# LIVING RIVER CITY

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Summer semester 2024

Drahotová- Fessler studio

# PROJECT BRIEF

**Studio leaders**

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**Project brief**

What will HERITAGE OF THE FUTURE look like?

By exploring the past and imagining the future we will get an idea for what to do today. We will have two basic parts to the semester: making city maps, and proposing specific architectural scale projects for the year 2150. Upon the assumption the population will double, and society will change (to some degree), Architecture will be considered at a scale that is not quite building and not quite city.

**Main goal of the project**

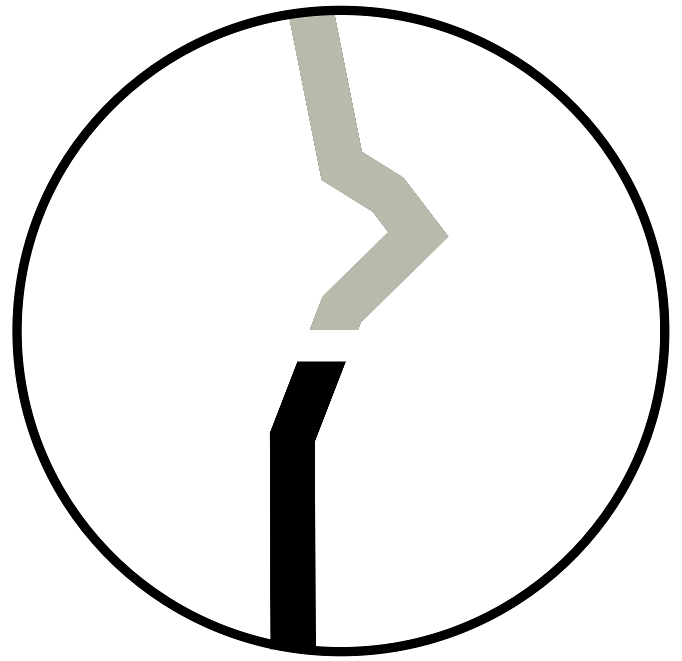
The primary objective of the project is to rejuvenate the River Vltava in Vrane nad Vltavou village by implementing a comprehensive infrastructure plan. This includes constructing new buildings along the riverbanks that double as residential and community hubs, while also acting as flood barriers. These innovative structures feature advanced wastewater filtration systems to actively purify the river, fostering environmental sustainability and improving the city's quality of life.

ARCHIP ARCHITECTURAL INSTITUTE IN PRAGUE

# CONTENT

# 01 INTRODUCTION

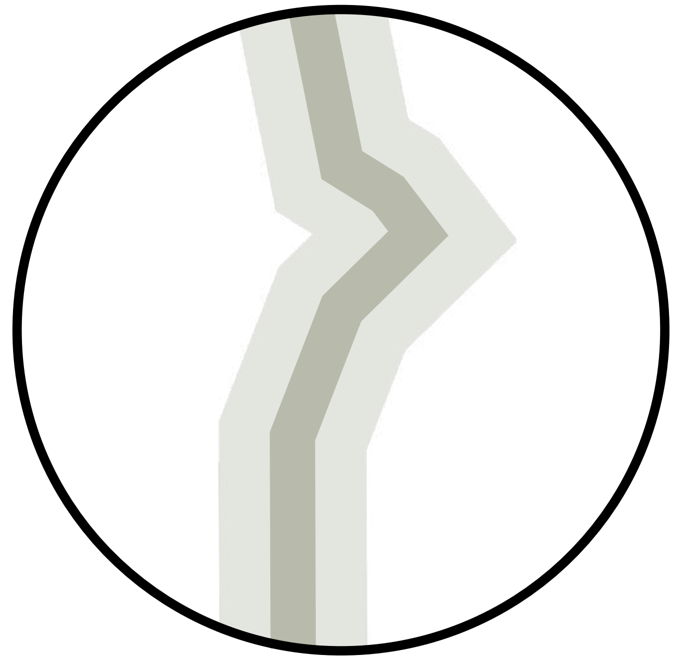
# IMPACT



**FIGHT WATER POLLUTION**

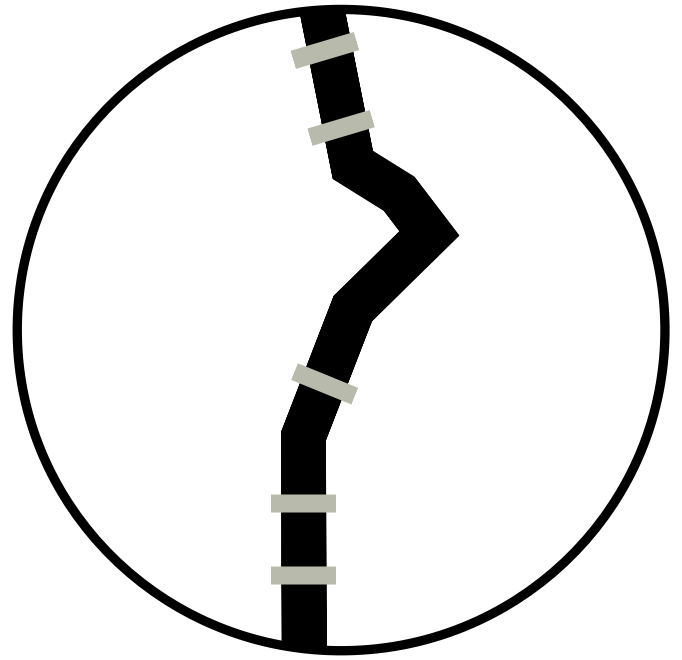
# 80%

Using root waste water treatment filters placed along the Vltava River at 4 km intervals, we effectively remove 80% of the pollutants from the water.



**FLOOD PREVENTION**

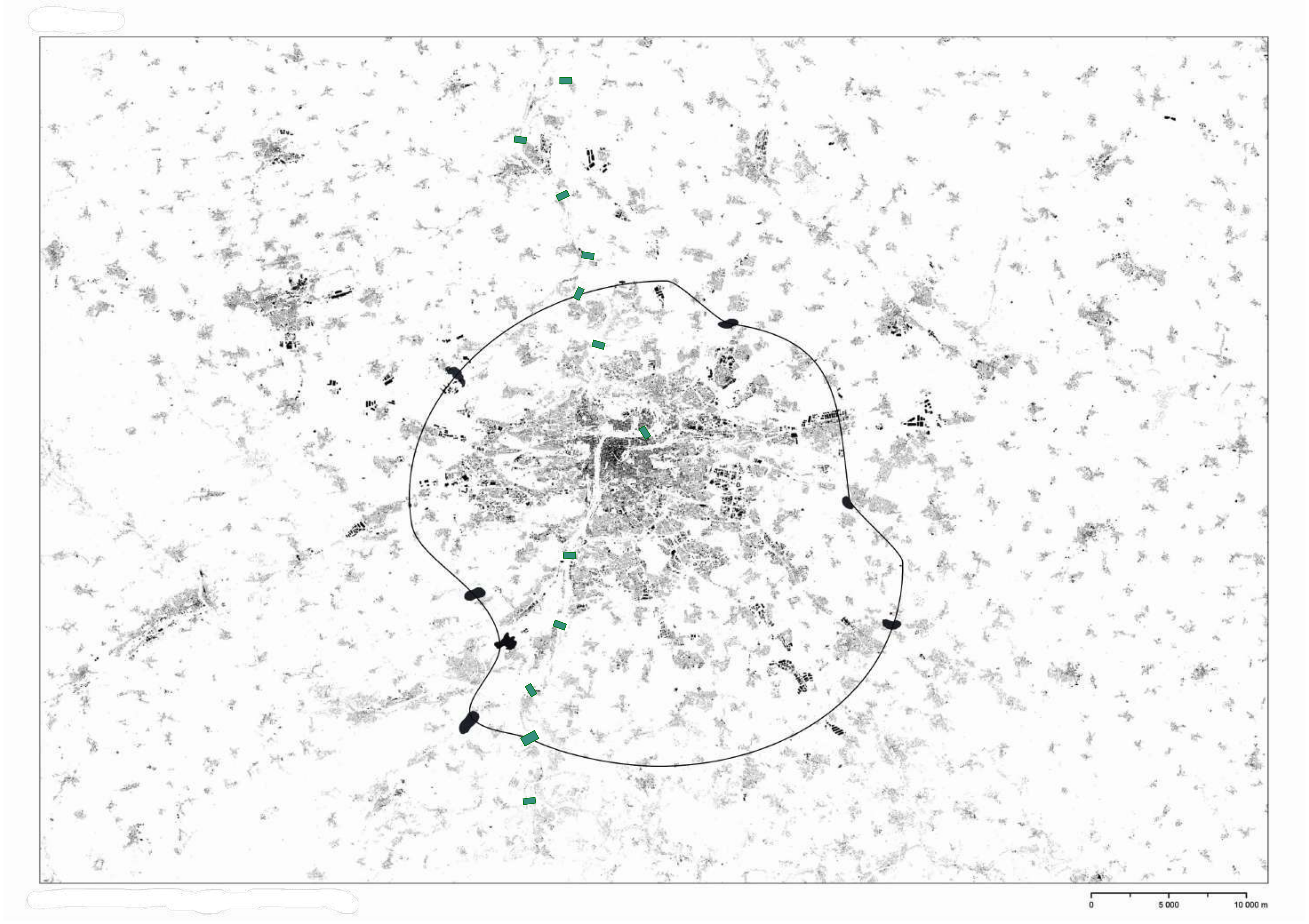
Mitigating flood hazards through the installation of pipes directing excess water to reservoirs.



**RIVER SIDE LIVING**

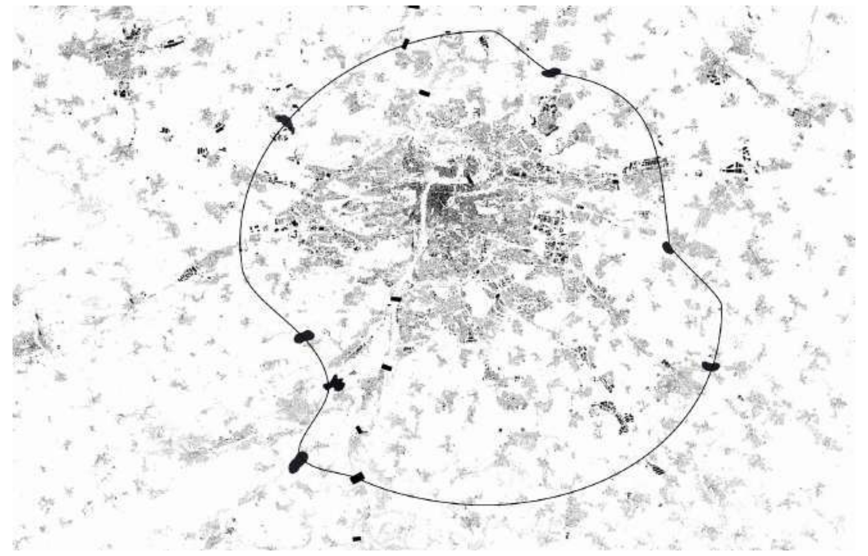
Developing new residential communitys.

# MASTER PLAN



The overarching objective of the master plan for Prague is to purify the River Vltava, incorporating root wastewater filtration along its entire 430 km length. Through meticulous calculation of river pollution and the capacity of root wastewater treatment, filters will be installed every 5 km to effectively cleanse the entire river. This initiative not only ensures river cleanliness but also establishes new residential and community hubs, enabling recreational activities such as swimming in the river.

# ART INSPIRATION



**ALFONS MUCHA**

Alfons Mucha was a renowned Czech artist known for his distinctive Art Nouveau style. His works often featured elegant, flowing lines, intricate patterns, and vibrant colors, capturing the essence of the Belle Époque period.

Mucha gained international acclaim for his iconic posters, which promoted various theatrical productions, exhibitions, and consumer products.

I got inspired by Alfons Mucha's poster featuring Sarah Bernhardt, I drew inspiration from the fluid lines and circular motifs. For the master plan of Prague, I utilized the circle as a boundary concept for my project and incorporated the flowing lines to symbolize the majestic River Vltava.

# SITE PLAN

**VRANÉ NAD VLTAVOU**

The municipality of Vrané nad Vltavou is located in the Prague-West district, Central Bohemian region, on the right bank of the Vltava River in hilly terrain in the southern part of the Prague Basin. It has approximately 2,700 inhabitants. The municipality consists of two historic parts, Skochovice and Vrané. The territory of Vrané also includes the development extending to Nová Březová (from the municipality of Březová-Oleško).

10 km

# HISTORY


**993**

The first written mention of the village dates back to 993, when it is mentioned in the founding charter of the Břevnov Monastery as property received by the monastery from Boleslav II for sustenance. In 1407, there was a change of ownership as the villages were sold to the Zbraslav Monastery.

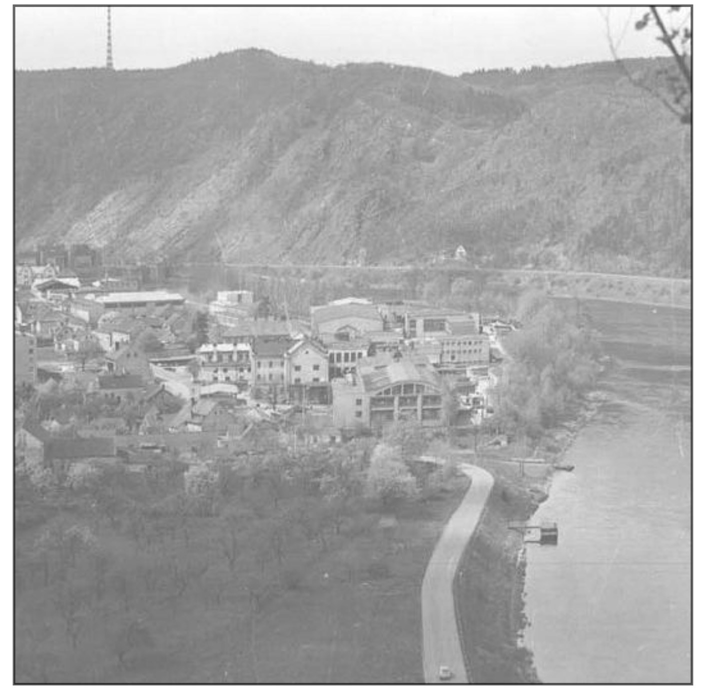
**1890 FLOOD**

**1930**

Between 1930 and 1936, a waterworks with a power plant was constructed near the village. In 1941, the village underwent complete electrification.

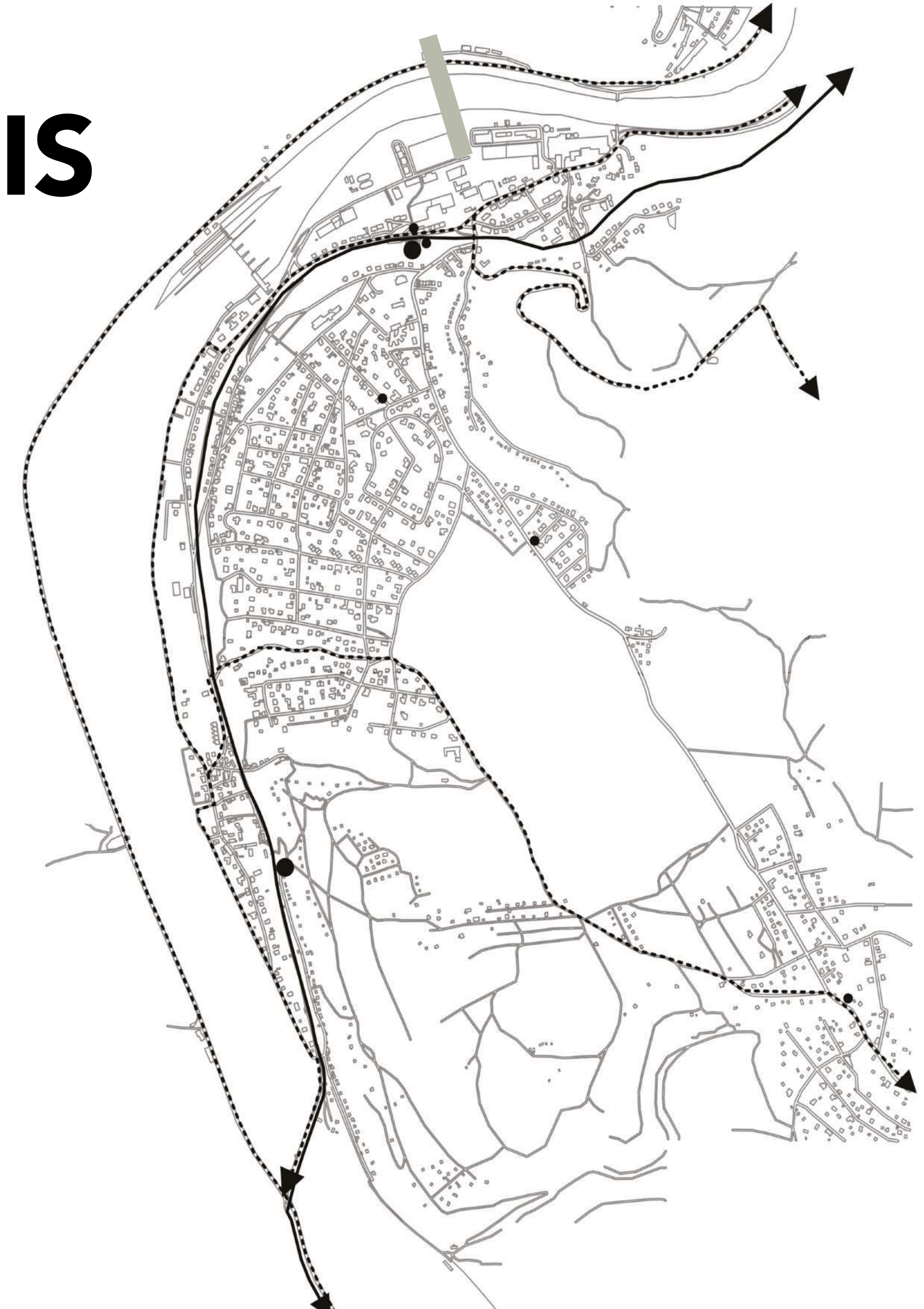
**1943**

In 1943, the villages had a total population of 1,890 people in 263 houses, with 100 cottages built. The electrification of the village was carried out in 1941, five years after the construction of the local power plant.

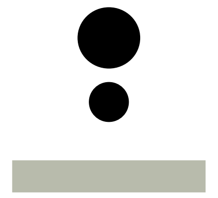


**2002 FLOODS**

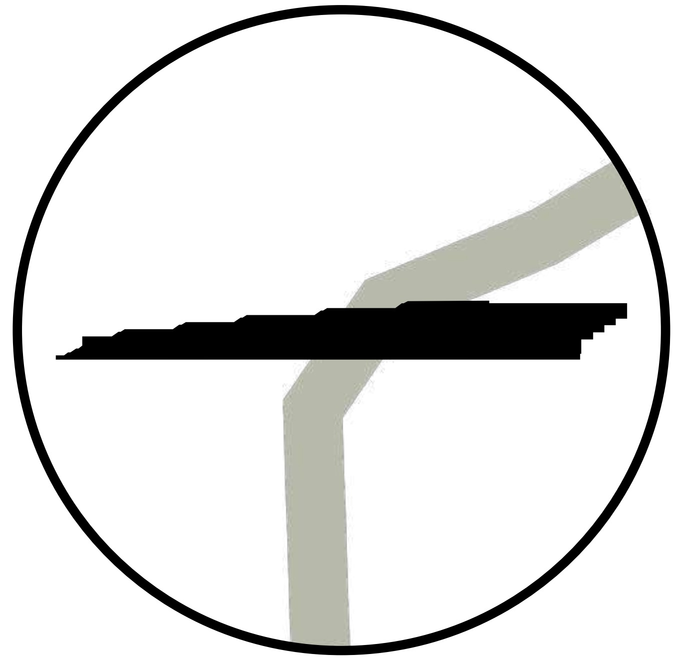
# SITE ANALYSIS



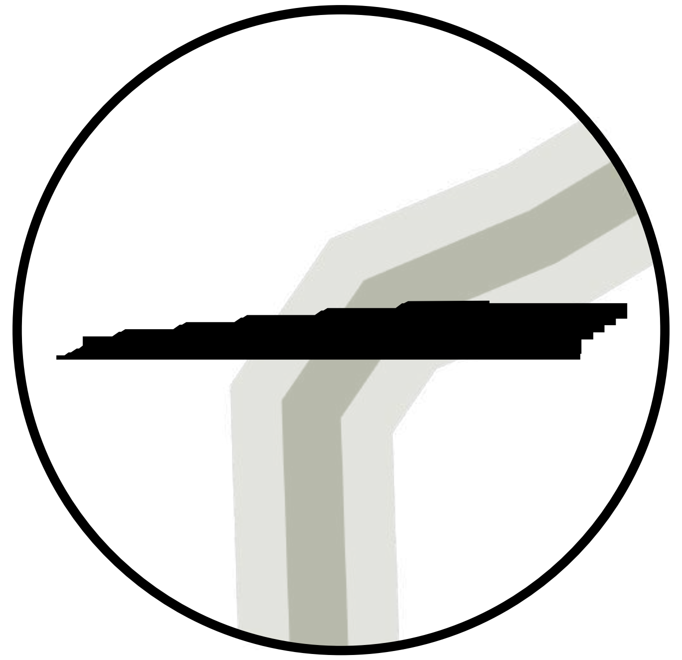
TRANSPORT




# CONCEPT

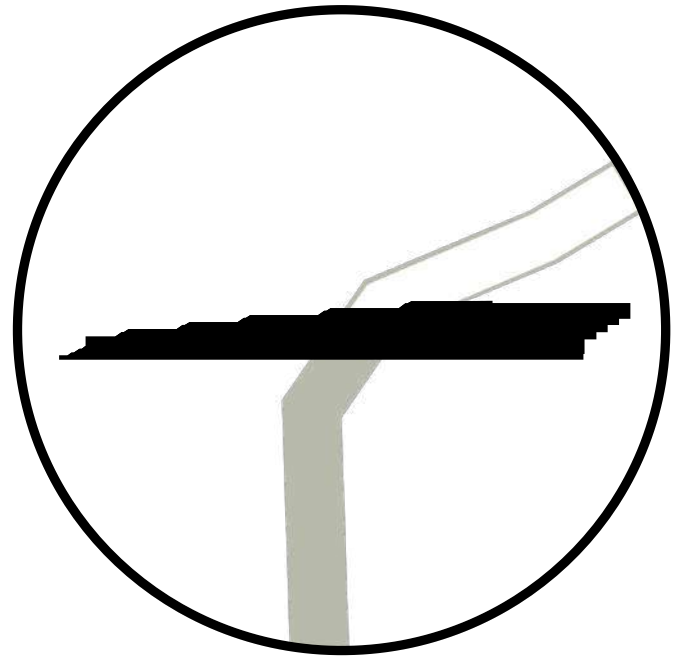


NEW RESIDENTIAL AREA



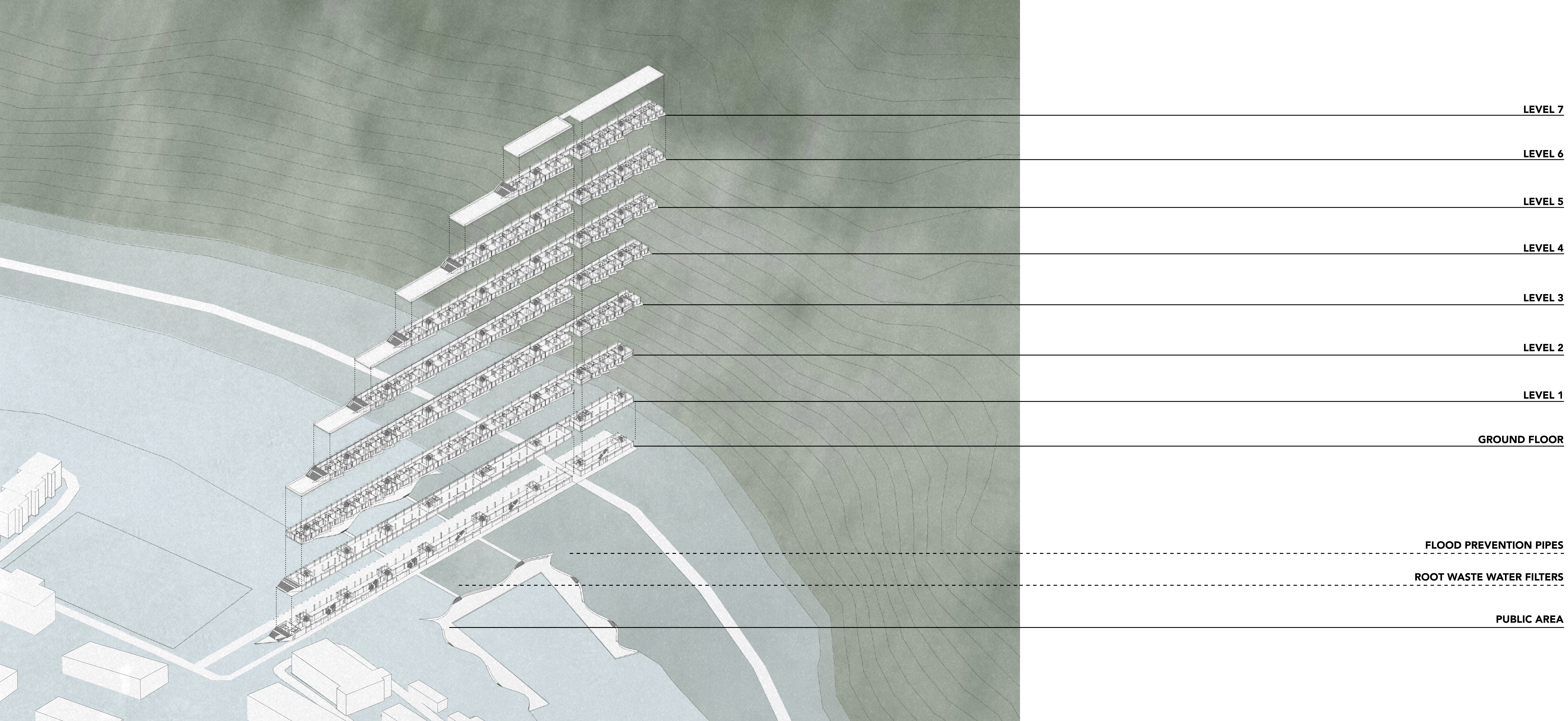
NEW CONNECTING BRIDGE

The structure is positioned atop a bridge intended to facilitate connectivity for automobiles, pedestrians, and cyclists. Its purpose is to establish a link between the pre-existing roadway and the villages of Vranne and Vltavou.

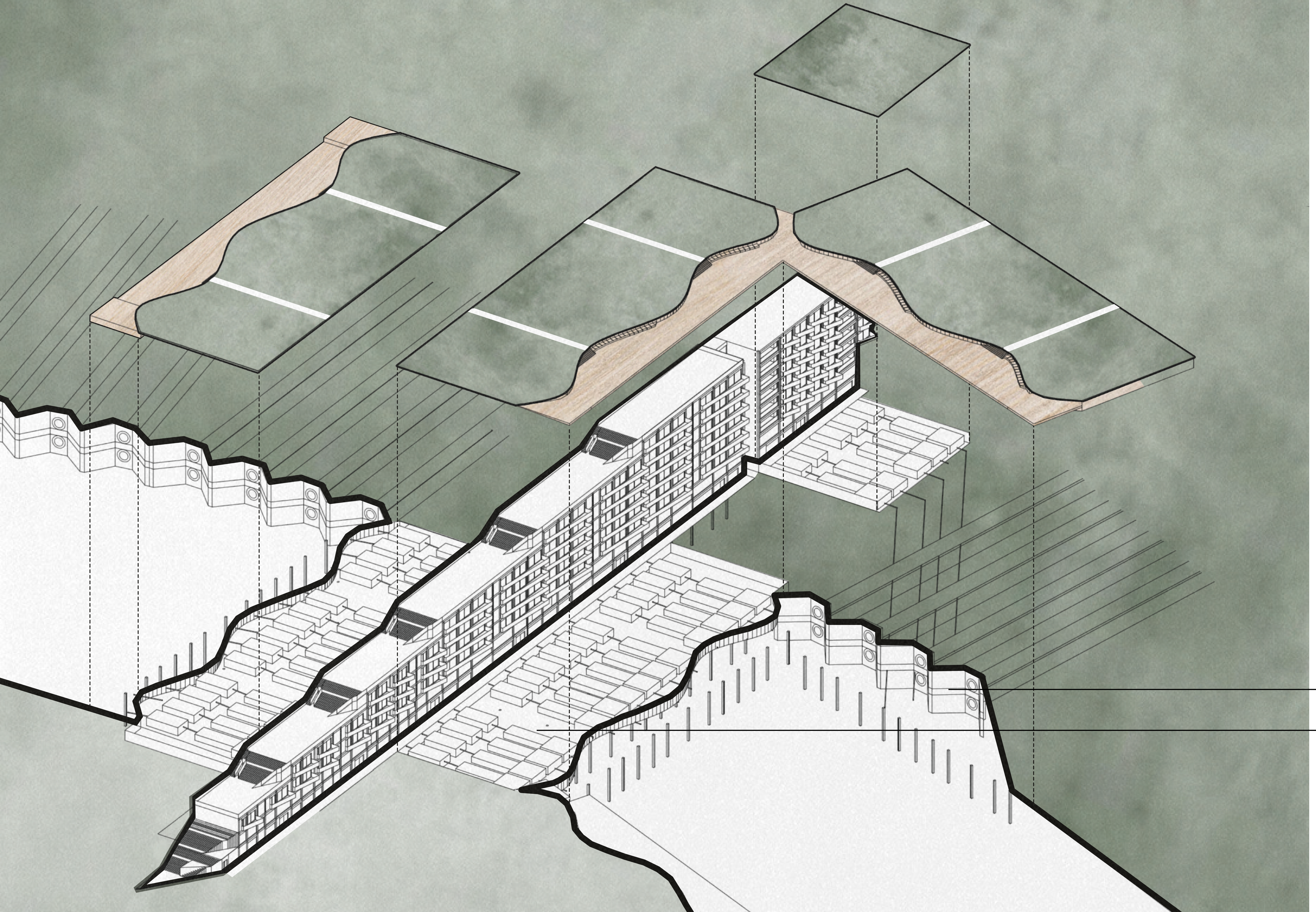


CLEAN WATER

# BUILDING DIAGRAM



# ROOT WASTE WATER TREATMENT - FLOOD PIPE DIAGRAM



# 02 PROJECT

# FLOOR PLAN 1:350
## Ground floor


**1** PARKING
**2** GATHERING AREA
**3** SWIMMING SPOTS
**4** CHANGING ROOMS

# FLOOR PLAN 1:350

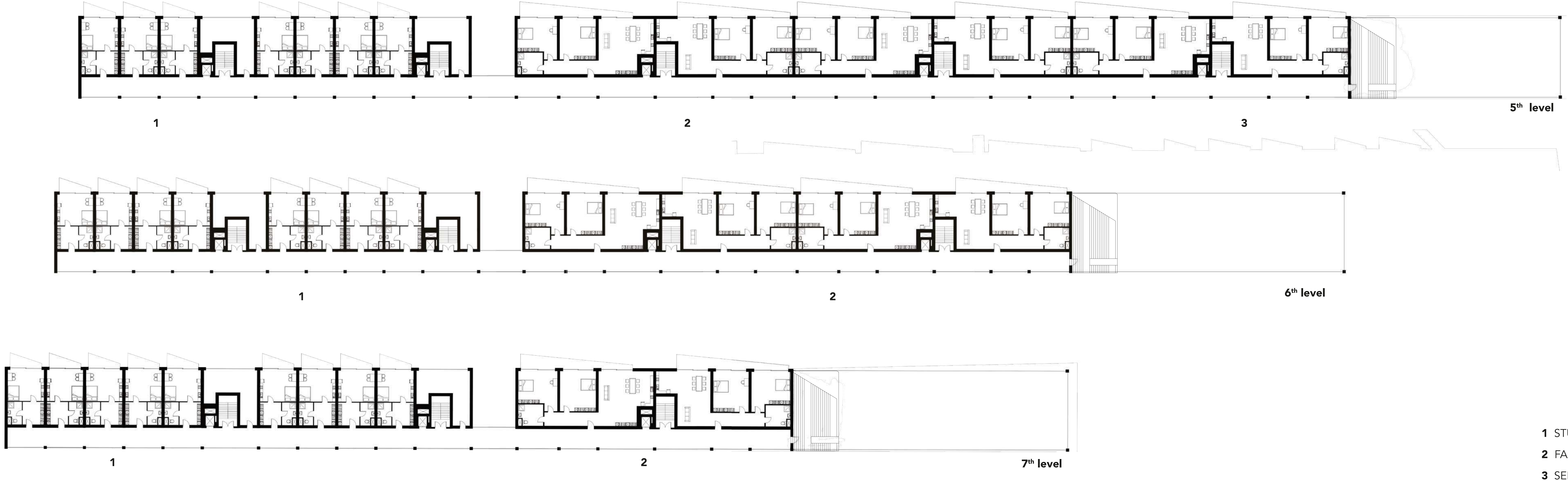
2nd level


**1** STUDY ROOM
**2** OUTSIDE AREA
**3** CAFE
**4** LIBRARY
**5** SEATING STEPS

# FLOOR PLAN 1:350


**1** STUDENT APARTMENTS
**2** FAMILY APARTMENTS
**3** SENIOR APARTMENTS

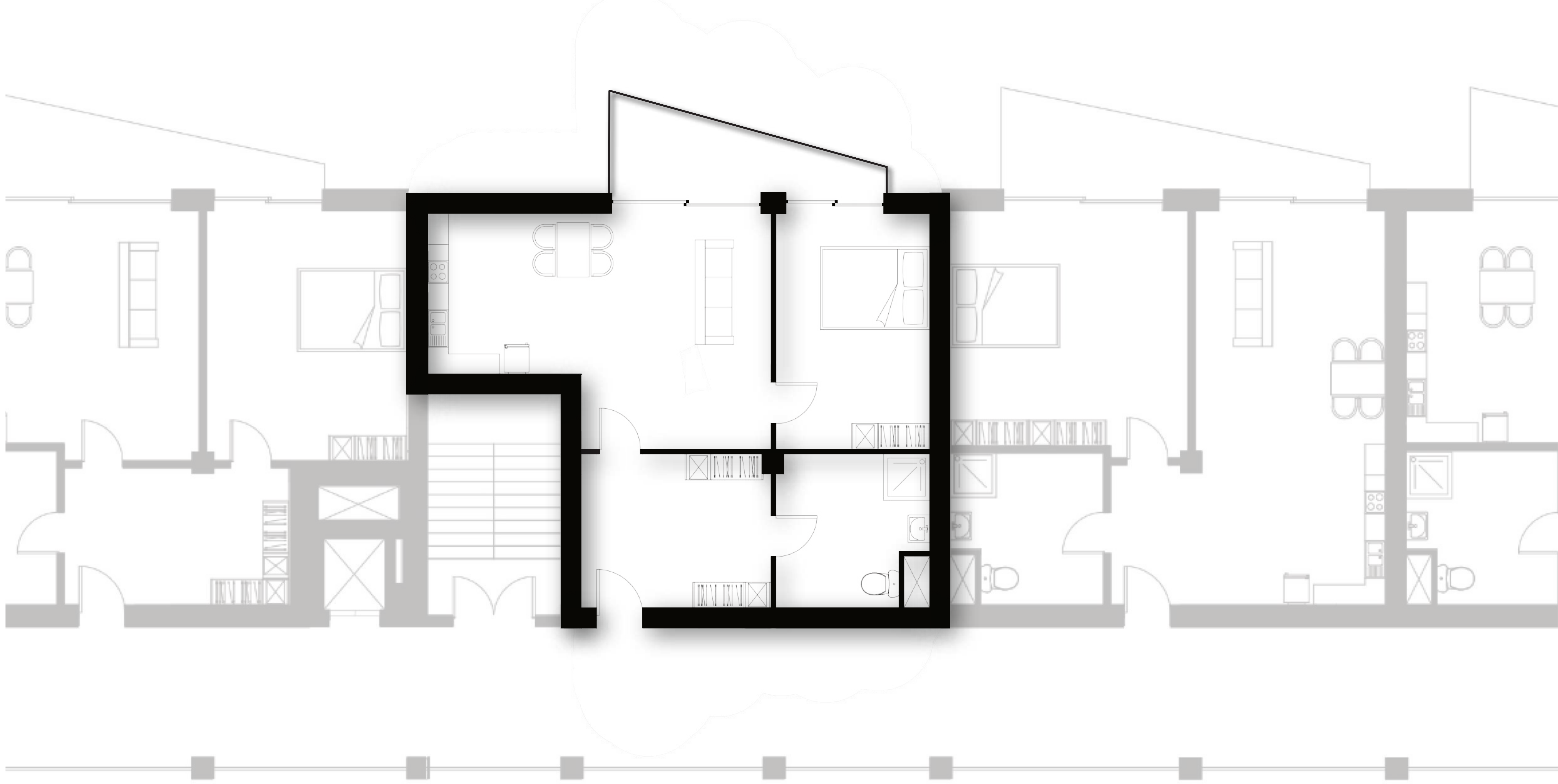
# FLOOR PLAN 1:350




1 STUDENT APARTMENTS
2 FAMILY APARTMENTS
3 SENIOR APARTMENTS

# APARTMENT MIXOLOGY

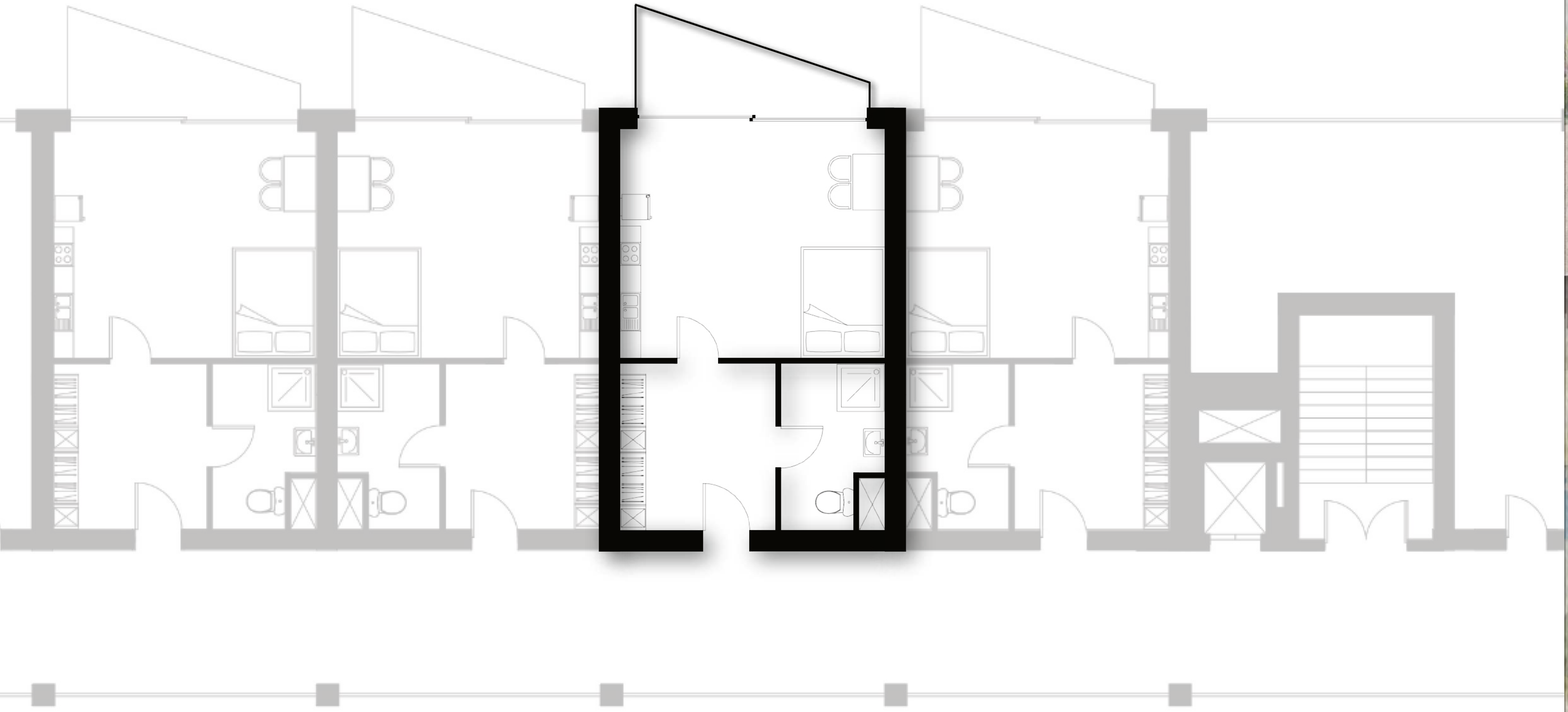
The apartment complex offers a blend of three types of units tailored to different demographic groups: seniors, families, and students.
Each unit is designed according to their specific needs and strategically positioned throughout the building.



FLOOR PLAN
Senior apartments

FLOOR PLAN
Senior apartments

FLOOR PLAN
Family apartments



FLOOR PLAN
Student apartments

# ELEVATION

**FACADE INSPIRATION**

The façade is designed to reflect the process of root waste water filtration, illustrating its functionality from top to bottom.

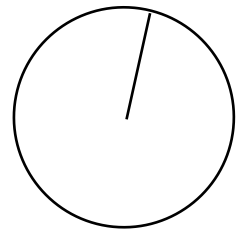
The display begins with a narrow section at the top, representing the initial stage where dirty waste water is depicted.

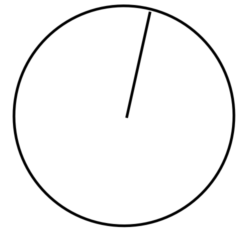
As it descends, the façade showcases the plant-based waste water treatment, incorporating actual plants into the design.

Further down, the filtration process is depicted using window mullions, providing a visual narrative of the filtration process throughout the building's exterior.

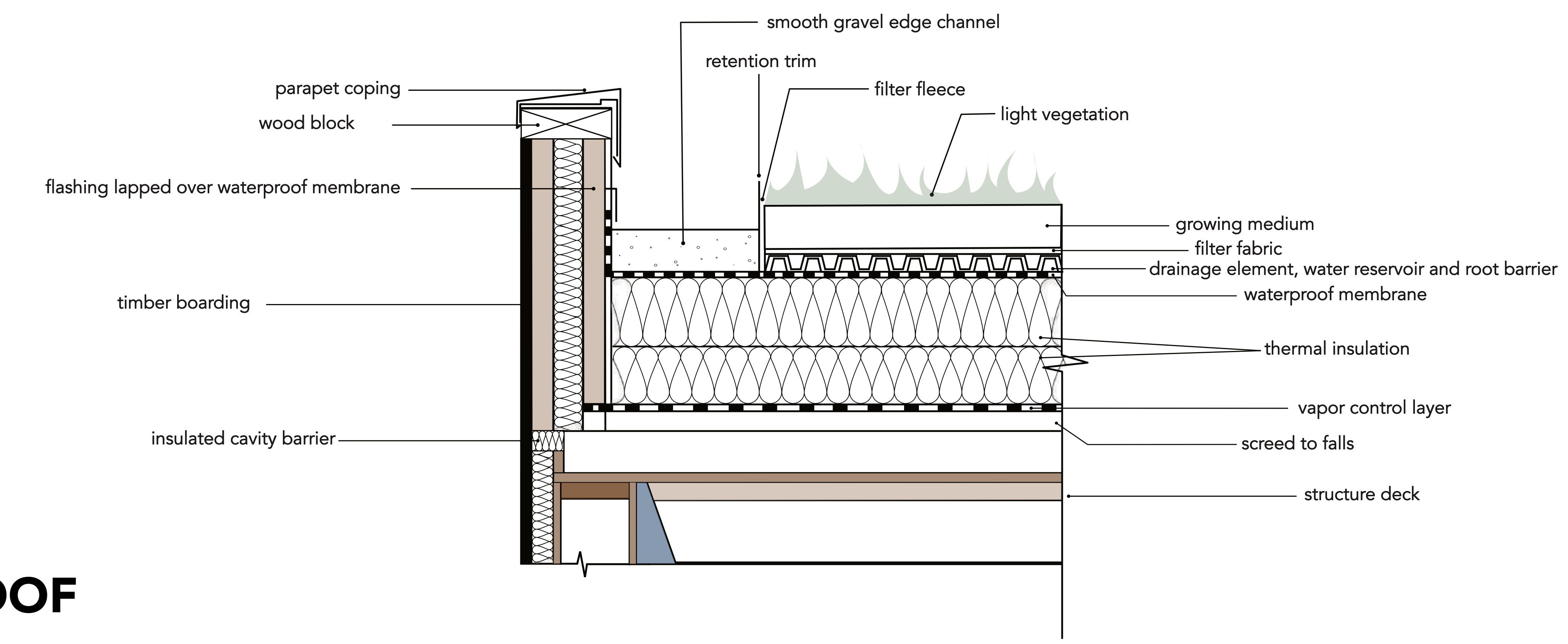
The final stage of the filtration process is represented on the facade by a clean surface devoid of plants and intricate detailing.

# SECTION

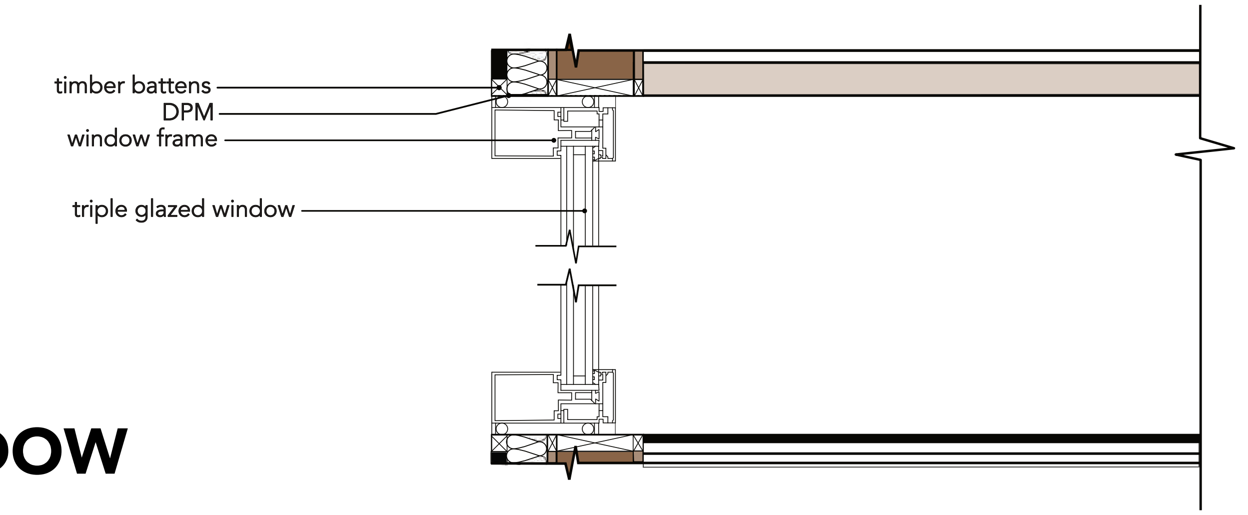




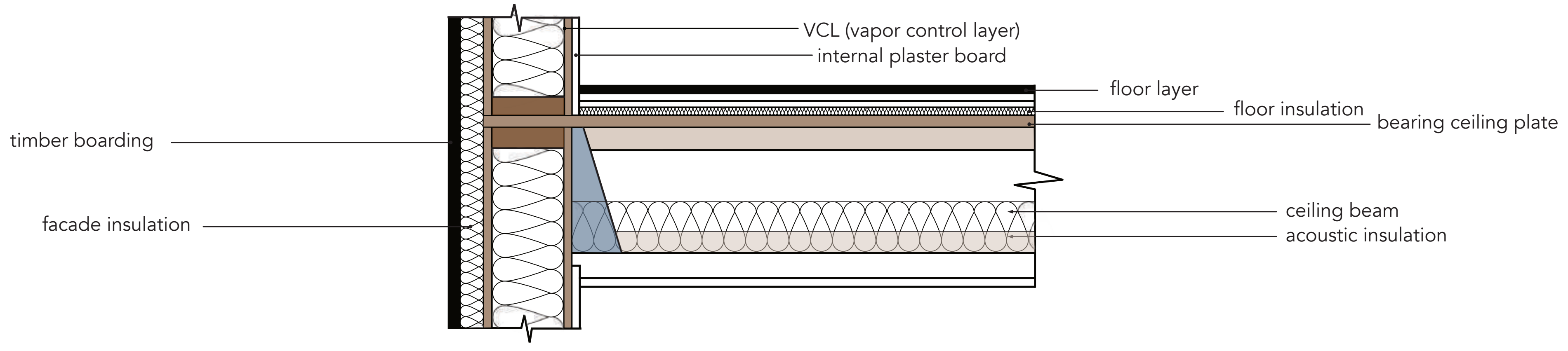
# CONSTRUCTION DETAILS



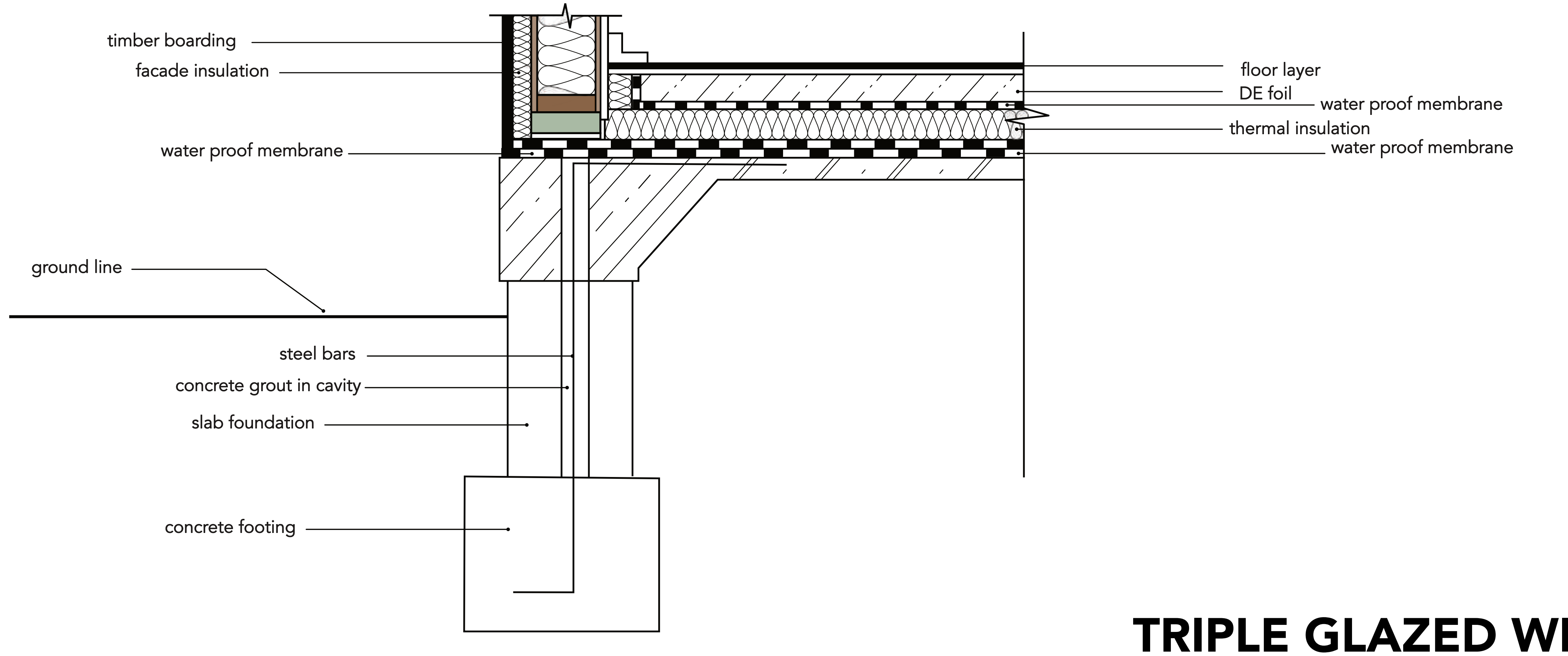

## GREEN FLAT ROOF




## TRIPLE GLAZED WINDOW




## FLOOR DETAIL




## TRIPLE GLAZED WINDOW

# ROOT WASTEWATER TREATMENT

**WATER REQUIREMENTS FOR 200 PEOPLE:**

Water requirement per person per day: 150 liters

Water requirement for civic and technical facilities per person per day: 20 liters

**Total water requirement per day for 200 people:**

= (150 liters/person/day + 20 liters/person/day) * 200 people

= (170 liters/person/day) * 200 people

= 34,000 liters/day

**wastewater quantities:**

Average daily dry weather wastewater flow:

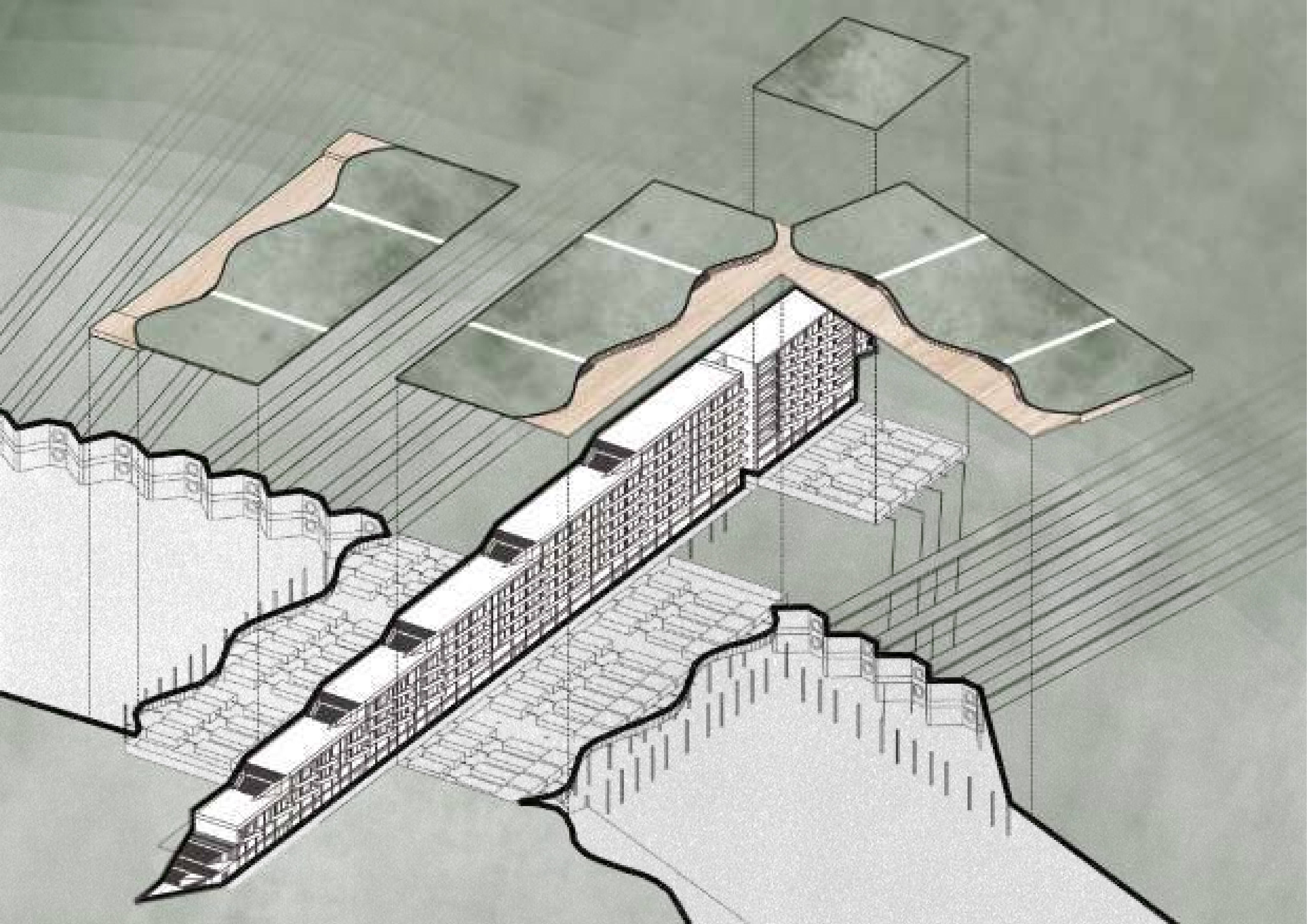
Q24 = 200 * (150 + 20) = 34,000 liters/day = 34 $m^3$/day = 1.42 $m^3$/h.

Maximum daily dry weather wastewater flow:

Qd = Q24 * kd = 34 * 1.5 = 51 $m^3$/day = 2.12 $m^3$/h = 0.59 l/s

Maximum hourly dry weather wastewater flow:

Qh = (Q24 * kd * kh) / 24 = (34 * 1.5 * 2.2) / 24 = 3.95 $m^3$/h = 1.10 l/s



**ROOT WASTE WATER TREATMENT**

To achieve the objective of purifying the river from pollutants, the building employs a waste water management system based on root waste water treatment.

This sustainable and natural approach allows the building to manage its waste water autonomously, thereby also filtering and cleansing the river in the process.

# ROOT WASTEWATER TREATMENT FILTERS

Root wastewater treatment plants operate on the same principles as natural wetlands, where self-cleaning processes occur.
The root filter is filled with fine stones, on the surface of which bacteria reside, ensuring the cleansing process.
Plants planted on the root filter has an additional function - they partially absorb nutrients, supply oxygen, bacteria reside on their roots, and in winter they act as thermal insulation.

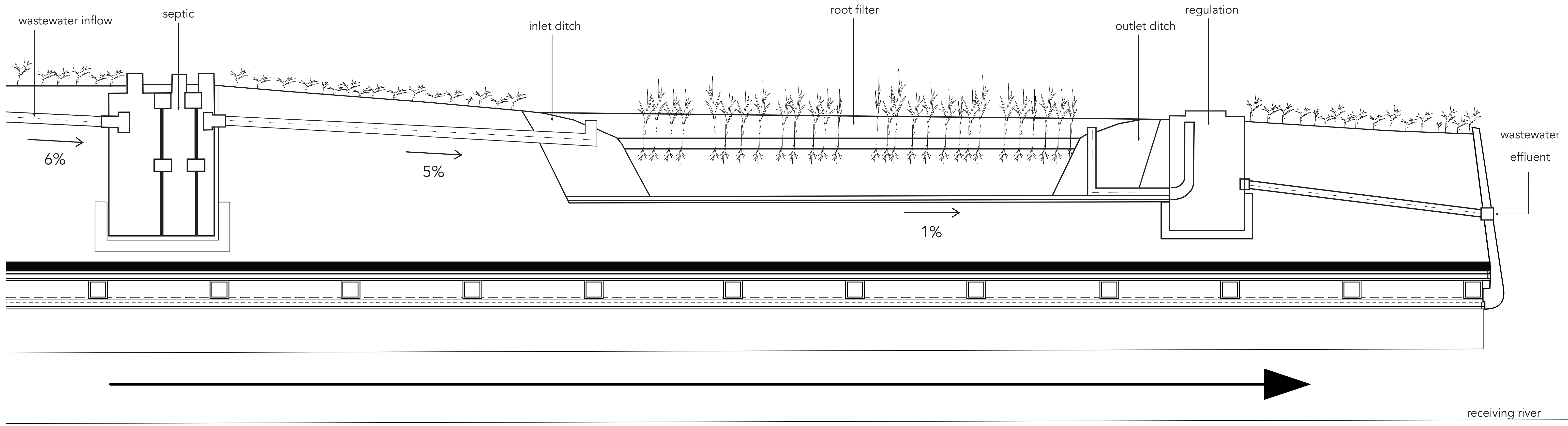
**SEPTIC**
Septic is used to ensure the long-term functionality and lifespan of the root filter, it is necessary to retain the maximum amount of insoluble substances.
For this reason, it provides a multi-chamber septic tank with directed flow, known as an anaerobic separator, as the first stage of treatment before the root filter.

**DISTRIBUTION SHAFT AND PIPES**
Serve to evenly distribute water over the surface of the root filter. The pipes are equipped with openings so that water flows evenly across the entire surface of the filter.

**ROOT FILTER**
A buried pit lined with impermeable insulation foil and filled with gravel of suitable fraction. The foil prevents polluted water from penetrating from the sewage treatment plant into the substrate, while the gravel filling provides a suitable environment for aerobic cleansing processes by bacteria settled on the filter filling and roots of water-loving marsh plants.

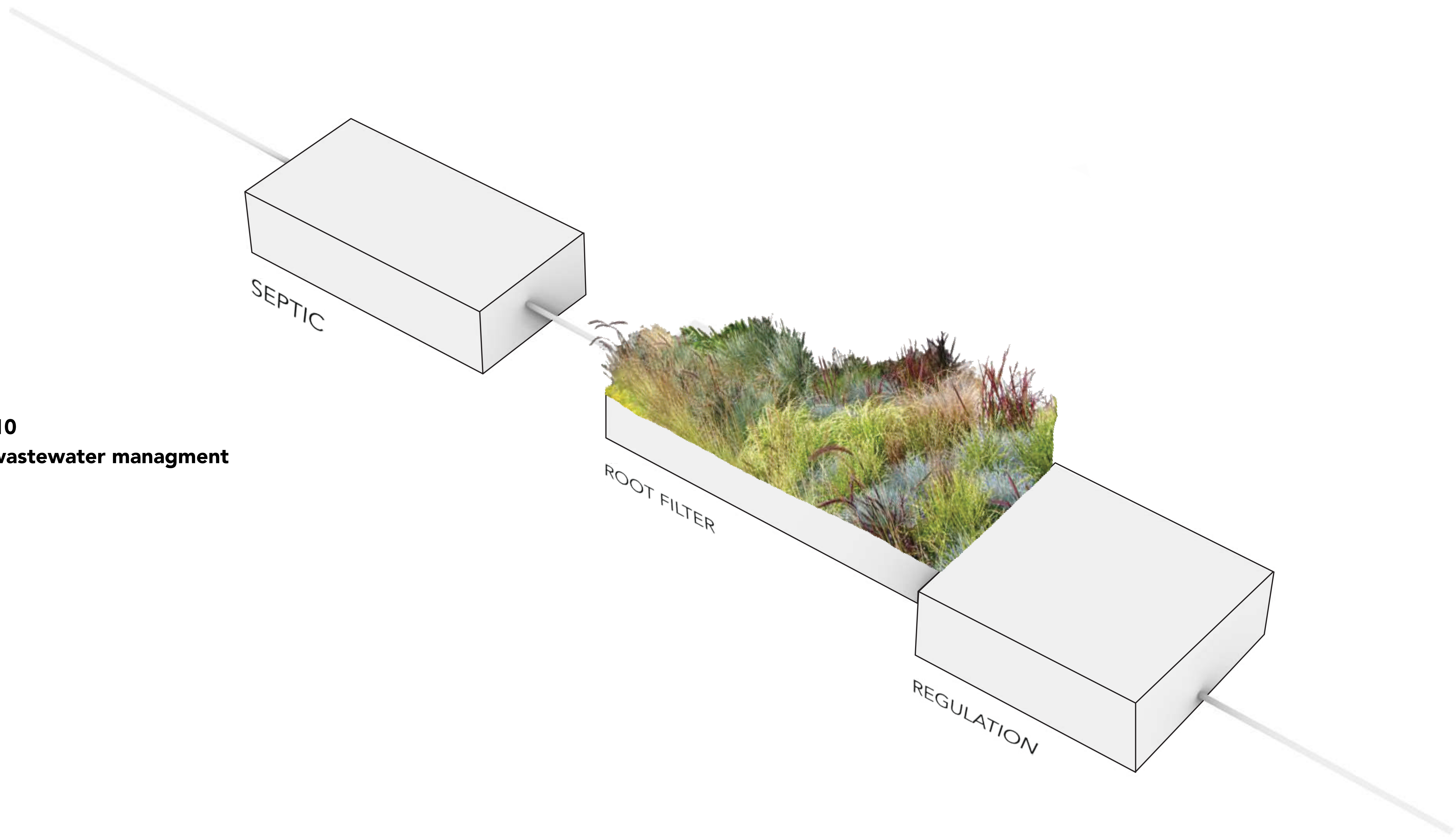
**REGULATION**
The regulation shaft is used to control the height of the subsurface water level in the root filter. The water level is maintained below the surface of the gravel (about 5-10 cm) during plant rooting, preventing the root sewage treatment plant from becoming a breeding ground for mosquitoes and odor. During normal operation, the filter is empty, and water flows through the filter by gravity to the drainage pipe. Wastewater flows onto the surface of the filter through the distribution pipe and then slowly passes through the entire volume of the filter, subsequently draining through the outlet shaft into the recipient.

**PLANTS**
The plants have a supplementary cleansing function, absorbing nutrients from the water and supplying oxygen to the filter. Plants that are primarily planted are species that enhance the beauty of the root sewage treatment. From spring to autumn, you can admire the flowers. Plants used for the wastewater treatment are duckweed, water iris, Siberian iris, common bulrush, club-rush, bulrush, cattail, reedmace, and various types of sedges.



# FILTER DESCRIPTION

I am using root wastewater filters from the company GRANIA. Choosing the FYTOVER 10, that surves to treate waste water for 8 to 10 people. The buliding accomodates around 150 peopple, for that I will be instaling 20 filters to manage the waste water. 20 filetr will manage the wastewater  from the apartments and also from the public part of the building

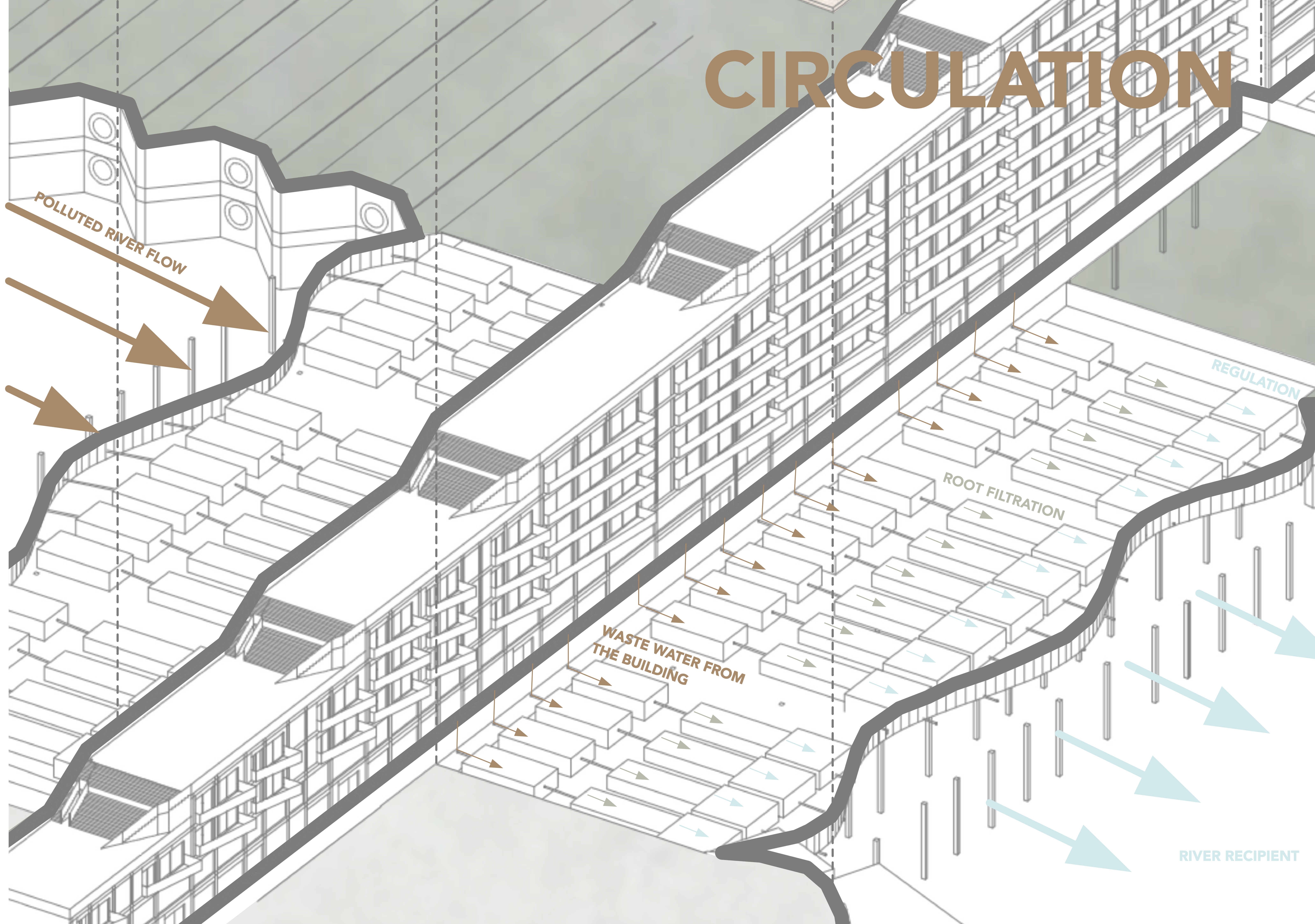



**GRANIA- FYTOVER 10**
**Amount of peoples wastewater managment**
8 - 10 people

**Size**
cca 32 m2

**Mesurments**
Septic - 4x 8 m
Root filter-  3,5 x 10 m
Regulation - 5,5 x 6 m

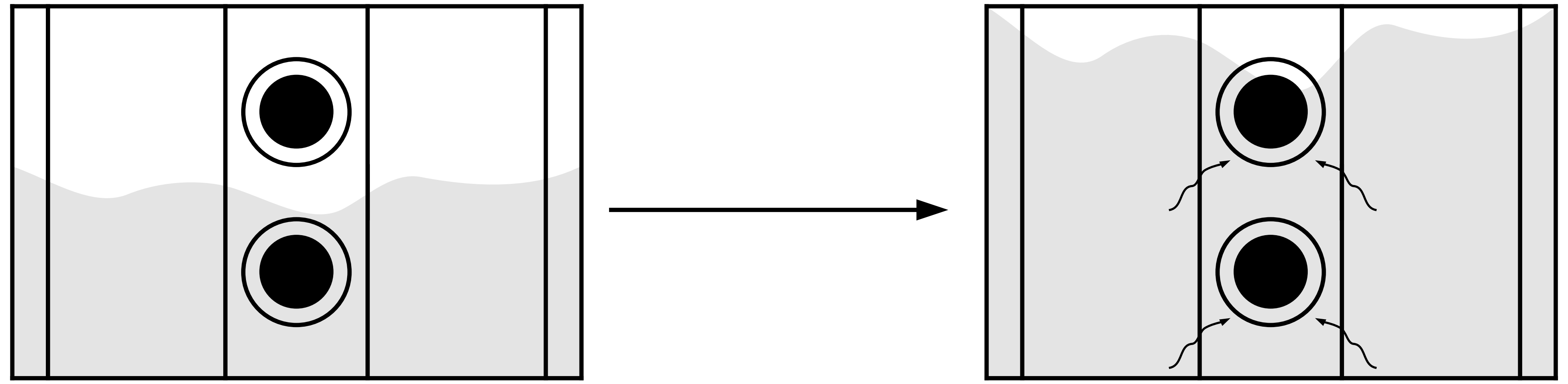
# CIRCULATION

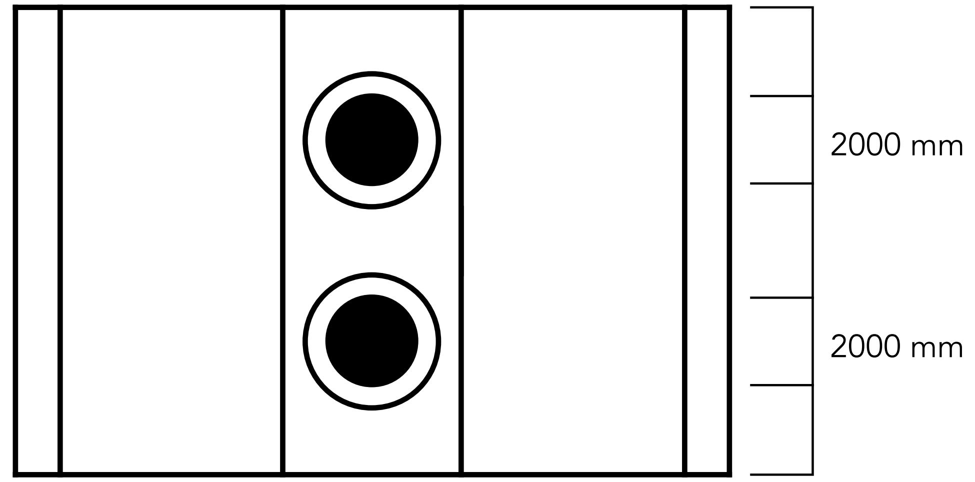


# FLOOR PREVENTION PIPES

To enhance flood prevention measures in this area, flood barriers have already been installed.
Additionally, to further mitigate the risk of floods, pipes have been placed along the riverbank beneath the building.

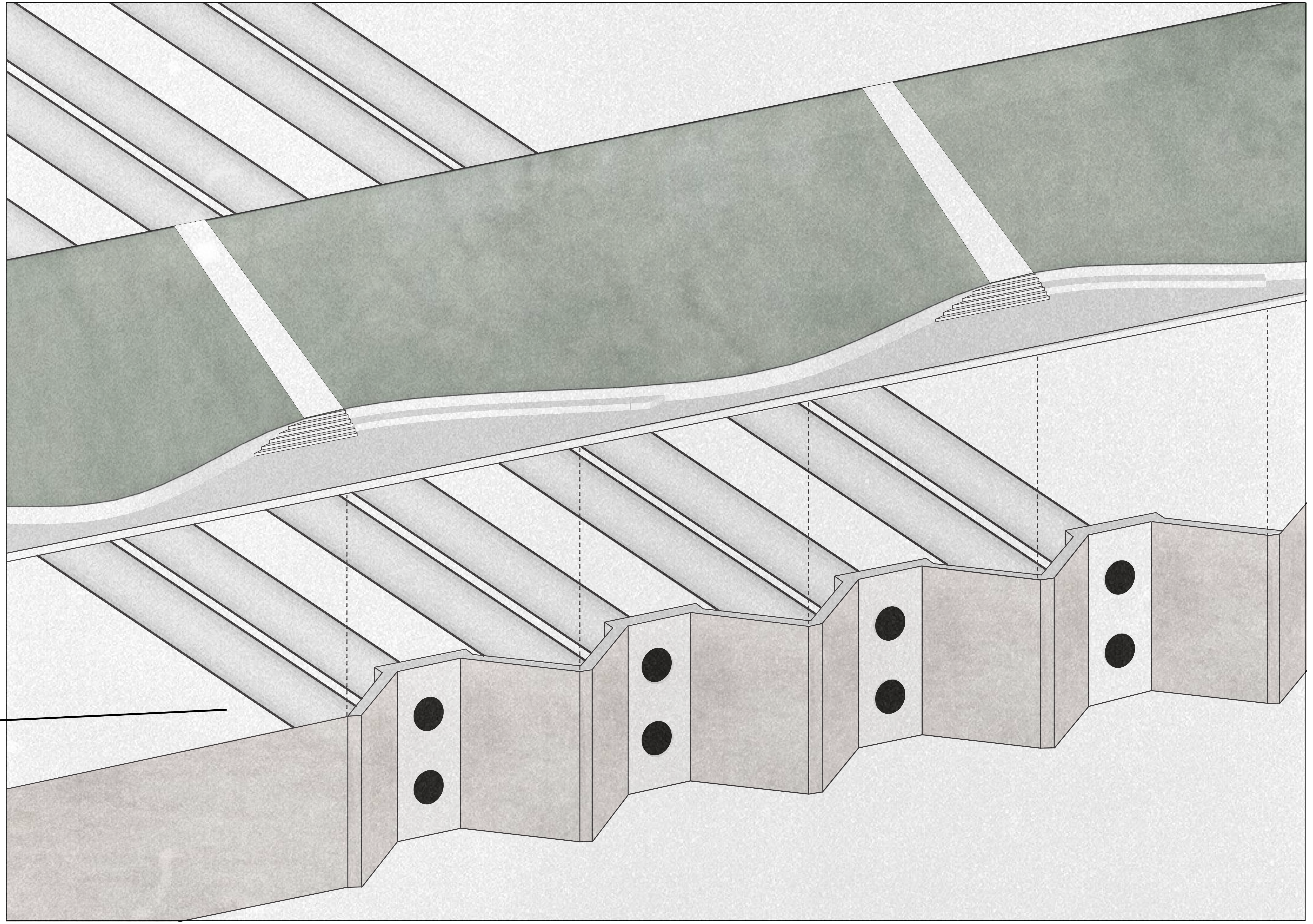
In the event of rising water levels, these pipes will redirect the water flow to a nearby reservoir, preventing it from spreading around the location and effectively managing the excess water.



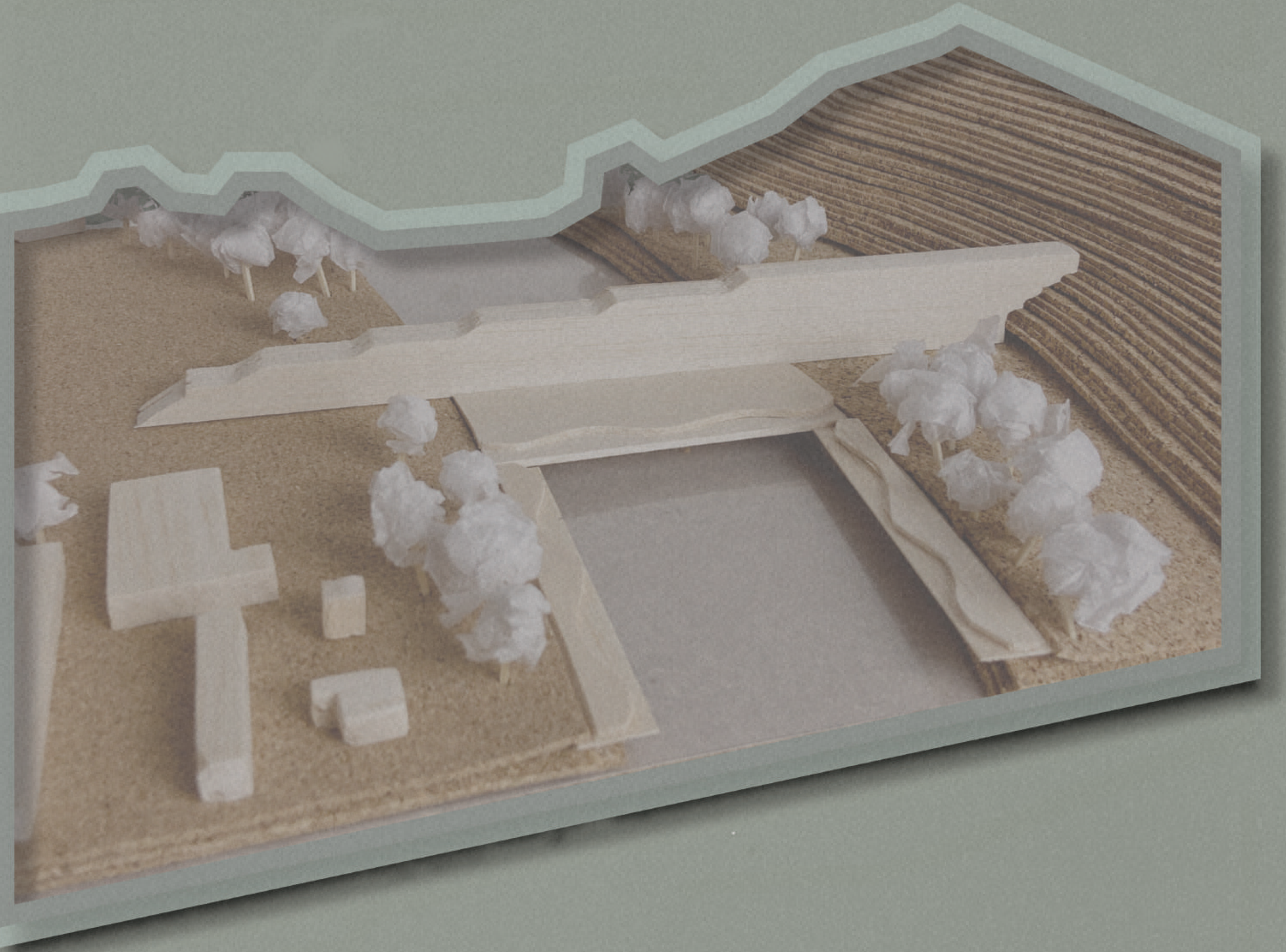


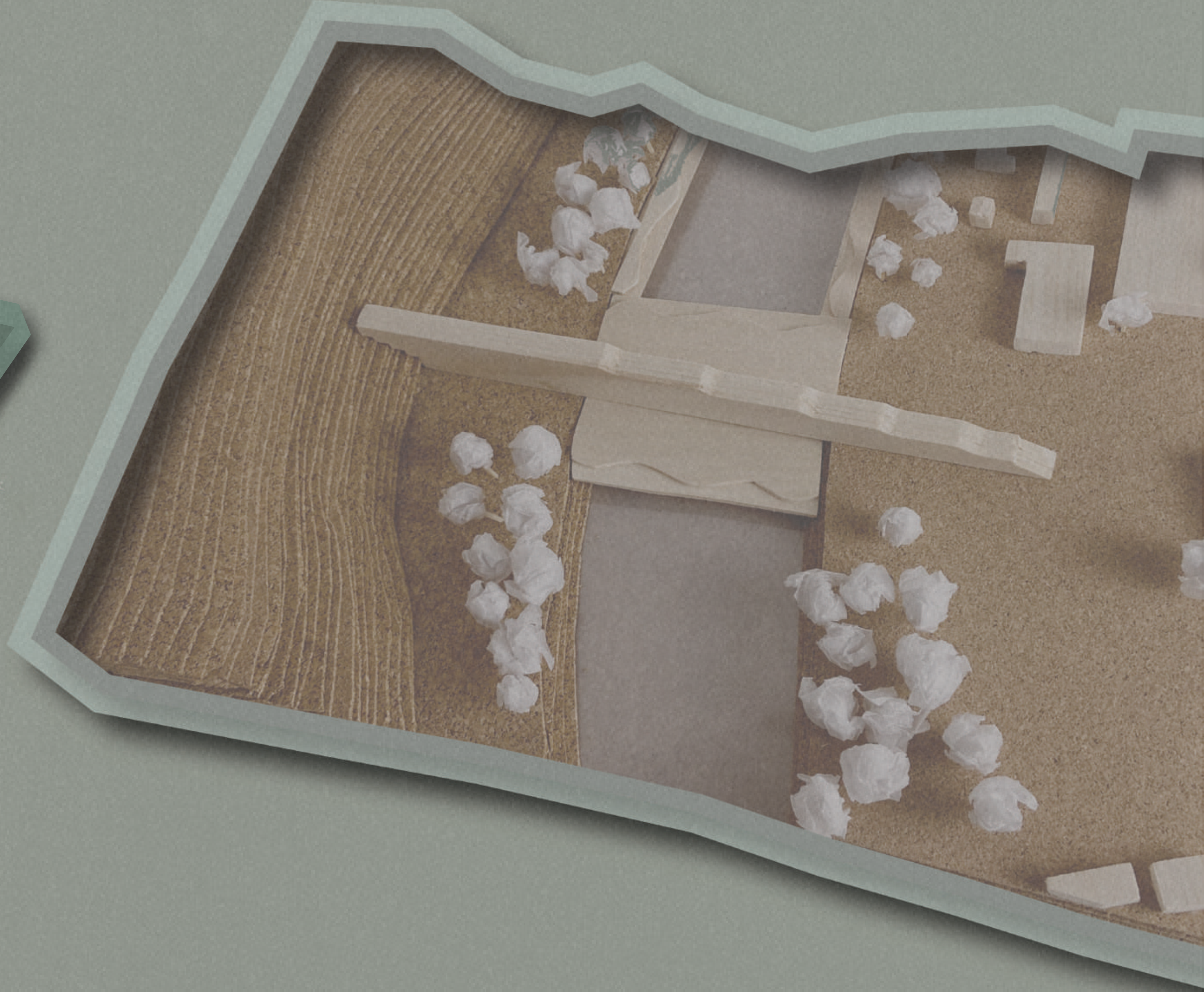

The pipes, measuring two meters in diameter, will channel water when the water level rises, preventing it from pooling in the area and spreading further.

# AVOID FLOOR RISK



# 03 MODEL





# 04 SUSTAINABILITY

**SUSTAINABILITY**

Living River City is a visionary project aimed at revolutionizing community and residential architecture through a self-sustaining waste management system. The cornerstone of this innovation lies in the implementation of root wastewater treatment filters, strategically integrated throughout the infrastructure to efficiently process wastewater.

Living River City is located along the banks of the Vltava River in Vrane nad Vltavou. The main goal of Living River City is to purify the entire Vltava River. To achieve this goal, this concept has to be placed at strategic intervals, approximately every 5 kilometers along the river's length. By placing these filtration systems, Living River City aims to maximize their effectiveness in removing pollutants from the river and ultimately creating a cleaner, pollution-free river and enviroment.

**MATERIALS**

The architectural design prioritizes sustainability, employing eco-friendly materials. At its core, the design emphasiyes the integration of wooden load-bearing columns, chosen for their structural resilience and capacity to mitigate carbon emissions while enhancing energy efficiency. This choice of material not only fortifies the structural integrity of the buildings but also serves as a proactive measure to minimize the environmental footprint of the building, aligning with its sustainability.

**Walls**

The building primarily employs wood as its main material. Sandwich panels are utilized for the walls to enhance the sustainability of the structure by improving energy efficiency and reducing overall energy consumption.

**Windows**

The building utilizes triple-glazed windows to enhance insulation performance, preventing heat loss and minimizing overheating within the structure. This improvement in insulation significantly boosts energy efficiency, ensuring optimal comfort levels while reducing energy consumption.

**Façade**

The facade incorporates vertical plants to enhance the energy efficiency of the structure. These plants provide shading, reducing the amount of direct sunlight that reaches the building's exterior. Through transpiration, the plants release moisture into the air, which helps cool the surrounding environment and maintains optimal moisture levels in both the leaves and the substrate. This integrated approach not only contributes to energy savings but also promotes a healthier and more comfortable indoor environment.

**Green roof**

One of the principles to the sustainable approach of Living River City is the incorporation of green roofs. Green roof has multiple benefits, such as storm water management, air quality improvement and energy efficiency enhancement.

**Root waste water tretment**

At the heart of Living River City's innovative approach lies the implementation of root wastewater treatment filters. These filters are designed to efficiently process wastewater using natural processes. By harnessing the power of nature.

The main root filter is the central component of the wastewater treatment system. It consists of a buried pit lined with impermeable insulation foil and filled with gravel. This substrate provides an ideal environment for bacteria to thrive, facilitating the aerobic degradation of organic matter.

Plants, such as duckweed and water iris, are planted on the surface of the filter, where their roots serve as conduits for nutrient uptake and oxygenation.

A regulation shaft controls the water level within the filter, ensuring that it remains below the surface to prevent stagnation and odor buildup. Once the wastewater has been purified, it flows into the recipient—the Vltava River—where it contributes to the overall health and cleanliness of the river ecosystem.

Living River City represents a bold vision for the future of urban development, where sustainability and environmental stewardship are prioritized.

By demonstrating the effectiveness of wastewater treatment in combating pollution, Living River City serves as a model for other communities seeking to achieve a cleaner, more sustainable future.

With its innovative approach to waste management and commitment to eco-friendly design, Living River City is paving the way for a greener, more resilient world.

# 05 STRUCTURE

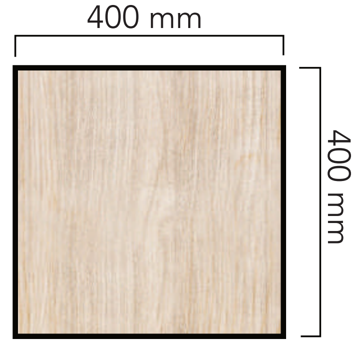
## TIMBER COLUMN

The architectural design of the building incorporates columns that are spaced at intervals of 5 - 7 meters along the whole building. The column are standing at a height of 3 meters.

These columns are constructed with a width of 400 x 400 mm and are engineered to withstand stress up to 21 MPa.

Through meticulous calculations of critical force and stress analysis, it is confirmed that the structural integrity of the columns ensures there is no risk of collapse or buckling.

dimensions




E= 12 GPa - 1 200 000 000 Pa

strength $\sigma$ = 21 MPa

dimensions:

cross section base : 400 mm

cross section length : 400 mm

height : 3000 mm = 3 m

area of moment of inertia :

$$I = \frac{0{,}4^4}{12}$$

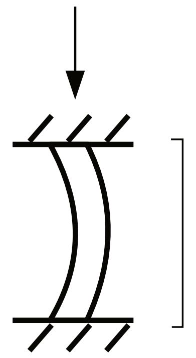
$$= \frac{4}{1875}$$

$$= 0{,}002\overline{13}\ m^4$$

effective length of column : L= 2 . 3 = 6 m

critical force:

P (buckling load)




$$Pcr = \frac{\pi . EI}{L^2}$$

$$P = \frac{\pi . 12\ 000\ 000\ 000 . 0{,}00213}{6^2}$$

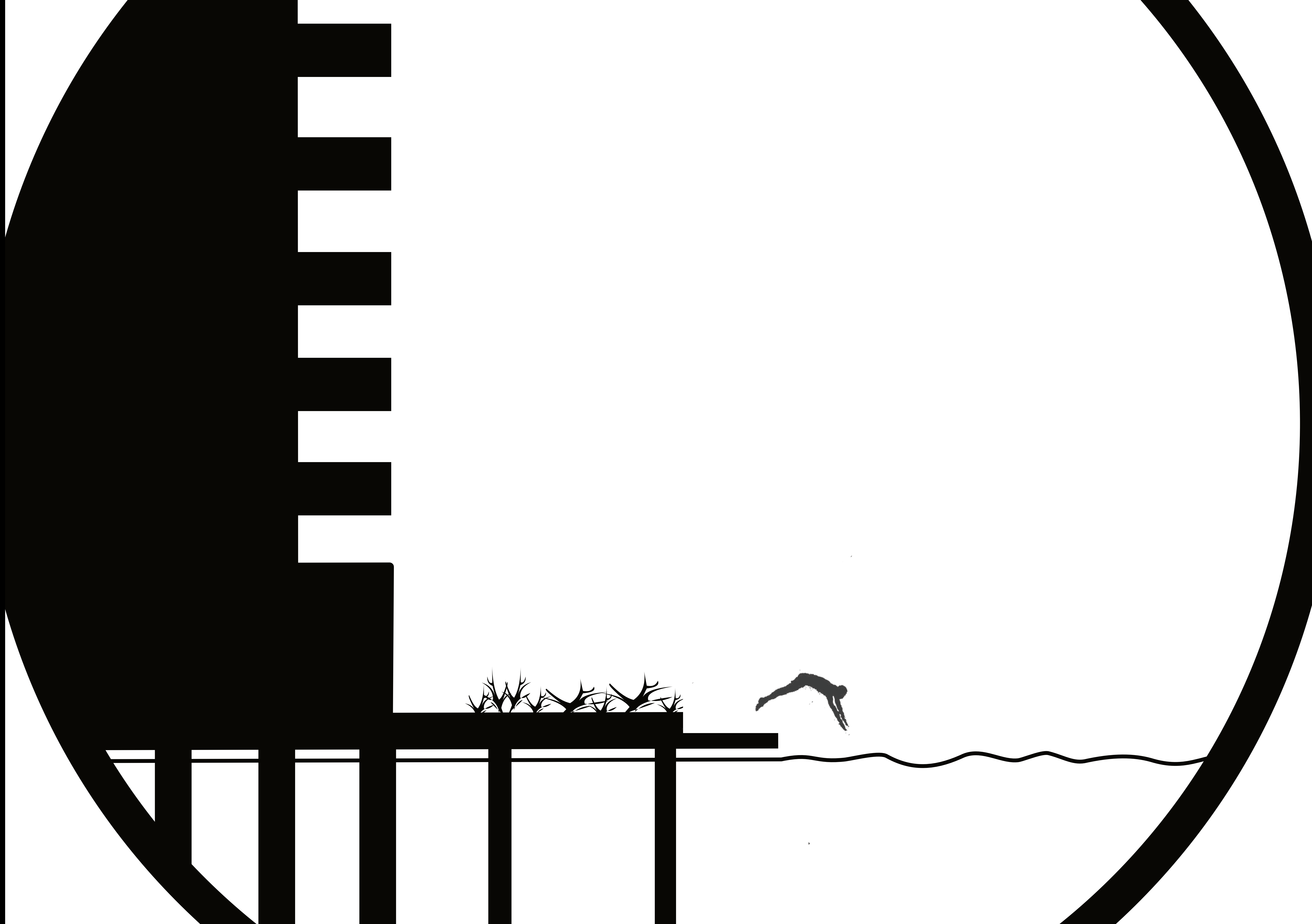
$$P = 2{,}23053 \times 10^6 N$$

critical stress :

$$\sigma\ cr = \frac{\pi^2 . 12\ 000\ 000\ 000 . 0{,}00213}{0{,}4^2 . 6^2}$$

$$= 4437500\ \pi^2 = 4{,}37964 \times 10^7\ Pa$$

# 06 TECHNICAL REPORT



## Abstract

The project Living River City, located in the area of Vrane nad Vltavou, aims to revitalize and purify the Vltava River, and also manage river overflow during floods. Living River City projects achieves this by constructing new infrastructure along the riverbanks, which will serve as residential and community spaces such as cafes, gathering spots, and libraries.
This building will be equipped with pipes managing river overflow and root wastewater treatment system to manage the wastewater from the building as well as actively removing pollutants from the river restoring its cleanliness.

## Contents



# 1. INTRODUCTION

## 1.1 Project brief

What will HERITAGE OF THE FUTURE look like? By exploring the past and imagining the future we will get an idea for what to do today. We will have two basic parts to the semester: making city maps, and proposing specific architectural scale projects for the year 2150. Upon the assumption the population will double, and society will change (to some degree), Architecture will be considered at a scale that is not quite building and not quite city.

## 1.2 Main goal of the project

The project aims to revitalize the River Vltava in a village of Vrane nad Vltavou by managing its overflow with a new citywide infrastructure project and new building structures along the banks that serve as residential and community centres while functioning as flood-resistant barriers. These structures incorporate innovative root waste water filtration systems to actively clean the river, promoting environmental sustainability and enhancing the city's liveability.

## 1.3 Purpose of the building

The housing complex is designed to cater to the expanding population of the village and its surrounding areas. Beyond merely accommodating growth, it serves as a solution to various challenges, including sustainable water management. Through innovative approaches such as root wastewater cleaning treatment system, the project ensures efficient water usage while prioritizing environmental sustainability. This method not only addresses the needs of the growing community but also contributes to maintaining the cleanliness and health of the local water resources, ultimately benefiting both residents and the surrounding ecosystem. In addition, to mitigate the risk of floods, an integrated system is in place to redirect excess river water flow to designated pipes, thus diverting it away from the village and potentially preventing flooding in Vrané nad Vltavou and even Prague. This proactive measure enhances the resilience of the community to natural disasters and safeguards the well-being of its residents.

## 1.4 Project identification data

1.4.1 Project name
Living River City

1.4.2 Location
The project is situated in Vrané nad Vltavou, approximately 7 kilometres from Prague close to Lipenec and Baně.
Vrané nad Vltavou is located on the right bank of the Vltava River about 5 km south of the 50th parallel (south of Prague). The lowest point of the village is in the north-eastern corner at the river level near the ferry, 190 meters above sea level. The highest point is the southern side of Chlumík hill, 330 meters above sea level. Vrané nad Vltavou consist of two historical settlements, Skochovice (about 2/3 of the area) and Vrané (about 1/3 of the area), with a total area of 416 hectares after boundary adjustments in 1997. There are 650 houses and 2408 permanent residents. The village is actively used for recreation, with 568 cottages built. Since 2001, there has been urbanization in the central part of Vrané.

1.4.3 Type of building
The residential building caters to three distinct age groups: students, families, and seniors. Its design encompasses amenities and features tailored to the needs of each demographic. For students, it offers communal spaces conducive to studying and socializing. Families benefit from family-friendly amenities. Seniors enjoy accessible accommodations and facilities designed for their comfort and convenience. By accommodating these diverse demographics, the building fosters inclusive community environment where residents of all ages can meet.

## 1.5 History

Vrané nad Vltavou, with its rich history dating back centuries, holds a significant place in Czech heritage. Originally established as a settlement along the Vltava River, its strategic location made it a crucial point for trade and transportation in medieval times. Over the years, Vrané nad Vltavou evolved into a thriving town, witnessing various historical events and developments.
Today, Vrané nad Vltavou remains a charming destination, offering a glimpse into the past while embracing the present. Its historical significance, combined with its scenic beauty and cultural offerings, ensures that it remains a cherished part of Czech history and identity.

## 1.6 Site Analysis

1.6.1 Traffic
Vrané nad Vltavou lies approximately 5 kilometres from Prague - Zbraslav. Transportation is provided by trains, with a train station in the village, ensuring excellent connections with Prague. There is also a ferry service operating here, transporting passengers to the other bank of the Vltava River, to Zbraslav, where bus connections are available. Within the village itself, there is also a bus stop, and a school bus line operates. In Vrané, 823 individuals commute daily to work or school outside the village.

1.6.2 Greenery
In Vrané, the residential green spaces are an integral part of the town's layout. They encompass public parks, including the cemetery, and efforts are underway to convert certain forested areas into green zones, enhancing the town's natural charm.
Beyond designated parks, greenery is layered out throughout the whole town, lining streets, adorning pathways, and framing water bodies. Private gardens and communal areas further enrich the town's verdant landscape.

1.6.3 River
The area's landscape centers around two main features: the Vltava River and the Vltava Valley. The Vltava River is wider here due to the Vrané reservoir, while smaller streams also crisscross the region, particularly to the east.

1.6.4 Context
In Vrané nad Vltavou, daily life is supported by a variety of essential services. These include the local hub comprising a municipal office, post office, kindergarten, primary school, library. Healthcare needs are met with a health center providing general medical services, dentistry, and pharmacy facilities.
The village also embraces community safety with the presence of a voluntary fire brigade in Skochovice, complemented by nearby fire rescue services.
Residents have access to sports facilities, from a gym through football field to water sports areas. Various clubs cater to different interests, fostering community engagement.

# 2. RESULTS OF CONDUCTED SURVEY

## 2.1 Project location

My project is strategically positioned nearby the former paper mills (Papírny), now considered as brownfields. Through the creation of this residential complex, I aim not only to revitalize this neglected area but also to forge a vital link to the opposite river bank. Integrating thoughtful urban planning and sustainable design principles provide alternative routes and access points, thereby enhancing connectivity within the community.

## 2.2 Geological survey

Within the geographical scope being examined, there are no documented occurrences of mineral deposits, designated protected mining zones, or areas subject to underground mining activities.

## 2.3 Hydro power plant

2.3.1 Vrané hydroelectric
In Vrané nad Vltavou, there's a water structure whose main job is to manage water flow from nearby hydroelectric plants, ensuring steady electricity production and maintaining water levels for navigation and drinking water supply to Prague. The dam is built with concrete and granite, housing gates and turbines for water control and power generation. It stretches over 13.4 km, affecting the Vltava and Sázava rivers.

2.3.2 Electrical Power Supply
The layout of power lines, including very high voltage lines, is closely tied to the Vrané water structure. These lines provide electricity to nearby areas, connecting to substations for distribution. Existing substations are expected to serve new development areas, ensuring continued power supply.

## 2.4 Site utilities

2.4.1 Drinking water supply
The town's water comes from a larger water system, which itself taps into another regional water network. Pipes running along Březovská Street bring water to most parts of the town.

2.4.2 Wastewater sewerage
Vrané has its own wastewater treatment system situated at the town's edge. Pipes collect sewage from different parts of the town, primarily using gravity, and some sections require pressure to move the sewage.

2.4.3 Rain water management
Rainwater is dealt with using a mix of open channels and pipes. For new buildings, it's recommended to manage rainwater on-site, while larger buildings use local drainage conditions to prevent flooding.

2.4.4 Waste management
Household waste is collected and taken out of town for disposal. There are separate bins for recycling glass, plastic, and paper. Hazardous waste areas aren't designated within town limits.

# 3. RESIDENTIAL HOUSING PROJECT

## 3.1 Functions

3.1.1 Basement
The basement functions as a conduit facilitating the movement of air and utilities across various floors and sections within the building. Enclosed within the structure, it serves as a connection point for the routing of wastewater treatment filter pipes.
It encompasses the filter field with all mechanical components, including interconnected pipes and septic, root filter, and regulatory systems. Following this process, the treated wastewater is discharged into the receiving river.

3.1.2 Ground level
The building has eight main entrances for residents, each accompanied by parking spaces and a connecting road for easy vehicle access. IN the public part of the building, there are seven entrances available, leading to shared spaces like cafes, library and gathering zones. The outside space is dedicated to gathering areas, providing a retreat for swimming and socializing.

3.1.3 1$^{st}$ level
The first floor is accessible from the ground floor via stairs, leading to communal areas such as cafes, a library, and gathering spaces for both the community and residents.

3.1.4 2$^{rd}$ - 7$^{th}$ level
Between the second and seventh floors, a diverse array of apartments cater to various demographics, including seniors, families, and students. These floors offer a range of living options, each designed to meet the needs and preferences of the residents.

## 3.2 Structure

3.2.1 Foundation
The structure comprises a total of 135 load-bearing wooden columns. These columns traverse the entirety of the building, extending from the 7$^{th}$ floor to the foundation. The building's foundation on the river bank extends to a depth of 4 meters and is 400 mm wide and the foundation for the part of the building situated along the river reaches a depth of 7 meters with the same width.

3.2.2 Walls
Thickness of the exterior walls is 400mm and in the partition walls is are 100mm and 400mm.
The wall is made of a sandwich panel with great thermal insulation, saving on production time. It includes timber boarding and wood panelling on the exterior, followed by two layers of wooden boards: a waterproof chipboard on the outside and a spruce frieze on the inside, with an insulation layer in between.

3.2.3 Floors
The dimensions of the floors are 400mm. The floor composition is floor covering, floor insulation, barrier ceiling plate, ceiling beam and acoustic insulation.

3.2.4 Windows
All the windows in the building are triple glazed windows.
Apartments for seniors: slider windows with dimensions 2500 x 1800, 2500 x 2000, 2500 x 3000 and 2500 x 4000.
Apartments for students: slider windows with dimensions 2500 x 4500.
Apartments for family's: slider windows with dimensions 2500 x 4300, 2500 x 4400, 2500 x 4500 and 2500 x 4800.
The façade has triple glazed windows.

3.2.5 Doors
Doors entering the building are automatic doors with dimensions 2500 x 1700mm. The doors used in this building are made of solid wood material. The entry hall doors measure 2000 x 900 , while those within the apartments are 2000 x 800 in size. Dimensions of Doors leading to the staircase are 2000 x 1600mm.
3.2.6 Staircases and elevators
The building has 8 elevators accompanied by stairs next to it.
The dimensions of the elevators are 1200 x 1400 mm.
All staircases in the building are in a span of 1500 mm. The treads measure 280 mm and the rise is 180mm.

3.2.7 Facades
The façade is made of wooden panels that change their size by going upwards. Plants will be used on a façade that will provide shading, reducing solar heat gain and improving building energy efficiency.

3.2.8 Roof
The roof will be a green roof. At its core is a waterproofing membrane, which prevents water from penetrating the roof and causing damage to the building below. On top of this membrane, there is a drainage layer that allows excess water to flow away from the roof, preventing waterlogging and ensuring proper irrigation for the vegetation.
Above the drainage layer is a filter fabric or mat, which helps to retain soil while allowing water to pass through freely. This layer also prevents soil from clogging the drainage system. The next layer is the growing medium, which provides a substrate for the plants to root and grow. It is typically a lightweight mixture of soil, compost, and other organic materials that promote healthy plant growth.
The top layer consists of the vegetation itself, which includes a variety of plant species such as grasses, sedums, and wildflowers. These plants not only provide aesthetic beauty but also offer environmental benefits such as: improved air quality, reduced energy consumption, and enhanced storm water management.

## 3.3 Insulation

The building employs a sophisticated insulation system, utilizing sandwich panel walls insulated with mineral wool. This configuration provides excellent thermal resistance, minimizing heat transfer between the interior and exterior environments. The building features triple-glazed windows, which further enhance thermal performance by reducing solar heat gain and preventing overheating. This combination of insulation materials and window technology ensures optimal energy efficiency and thermal comfort within the building, while also contributing to sustainability goals by reducing energy consumption and carbon emissions.

## 3.4 Damp proofing

The walls are treated with damp-proof paint, which will form a protective barrier to prevent moisture infiltration and deter mold growth. This process involves applying the paint directly to the underlying substrate, followed by the application of a render or plaster to further reinforce the barrier against dampness.

## 3.5 Materials

The primary materials utilized in the construction of the building include wood, white stucco, and float glass for the windows. Additionally, the bridge structure incorporates wood, while steel is employed in the construction of the area dedicated to root wastewater treatment filtration.

## 3.6 MEP

3.6.1 Mechanical system
The building incorporates a combination of natural ventilation through operable windows and mechanical ventilation utilizing strategically positioned vents. Fresh outdoor air is drawn into the building through intake vents, where it is then distributed and circulated throughout the interior spaces. This ventilation system ensures a continuous flow of fresh air while effectively regulating indoor air quality and comfort levels.

3.6.2 Electrical system
The electrical power supply for the building will be sourced from the nearby Vrané and Vltavou hydroelectric power plants. The Vrané hydroelectric facility, boasting a capacity of 13.88 MW, generates cost-effective and environmentally friendly electricity.

3.6.3 Plumbing system

3.6.3.1 Water supply system
The municipality is supplied with water from the VOVEVRA group water supply system, which is fed by the Posázavské group water supply system. The water supply pipeline, with a diameter of DN 150, runs along Březovská Street, serving the central areas of the municipality (up to Oblouková Street), from where street distributions branch off to individual properties.
3.6.3.2 Waste water treatment
The wastewater will undergo treatment using root wastewater treatment filters, which will filter the water before it is discharged to the receiving river.

6.4 Fire protection

6.4.1Separated fire zones
The building is equipped with separated fire zones, ensuring that the enclosed staircases act as effective barriers against the spread of fire. These designated zones not only enhance fire safety within the structure but also serve as crucial emergency exits, providing occupants with a secure means of evacuation during fire emergencies.

6.4.2 Active fire protection
Within this building, a comprehensive active fire protection system is been implemented to ensure the safety of its occupants. This system includes fire alarm systems, strategically placed sprinklers to suppress fires effectively, and clearly marked emergency exit signs to guide individuals to safety in the event of an emergency.

6.4.3 Passive fire protection
Building includes various passive fire protection features to enhance safety measures. These include emergency escape routes integrated into the staircases, along with fire- resistant walls, windows, and doors meticulously designed to withstand the spread of fire, smoke, and heat. The EPS panels have EI and RE15 fire resistant values, ensuring they will stay intact during fire.

## 3.7 Root waste water treatment

Root wastewater treatment plants operate on the same principles as natural wetlands, where self-cleaning processes occur. The root filter is filled with fine stones, on the surface of which bacteria reside, ensuring the cleansing process. Plants planted on the root filter has an additional function - they partially absorb nutrients, supply oxygen, bacteria reside on their roots, and in winter they act as thermal insulation.

3.7.1 Septic/Anaerobic Separator
Septic is used to ensure the long-term functionality and lifespan of the root filter, it is necessary to retain the maximum amount of insoluble substances. For this reason, it provides a multi-chamber septic tank with directed flow, known as an anaerobic separator, as the first stage of treatment before the root filter.

3.7.2 Distribution shaft and pipes
Serve to evenly distribute water over the surface of the root filter. The pipes are equipped with openings so that water flows evenly across the entire surface of the filter.

3.7.3 Root filter
A buried pit lined with impermeable insulation foil and filled with gravel of suitable fraction. The foil prevents polluted water from penetrating from the sewage treatment plant into the substrate, while the gravel filling provides a suitable environment for aerobic cleansing processes by bacteria settled on the filter filling and roots of water- loving marsh plants.

3.7.4 Regulation

The regulation shaft is used to control the height of the subsurface water level in the root filter. The water level is maintained below the surface of the gravel (about 5-10 cm) during plant rooting, preventing the root sewage treatment plant from becoming a breeding ground for mosquitoes and odor. During normal operation, the filter is empty, and water flows through the filter by gravity to the drainage pipe. Wastewater flows onto the surface of the filter through the distribution pipe and then slowly passes through the entire volume of the filter, subsequently draining through the outlet shaft into the recipient.

3.7.5 Plants
The plants have a supplementary cleansing function, absorbing nutrients from the water and supplying oxygen to the filter. Plants that are primarily planted are species that enhance the beauty of the root sewage treatment. From spring to autumn, you can admire the flowers. Plants used for the wastewater treatment are duckweed, water iris, Siberian iris, common bulrush, club-rush, bulrush, cattail, reedmace, and various types of sedges.

### 3.8 Bridge structure

Below the structure lies a roadway that spans both sides of the river, facilitating connectivity between the river banks. Positioned underneath this thoroughfare are specialized filters designed to purify the river water, ensuring its cleanliness and environmental integrity.

Including the issue of flood risks, there is a sophisticated system underneath the bridge, to redirect the excess water flow to a strategically installed pipe network. This mechanism efficiently channels and diverts the surplus water away from the residential area, safeguarding the inhabitants and their homes from potential flood damage.

## 4. CONCLUSION

This vision for the year 2150 aims to achieve a clean Vltava River by eliminating all pollution. The approach involves constructing residential buildings catering to all age groups, which draw water directly from the Vltava. After usage, the water undergoes purification through root treatment tanks before being returned to the river, showcasing a sustainable cycle of water usage and purification.

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