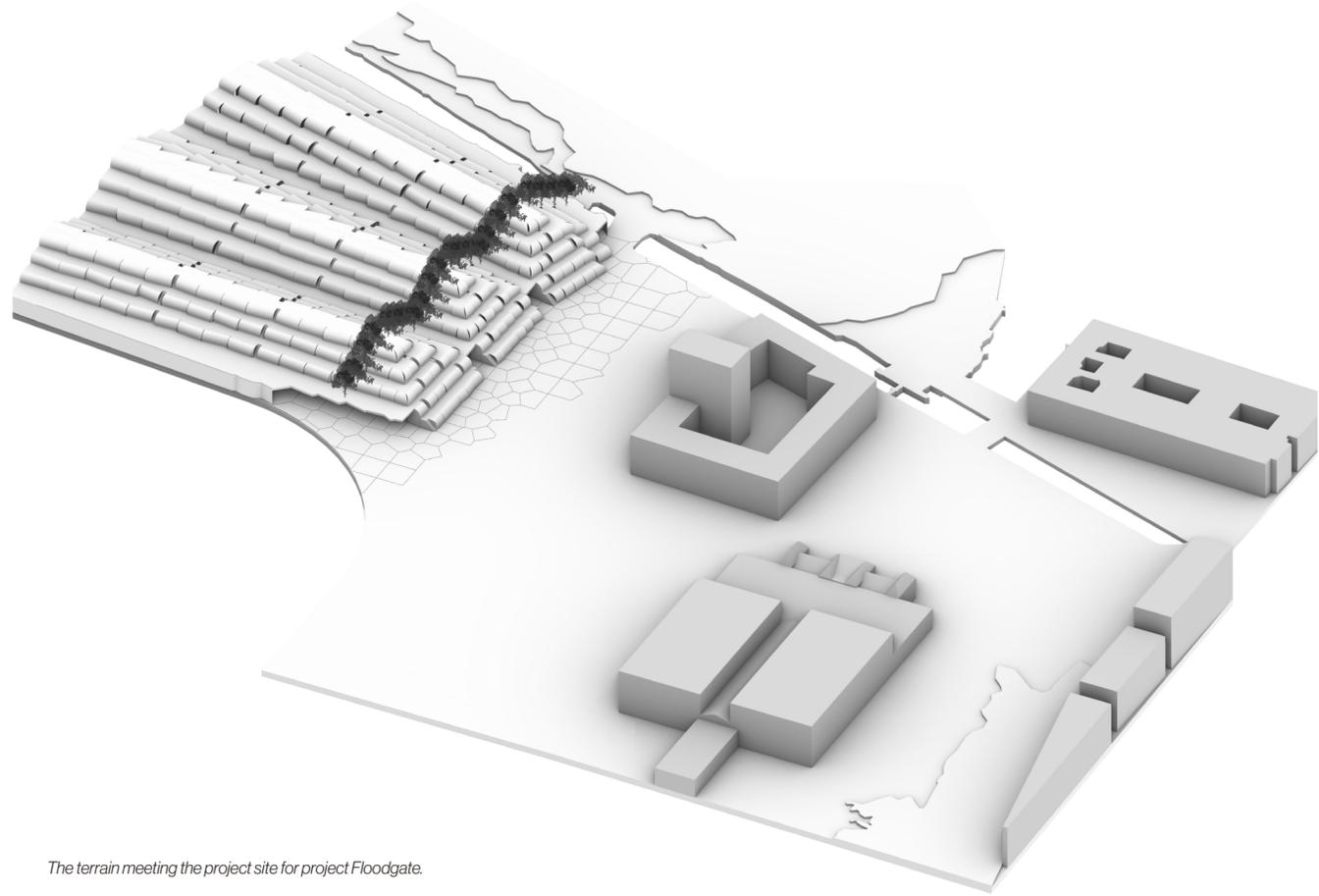


Section B-B 1:100 Public interior spaces facing Åkareplatsen



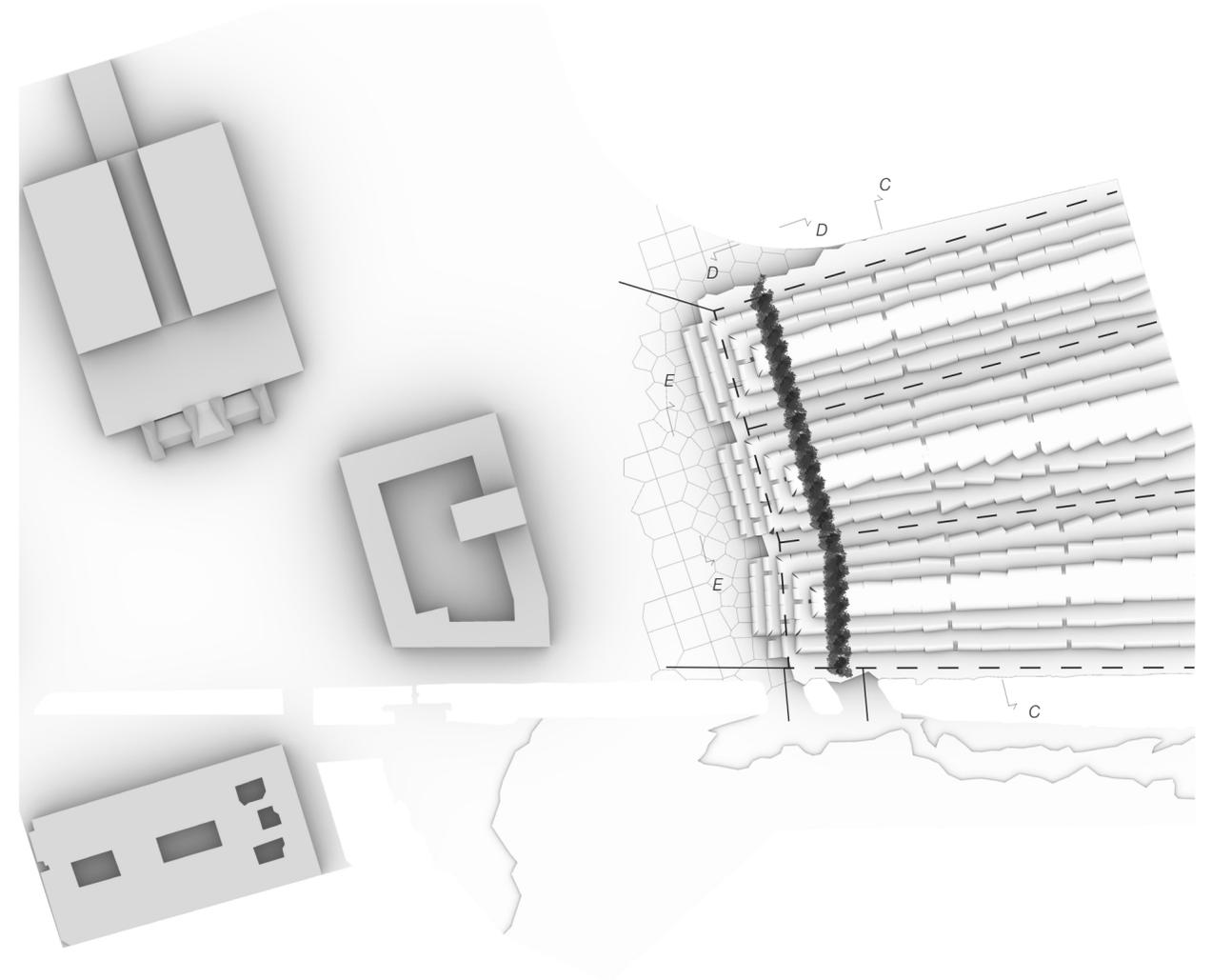
Facing the public Åkareplatsen are public indoor spaces. The depth of the spaces allows for openings without doors, mimicking the openings of traditional caves. These are potential places to sell food produced in the aquaponic system. A row of trees create a barrier between the public and private spaces.

Situation Plan 1:2000



The terrain meeting the project site for project Floodgate.

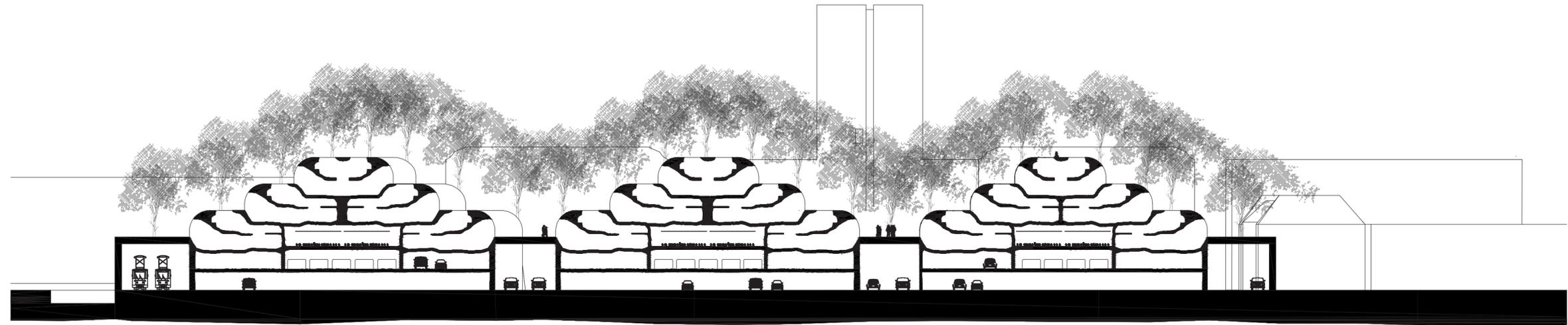
Situation Axon. 1:2000



Infrastructure moves underneath the surface of the landscape and continues out over the site.

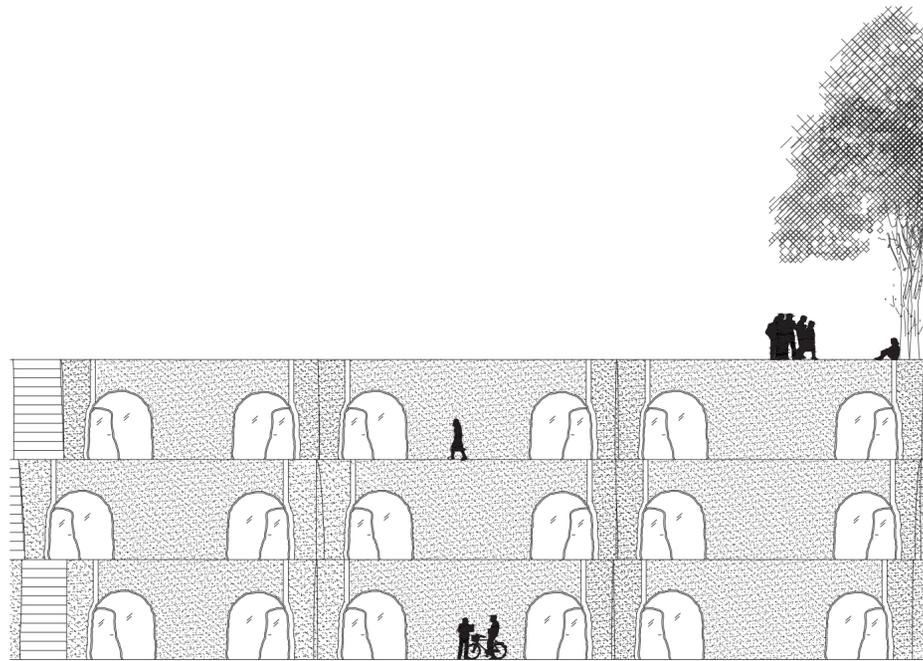


Situation Section C-C 1:500



The three hills of the terrain consists of paths for infrastructure, parking, aqua ponics and housing, aswell as public spaces not visible in this section. The terrain seperates people traveling by foot and bicycle with those traveling by car, tram and bus by eleveting the ground level two floors and allowing the heavy traffic to flow underneath.

Elevation D-D Housing 1:100



Overlooking the housing units. The openings have an uneven texture to them, referring to the shapes of the traditional caves. Two units share a common garden. In between those are canals for water and pathways for walking. Some of the pathways are covered by stairs to increase mobility.

Elevation E-E Public spaces facing Åkareplatsen 1:100



Overlooking public spaces facing Åkareplatsen. The openings into the landscape are not covered, meaning the connection between outdoors and indoors is strong.



Housing units - life underground

Project Floodgate - exploring a terrain of extruded mass

Architecture and Urban Space Design

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