Master's Degree Project

URBAN WATER

A New Layer In The City Landscape

Sustainable Urban Design, Lund University, Sweden

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"We do not inherit the planet from our ancestors, we borrow it from our childern. "
Native American Saying

SUDes
Sustainable Urban Design

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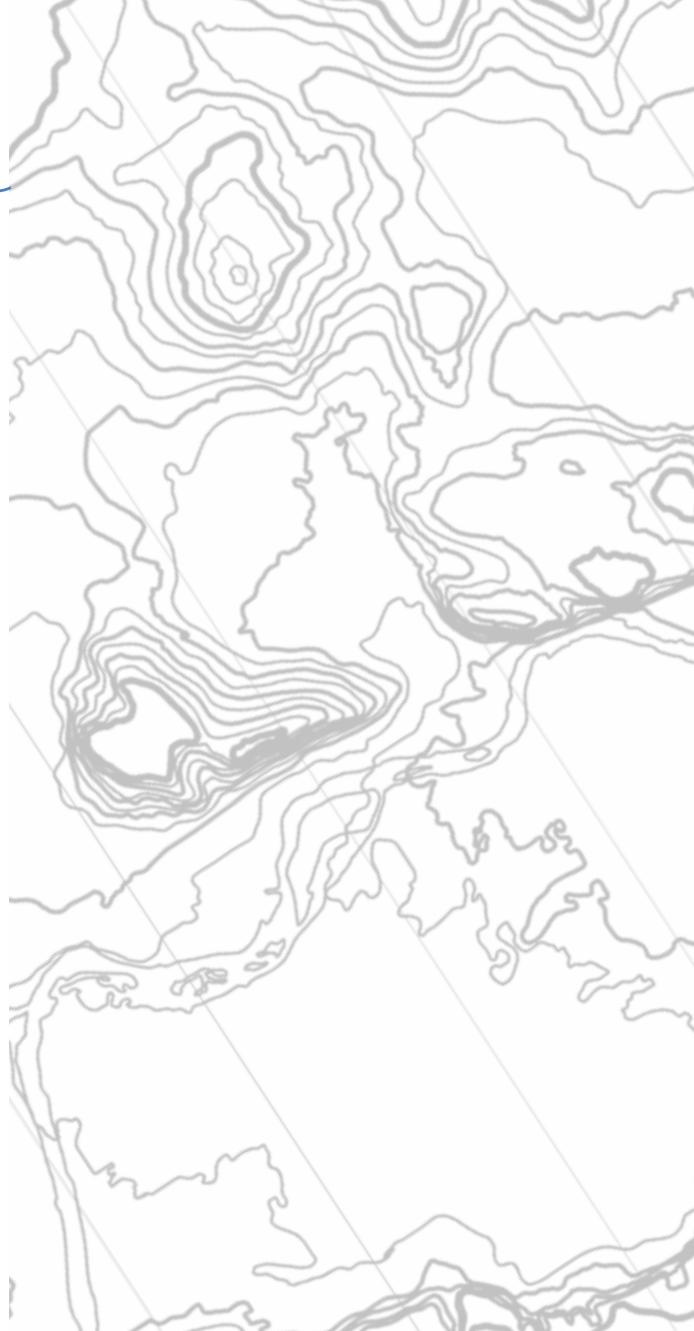


SKOPJE

Introduction

Urban Water is an attempt to investigate the possibility for ecological treatment of Skopje sewage waste water which currently pollutes the river Vardar. The proposal is giving a spatial and technical solution for transforming the available city landscape, activating it in order to preform water purification through the use of ecological and biological system called 'The Living Machine'. The purified water from the living machines becomes a new element in the city urban fabric. It gives the possibility for creation of new activated landscapes which allow reuse of the purified water. The system tries to adapt and to interact with the surrounding context, creating more vibrant neighborhoods and city life. Waste water becomes Urban Water which sustains urban life and no longer pollutes the river.

The inspiration for this project came right after I attended a conference at Lund University. 'Urban Water Urban Form' was a conference focused on the current use and pollution of water in urban areas. There was one project in particular which came to my interest, and inspired me to think in a familiar way about Skopje. 'Growing Water' by Urban Lab, explored the 'Eco-boulevard' concept in Chicago, USA. It tests the possibility for treating Chicago waste water with living machines integrated in the street system of the city, becoming a functional layer in the city landscape.

Therefore i decide to put my focus in this thesis on the topic of water. One of the main qustiones of the project: Is the way that we treat and use water currently in our modern lives sustainable, and do we see the problems which arise from that? Do we really treat water as the crucial substance for life on this planet?

and the distribution and treatment of the waste water coming directly from the domestic sewage discharge. I am raising the question of how this water is distributed, managed and discharged, and how that influences the natural environment of the city. How it effects the city ecological balance?

As I mentioned before, water is the main inspiration, focus and topic in this thesis. This gives me the responsibility to analyze and understand how water cycles and interacts with life on earth. The water cycle is the most important cycle which supports all life. I will try to give a short explanation of the water cycle, where I will point out the critical points where that cycle is disturbed, or in danger by the way we use fresh water, and treat as well as release the waste water in urban areas.

Water cycle processes.

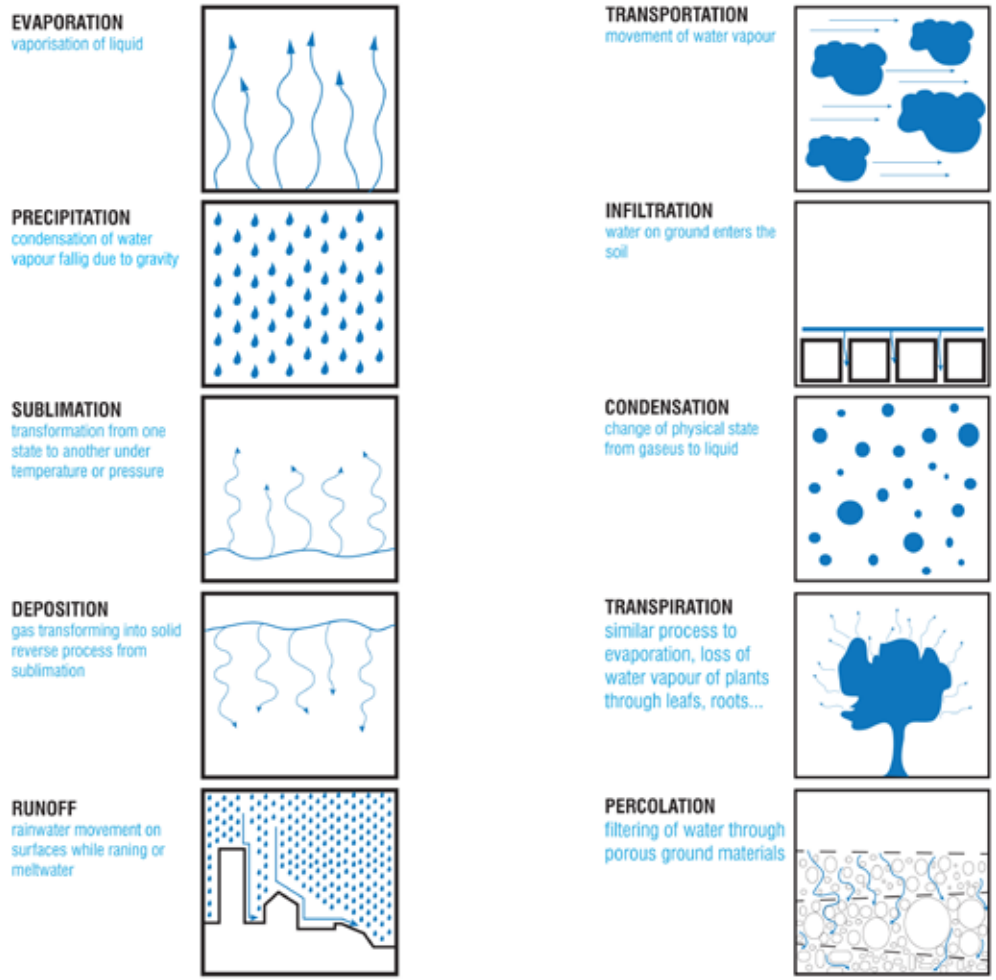


Image 1.

How much water is there on earth?

Water is a limited resource. The physical boundaries of our own planet make that a logical conclusion. Water is in oceans, seas, lakes, rivers, ponds, wetlands, soil, air, plants, animals, our own bodies, water is everywhere. It can be found in different stages, from gaseous, liquid to solid. It reacts on temperature and pressure, and it underlies many chemical processes while changing it's physical state. Water is the main reason there is life on this planet. Life began in Water.

So, let's see, how much water is there on Earth? To answer this question we need to be aware of the processes that water takes part in.. These processes are known as *Water Cycle*.

The Water Cycle can be understood as the path that the limited amount of water goes through during the seasons change, while temperature changes, while all life happens.

Evaporation is vaporization of water from surfaces of the oceans, lakes, rivers, ground, and other open water surface areas, under the influence of the sun. It is an essential part of the water cycle. It enables the formation of clouds. They have a crucial part of *Transportation* of water vapor. *Condensation* falls in form of rain, a process called *Precipitation*. The rain water from precipitation falls on the ground surfaces *infiltrating* the soil from where some of the water *Percolates*, fills in the underground water wells, and another part is used as plant uptake. Plants feed with water through the process of osmosis and preform natural breathing through their leaves which enables *evotranspiration*, giving back water vapor in the air, finishing one part of the water cycle. The precipitation in the form of snow, melts and turns into liquid water under the influence of high temperatures. If temperatures rise higher, sublimation takes place. *Deposition* is a reverse process of *sublimation*; it means that vapor can turn directly into ice without undergoing the liquid state. This of course happens when temperatures are quite low.

The quantities of water that take part in the water cycle can be measured. The amount of water which evaporates from land areas is around 9.000km3. The same amount falls back as precipitation. There is an obvious balance in that exchange of water quantity. It is an interesting fact that there is more water evaporating from oceans and seas than it actually goes back as evaporation. The amount of precipitation on mountain areas is higher than the overall evotranspiration processes that take palce. The amounts of runoff from internal and external areas seems to be equal and it is around 119 mil.Km3. The amount of water in oceans and seas is approximately 361 mil.Km3 of water.

It can be concluded that water can be found everywhere. and it can be measured in quantity. It can be found in many stages. It can be in liquid stage (most known and common), solid (ice), and gaseous (vapor). It depends on pressure and temperature -

Colorado river - Since the mid-20th century, intensive water consumption has dried the lower 100 miles - (160 km) of the river such that it no longer reaches the sea except in years of heavy runoff!

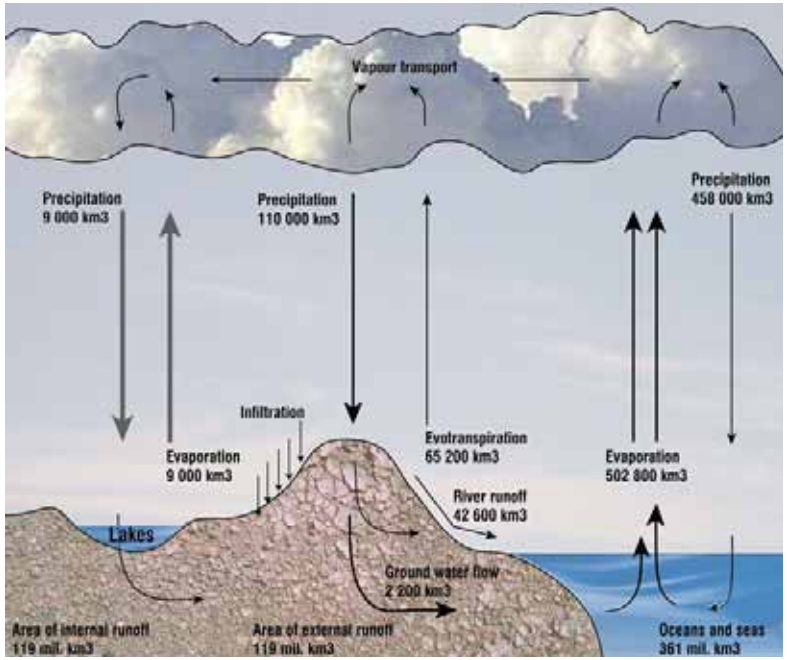


Image 2.

how long it can obtain a certain state. Image 2. gives the illustration of water movement, water quantaties that take part in the cycle and the stages of the Water Cycle.

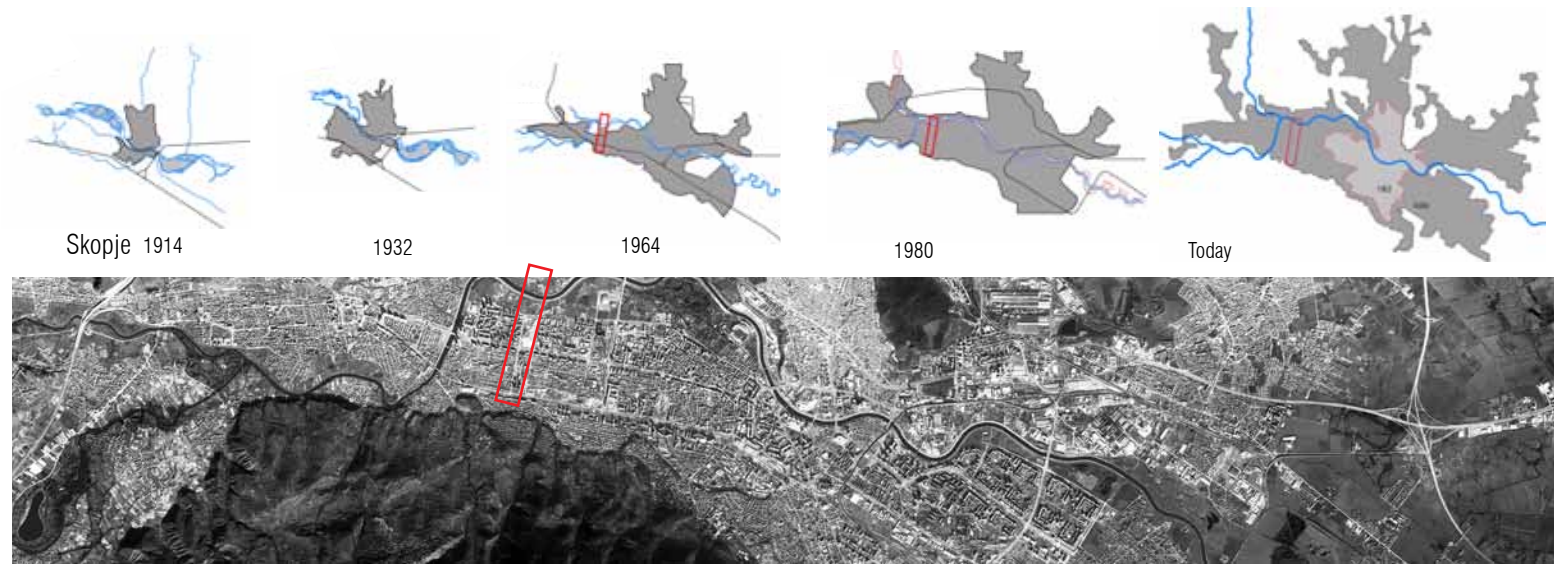


Image 3. Development of the city and the river through time

The topic of my thesis research as well as the project design proposal is about the city of Skopje. The history of the city and its fragmented development through time are important for this project. When was the city formed and by whom? What encouraged the urbanization and the growth of the city? Are there any unique natural and historical factors which influenced the urban development? How did the importance of the city change through time and why? How did the planning process influence the current situation of the city? What were the main planning decisions and realizations that created the current city image? How is this related to the topic of my thesis? What are the problems or issues that I identify, and how is my project taking that into consideration? And finally: What is my thesis?

I needed to ask these quiestiones, so that i could structure my research, understand the problem which I am researching and trying to resolve.

The development of the city can be divided into eight periods. Within these periods there were different factors which influenced the city development: natural disasters, occupations, migration, regional positioning, location and etc.

The *first period (9-3rd century BC)* - Is the Period when first urban formations appeared in the Skopje plain. The urban for mations were wall protected areas, fortifications where urban life took place.

The *second period (1-6 century BC)* – The ancient city Skupi was formed. It lays between one of Vardar's tributaries the river Lepenec, and the river Vardar. In relation to the current position of Skopje, it is on the north-west side of today's city center. Skupi was later occupied by the Romans. The roman influence is visible by the typical orthogonal street pattern with two main street axes. One axis was spreading from east to west, and the other from north to south. In that particular point of time, the city of Skupi was spread on the whole territory of Skopje plain (40ha). In the year 518, a devastating earthquake hit the ancient city, destroying almost all of the built environment. The city existed until the year 535.

The possibility for creating a livable urban environment was recognized more to the east of the city, todays Kale fortress, lying in the city center, where the next urban development of Skopje took place.

The *third period (12-14 century)* – During this period, the city was situated on the left or the north side of the river Vardar, on the territory of where today is the fortress Kale. The city had a highly developed street network, palaces, houses, market and a lot of small shops. The city was under Macedonian leadership (tzar Samoil), but was at times occupied by the bysantians. In the 1346, the Serbian tzar Stefan Dushan took over the leadership of the city, and Skopje became the capital of the Big Bal-

Image 4. River Vardar and the city - harmony between the natural flow of the river and the city of Skopje

kan Kingdom.

The *fourth period (14-20 century)* – Skopje falls under Turkish occupation. It is totally destroyed by the Turks in 1392. During the 14th and 15th century the city was lying on the territory of the fortress Kale and did not have any importance in the Ottoman Kingdom. The city numbered 4.957 inhabitants.

In the following years Skopje will again experience a total destruction. This time Pikolomini, during the war between Turkey and Austria will burn the whole city down. But Skopje, the fenix city resurrects at the end of the 18th and the beginning of the 19th century, when the Turkish power begun to fade.

It became a regional center after the built of the first railway line Belgrade-Skopje-Solun. At this time the city started spreading on the right side of the river. which had encouraged more intensive urbanization of the right river bank.

During 1689 the city had 60.00 inhabitants, in 1840 about 15.000, and in 1912 approximately 37.000 inhabitants.

The *fifth period (1912-1941)* – During this period Skopje changes its identity. The city becomes a very important geo-political and social center. The Muslim inhabitants start to move out ofthe central city territory and Christian inhabitants start to migrate. This period is characteristic for the first planning gestures brought by the first urban plans for the future development of Skopje.

The first urban plans show concentric development of the city, the organic urban morphology dominates the plans. The north-south axis is the main element emphasized with the planning gestures, the railway station, the stone bridge are one of the main structural elements of this city nucleus. The further city development was encouraged and influenced by the industrial revolution. The east and south-east side of the city were planned for the first industrial developments. The residential zones also started spreading more to the south or the right side of Vardar river. The land was organized and planned into urban blocks. The city borders started spreading on the north-west, south and south-west.

The northern and eastern borders remain unchanged. The city now counts 47.384 inhabitants. That number increases until 1031 when in accedes 68.000 inhabitants.

The *sixth period (1945 – 1963)* - After the Second World War, Skopje becomes the capital of Macedonia. This will influence the future urban growth of the city. As a geo-political regional center, Skopje started attracting new labor force which put extra pressure on the existing residential capacity of the city. That was the main reason for a necessity of a new urban plan, a plan which will mostly influence the current physical and morphological image of the city. The Czech architect Lujdek Kubes, an orthodox modernist, was invited to give his personal view on

Image 5. Plan for Skopje from 1890.

Image 6. Plan by D. Leko from 1914.

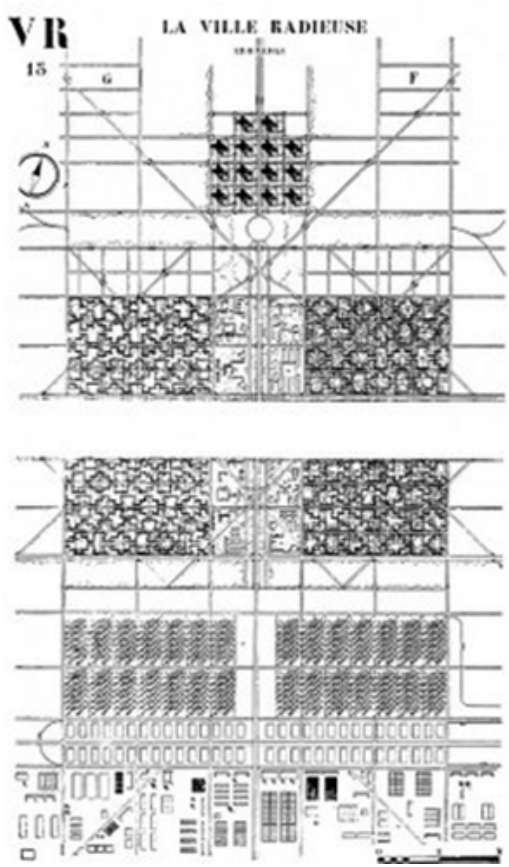


Image 7. LaVille Radeieuse, Le Corbusier, 1931

the future appearance and development of Skopje. The plan mainly changed the past concentric concept of urban organization into a linear one.

The linear city concept from the Russian architect and planner Milyutin who made the plan for Magnitogorsk (the linear city concept) from 1931, was undeniably incorporated into the plan drawings. But the Le Corbusier's La Ville Radieuse, seemed to be the guiding image, the absolute inspiration, disregarding the important local elements and characteristics of the city which should be considered in the city planning process.

The Kubes plan completely ignored the cultural and historcal heritage, as well as the topographical disposition of the city. It took Le Courvoisier's Radiant City idea as a direct inspiration. Here for the first time, the industry was taken into consideration, and zoning was applied. The residential zones were separated into Mega blocks with residential building blocks which 'float' in the vast green areas, interconnected with traffic infrastructure. The residential zone takes around 23.61% of the overall built area. The automobile revolution also pressured the planners to make the car, or the traffic infrastructure very important guiding element in the spatial organization of the city blocks.

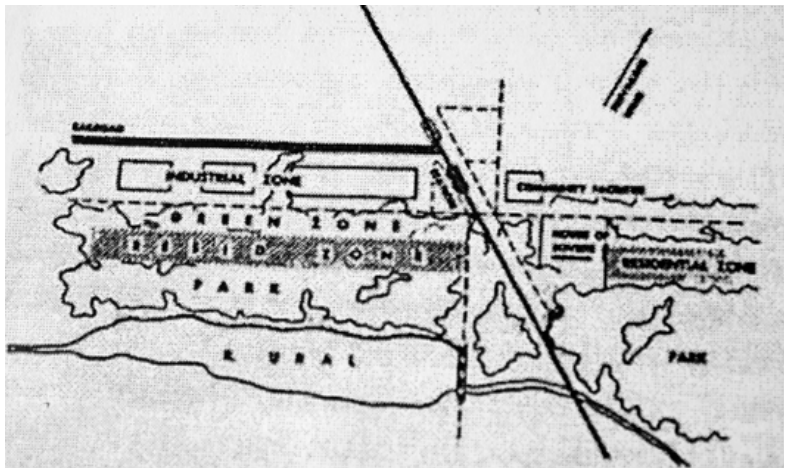
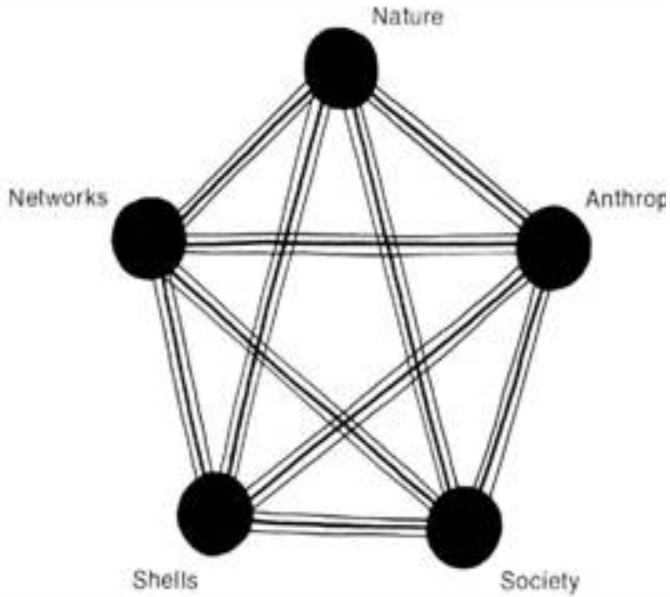


Image 8. Linear city plan influence

And here in this plan I come to the very important connection between the city planning and its influence on the unique natural element The River Vardar. It was here, when planners had the idea to transform the river into a big floating canal. The idea to make Vardar into a floating river was never considered before, and it was a very bold idea and intention. The river was supposed to be the connection between central Europe and through the Danube to establish a connection to the Mediterranean Sea. It was supposed to be one of the biggest transportation connections at that time. A very big port was planned at the south-east industrial area, from the left side of the river. This idea was never realized and was never mentioned again. In 1948, one of the main city arteries was starting to get built.

Partizanska Boulevard today is one of the busiest and widest streets in the city, taking the majority of the pressure form the city car and public transportation. The street intersects the site that I am working with, and it has a crucial importance in my thesis proposal.

The *seventh period (1963-1985)* – The year 1963 is the year that Skopje and its citizens will never forget. The most devastating earthquake hit and destroyed almost 80 % of the city. Around 150.000 inhabitants were left without their homes. The next period will become one of the most progressive periods in Skopje development ever known. The city plain becomes a tabula rasa,



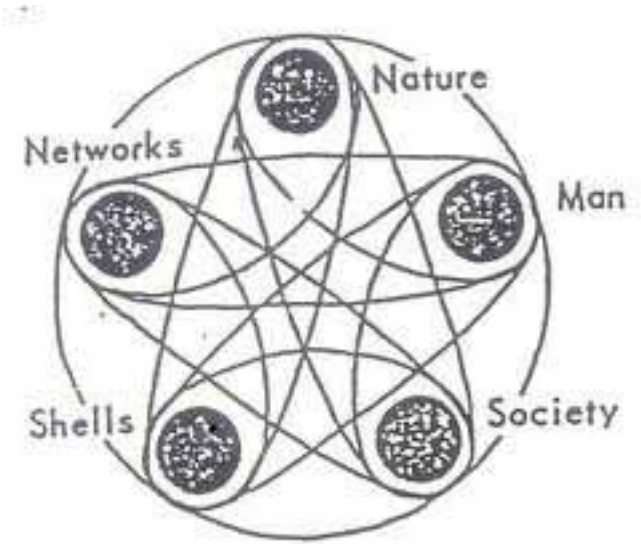


Image 9. Ekistics diagram

blank canvas, emptiness that needs to be filled. The financial help form the United Nations (*Skopje Resurgent*, United Nations Special Fund Town Planning Project, 1970), as well as the support that comes from the countries from all over the world, creates a perfect platform for a new beginning, a new rise of Skopje. If there was ever a chance to correct the mistakes from the previous modernistic planning, this was the perfect chance to do it. A a big effort was put into the new spatial organization of the city. An international team of planning experts was invited to give creative and efficient ideas for building the new-modern Skopje. They were supposed to give the right answers to almost all aspects of thenew urban plan. The plan from 1965 was led by the Austrian architect Adolf Ciborovski, a world-wide known expert in reconstruction of devastated urban areas.

The architectural design was left to a much known Greek architect and planner Konstantinos Dioxiadis, the creator *Ekistics*, the science of human settlements. For Dioxiadis, the residential unit(community) is the basic cell in planning the city, while man has central, most important meaning in the planning process. His research is based on constant monitoring and analysis of the human settlements, and the factors which influenced their shape, spatial organization and appearance. He analyzes the energy invested in movement and functioning of human settlements depending on their context and size. According to him there are five elements which contribute to achieving balance in planning: networks, nature, man, shells (buildings) and society. And five sciences which contribute to ekistics: cultural disciplines, economic sciences, social and technical disciplines as well a political sciences and communication.

Dioxiadis's contribution to the plan had a great importance since he put man and the living unit as a central point in the process of planning for the new city. During these planning processes were taking places, the people who were left homeless by the earthquake, were accommoddated in the new eighteen urgent settlements. The rest of them were brought back to their renovated or reconstructed homes. Some of these urgent urban settlements still exist today.

The Plan from 1965 does not express an architectural vision. It is an expression of a much needed reality. The city was in urgent need of fast rebirth. The plan took into consideration an area of 2.100 km2, a length of 47 km and width of 50 km. It was planned for more than 300.000 inhabitants, a number which exceeded fast in the following years. This was a quite big extension of the city borders than the previous periods, or a total increase in size of 40% than in the sixties. The plan for reconstruction of the city center is also of a great meaning and importance of how it influenced the city development.

Kenzo Tange, a Japanese architect(metabolist), and his team

won the competition. Tange's plan took into consideration the old historical part of the city and further emphasized the old but very important north-south axis. The City Wall is also another element which got realized and put a unique architectural and spatial feature, defining the city center. And finally the new train station was put on a different location, which connects Skopje with the region and Europe. One important note here, the vision of turning the river Vardar into a floating river wasabandoned, and very important decisions concerning the regulation of the river follow. I will explain that later, when I elaborate information about the river origin and its life.

The *eighth period* (1985-2000) – the city now becomes the capi tal of independent Republic of Macedonia.The planning processes stagnate, and the plan from 1985 had no influence on the overall concept of the city. The plan from 1965 was partially realized. Most of the projects were in the residential domain, answer to the pressure and the need of new dwelling space, as well as the intention to reach a certain density, to stop the city sprawl. The city borders change, the satellite settlements and small villages that surrounded the city, were now considered a part of Skopje. The city grew to a number of 444.760 inhabitants. The unstable natural conditions, the frequent occupations, and the constant change in the geo-political position of Skopje, proved to be essential for what Skopje is today. It was important for me at this stage to give a brief historical introduction of Skopje, because although I knew the certain specifics about the city development, I still needed to pay attention to and acknowledge the main reasons for the current situation.

SKOPJE

The River

Vardar exists for a very long time. The river was feeding the big lake which occupied the Skopje plain. The formation of the river goes back in the late quarter, the period of the last ice age on the planet. During that time important terra forming took place, when the big land masses from the south part of Balkan Peninsula or the land called *Egeida* sank into the Mediterranean Sea. Skopje Lake emptied its water into the Sea, forming the river Vardar and the Peninsula. The plain of Skopje turned into a big wetland area, and it was gradually drying and becoming a vast valley. Vardar tributaries were intensively eroding the remained lake material, focusing their stream into the lowest part of the valley, shaping the river.

Vardar was constantly changing the position due to the big quantity of the eroded material brought by the tributaries. It is believed that the edge of Vodno Mountain, the side facing the city, was the first original position of the river. It also meandered a lot, because of the flatness of Skopje valley. The river was searching for the lowest points, so that the water could go through.

It is believed that the river moved throughout the valley, a fact proven by the soil characteristics dug out underneath the city. Great quantity of gravel, fine sand and clay are found while digging out soil from the ground. Another fact which points out the before mentioned, is the high level of underground waters to a close proximity of the riverbed.

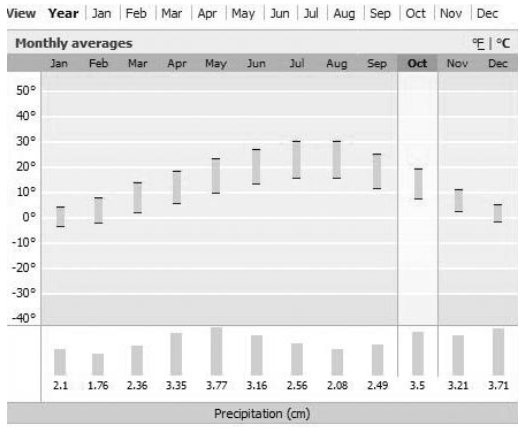
The river side before the regulation

View over the Stone Bridge during the flood - 19.11.1979

Vadar is historically known as a very dynamic river. Vardar today appears to be is a river which is one hundred percent controlled by man. During the past century there were two dams built on the tributaries, which had resulted to fewer or no floods at all. Floods hit the city quite frequently, in an interval of only several years in-between. At least three to five big flooding's occurred per century. The first one from 1778. The last one was right before the regulation of the river, in 1979. This one was one of the biggest floods that happened in the known history of the river, but the city center was not affected, due to the recent regulation of the river.

It was only the south part of the Skopje valley, the urban settlement of Madzari that felt the effects of the flooding.

Since 1778 until today it has been determined that around 15 floods had happened on the river Vardar. The majority of the floods happened in December, few in November and May. This of course coincides with the annual precipitation data. In the chart (Image 10.), it is clearly shown when the most rain- falls happen in Macedonia. The strongest floods were during 1962, and the one that happened 1979. The first one almost completely flooded the central city area, while the second due to the regulation done in the beginning of the seventies, prevented further flooding and damage to the central city area.



Monthly averages			℉ | °C
January	Avg low: **-4°**	Avg hi: **4°**	Avg precip: **2.1 cm**
February	Avg low: **-2°**	Avg hi: **8°**	Avg precip: **1.76 cm**
March	Avg low: **2°**	Avg hi: **14°**	Avg precip: **2.36 cm**
April	Avg low: **6°**	Avg hi: **19°**	Avg precip: **3.35 cm**
May	Avg low: **10°**	Avg hi: **24°**	Avg precip: **3.77 cm**
June	Avg low: **14°**	Avg hi: **28°**	Avg precip: **3.16 cm**
July	Avg low: **16°**	Avg hi: **31°**	Avg precip: **2.56 cm**
August	Avg low: **16°**	Avg hi: **31°**	Avg precip: **2.08 cm**
September	Avg low: **12°**	Avg hi: **26°**	Avg precip: **2.49 cm**
October	Avg low: **8°**	Avg hi: **20°**	Avg precip: **3.5 cm**
November	Avg low: **2°**	Avg hi: **11°**	Avg precip: **3.21 cm**
December	Avg low: **-2°**	Avg hi: **5°**	Avg precip: **3.71 cm**

Image 10. Annual precipitation and temperature chart

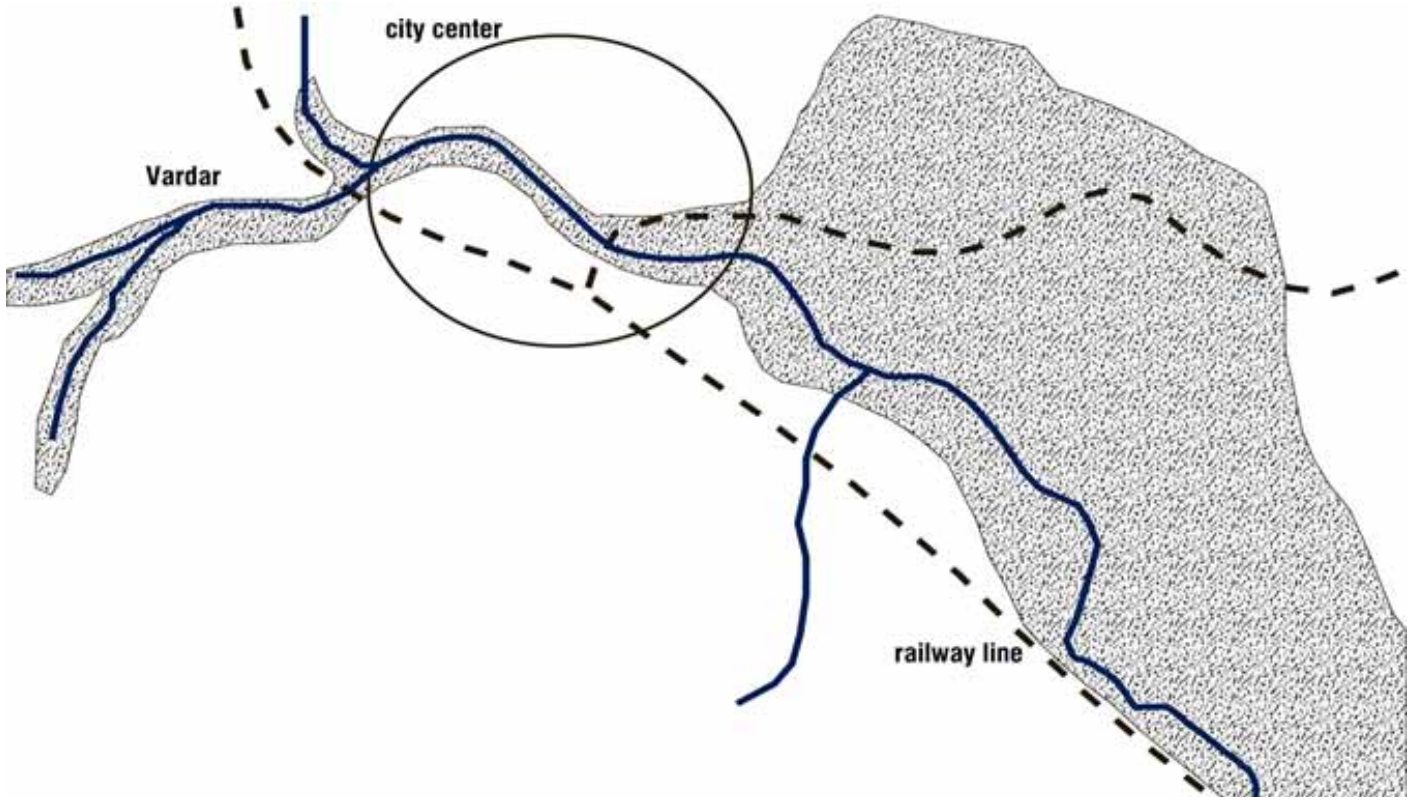


Image 11. Flooded areas, 1972

The floods have caused a lot of damage to the developed central city area. The land in the central city area is on a lower altitude than the river banks, due to the frequent flooding and the river material that has been transported during the floods.

The biggest morphological changes of the river body and flow through the city happened in the second half of the twentieth century. The changes were carefully classified in four periods:

1. *First period* until the earthquake in 1963, morphologically the river did not change and the river processes were natural.
2. *Second period* from 1963 until the beginning of the regulation in 1965. At this time the river body was changed dramatically.
3. *Third period* is the period of the regulation, when the river axis and its morphology were completely changed.
4. *Fourth period* after the regulation, when the river body is completely degraded.

The research about the hydrological and hydraulical behavior of the river was done by a Norwegian company - Nordconsult. They gave a proposal for the optimal profile of the river which initaially was supposed to be 35m, which differs from the 45m section that was built. For the hydrological analysis they used the peak of the flow as well as the peak of the flooding waves which happened previously in the sixties. With that analysis it is concluded that the river Treska, one of the biggest tributaries of Vardar, has 60% contribution to the big water flow of the river. That is why it has been decided to build a dam on the Kozjak Mountain, from where the river originates, and finally put a stop to the excessive flooding.

The project was started in 1968 and finished in 1974. While the project was being prepared, a great deal of the river flow in the area close to the park and up until the Vlae settlement (both close to the center of Skopje) was completely degraded and the high vegetation completely lost. This happened because of the frequent digging out and use of the eroded river material.

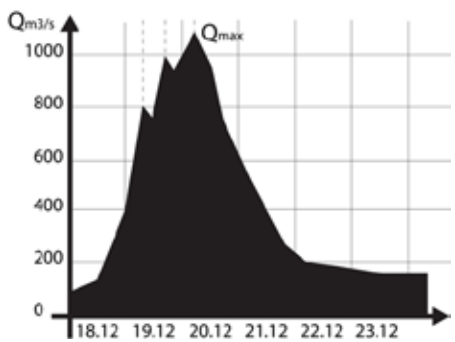


Image 12. Peack wave graph, 1972

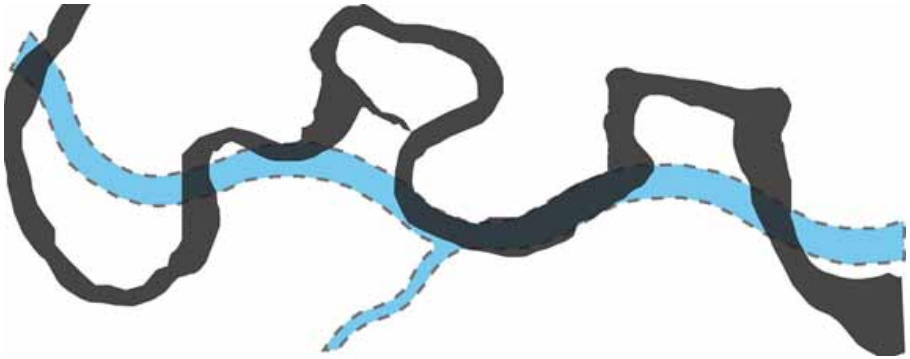


Image 13. Regulation fragment, situation from 1965

Image 14. Proposed sections 1. Section of the regulated river bed through the central city area, 2. Section of the river bed through the rest of the city

The sections proposed for the different areas in the city where the river is flowing through were from a trapeze shape for the minor riverbed, and rectangular for the major riverbed. In the center of Skopje a triple riverbed with double rectangular sections on the major riverbed was proposed. The minor riverbed was kept as a trapeze. The width of the riverbed on the overall city area is 45 m, except at the city center where it's widened at 62m, due to the four openings of the Stone Bridge.

The major riverbed in the center is built by concrete walls covered with stone. Beyond the city center the major riverbed has a trapeze shape, built by concrete cubes, placed on a concrete heel. With this very strong built of the riverbed, the further possible changes of the river flow were made almost impossible. Image 13. shows how the river flow meandered before the regulation, and a small part of the regulation project, showing how the river can be put completely into a strictly shaped riverbed. This solution made significant changes in the natural behavior of Vardar. Of course that it made improvements and stopping the further flooding of the city, but on the other hand, most importantly, it completely ruined the morphological, ecological, hydrological characteristics of the natural flow and life of the ruver. The loss of high vegetation, the exploitation of the river material as well as the continuous removal of the reoccurring vegetation on the already regulated riverbed, creates and opens up possibilities for other problems to occur.

The deformations on the existing regulated riverbed, are an ongoing process which also demands further and continuous research and investigation. How this effect the capability of the river to purify its own waters is another problem.

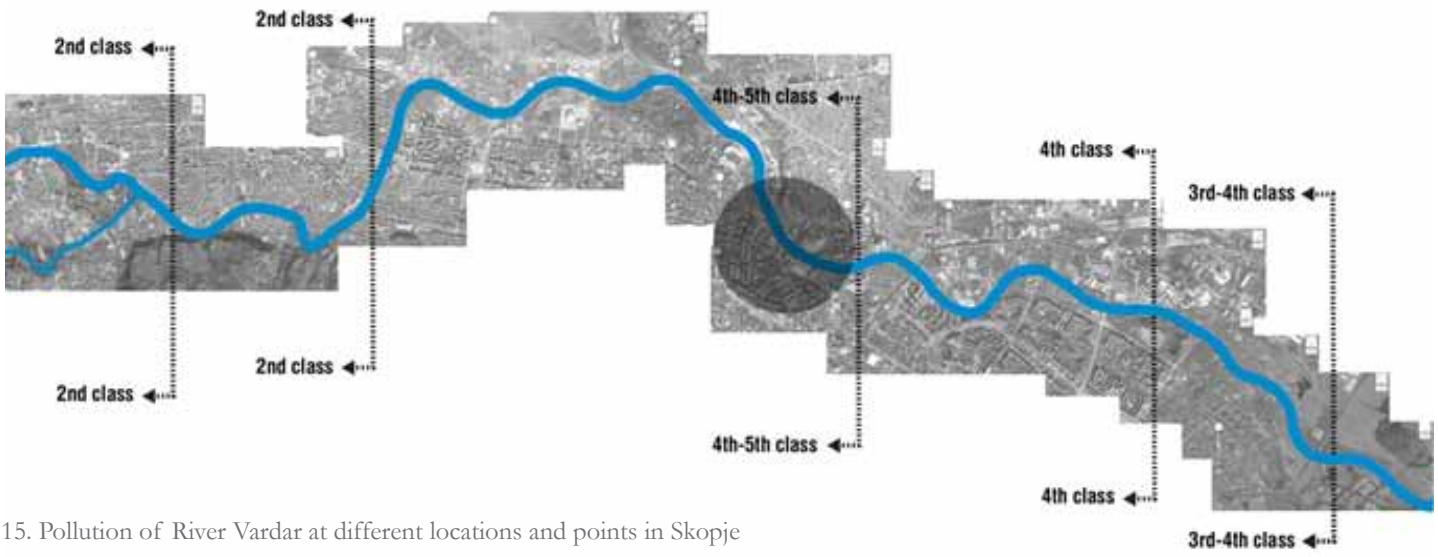


Image 15. Pollution of River Vardar at different locations and points in Skopje

	class 1	class 2	class 3	class 4	class 5
BOD (mg/l)	<2.00	2.04 - 4	4.01 - 7.01	7.01 - 15	>15

Image 16. Table showing the classification of polluted waters according to the quantity of BOD levels

The origin of the name Vardar derives Bardários from Thracian, meaning *'black water'*. In German, *schwarz* meaning 'black', Latin *suāsum*, meaning *'dirt'*. Also found in another name at the mouth of the Danube, Axíopa *'dark water'*, renamed in Slavic Crna voda *'black water'*. In Albanian, the word *'varda'* means a place where two creeks or rivers join together, or the joint flow of two rivers. The etymology of the name is unclear. The word is also an adverb meaning 'consecutively 'or 'actively' and may be related to its synonym 'varda'(whose dictionary definition also includes "freely" or "unimpeded") and the verb 'vardoj'/'me vardue', which means 'to work (extensively)'. The words may ultimately derive from the Indo-European root 'wer'- which is also the source of the English word 'to work.' *(Source: http://en.wikipedia.org/wiki/Vardar)*

The water of the river Vardar today is one of the most polluted river waters in the country and on the Balkan Peninsula. The pollution levels in the water vary at different points in the flow, but at times it reaches critical values. The pollution in water is determined by the presence of BOD or Bio dissolved oxygen. The higher the value of the BOD, the higher the pollution. There are five distinct classes of water pollution, dependent of the quantity of BOD (mg/l). So the main question is, where does all the pollution in Vardar come from. If we look back at recent history, Vardar was a river where people used to spend their summer days by, swimming and spending their time on the frequent beaches along the river.

Today that is almost impossible to happen. Image 15. shows the different pollution levels of the river while it reaches different locations in the city. Today when Vardar enters the city, the pollution level is class 2. The most polluted fragment unfortunately is in the center of the city, the water pollution reaches class 5, the most severe pollution level. So, what causes such sever pollution in only 2-3 km of flow through a modern and civilized city?

There is hardly any industry left to be kept responsible for any kind of discharge in the river. The agricultural areas are not that vast or significantly large so that they could be held responsible for it. So where is that pollution coming from? All the waste water is discharged directly into the river without any prior treatment or purification. So, in the case of Skopje, all the sewage and waste, along with the atmospheric runoff is being directly pointed into Vardar. For me the most interesting part is the part which causes the high pollution in the city center, and that is the waste being discharged from the settlements lying on the south-west part of the city. The river exits the city with a pollution of class 3, and gets its waters purified along the natural unregulated flow until it reaches the city Veles where it again becomes a collector of all the sewage discharge of differ-

In the past the river offered people vibrant socal life and activities. There were a number of beaches throughout the flow within the city limits.

ent kinds of sources, with the residential discharge having the leading role. In this project I will remain focused on the case of Skopje and the above mentioned settlements that cause the dramatic river pollution in the city.

Unfortunatley, today we shower next to the river!

What is my thesis?

'Cities can operate as mindful gatekeepers of a critical resource.' - Martin Felsen, Urban Lab

Image 17. Overall city strategy, placement of 'eco-boulevard' systems along the city topography

What if the city can clean its own waste water? Is that really possible?

The city consists of seven municipalities. All of them originate from different periods from the city development. The borders of the city also changed frequently, and with that the overall area and city density changed accordingly. It seems since the seventies the city density has decreased than previous years. This is due to the growth of the city area. The densiest part of Skopje is the center, where all the important cultural, public and service institutions are placed.

Image 17. shows a graphic concept diagram which represents a way of thinking of how the city can be divided in parts which could used as areas for waste water purification.

There is not even a single waste water processing plant built along the flow of the river in Skopje. According to the plan form 1965, there were supposed to be two waste water processing plants, built on each end of the river at the point where it is exiting the city. Two big sewage water collectors were supposed to be placed along the southern and northern bank of the river, and take the collected sewage to the waste processing plants. The clean processed water was supposed to finish in the river. Aulthough this seemed to be a very good idea, it unfortunately lacked the investment, and to build such facilities turned out to be unrealistic for the time being, when the whole city was being rebuilt and reconstructed after the devastating earthquake.

The city topography as well as the infrastructure positioning and urban development allow a simple way of rationalizing how to deal with the problem. The longitudinal spread of the city as well as the orthogonal street pattern, create a very good base for identifying and proposing a pattern of spaces where waste water can be handled. The handling of the waste water will be done by an efficient ecological system of microorganisms, bacteria and plants, system called *Living Machines*. These living machines can be placed in buildings as well as the available landscape. From these treatment facilities the treated water will be released into the public urban space, in an appropriate infrastructure which will bring new urban space qualities.

The storm water system in the city today is handled in two different ways. In most cases the storm water pipes are independent system and most of them are directly connected with the sewage pipe system, and with that, adding additional pollution to the sewage waste water. In my design proposal, the intention is to create a separate storm water system to collect, ecologically purify and cleanse as well as slow down storm water runoff. This can be handled by the system called Bioswales.

They can be applied along street ends or street sides, where normally outlets for draining the storm water are installed. The slope of the street can be used to lead water by gravity into the

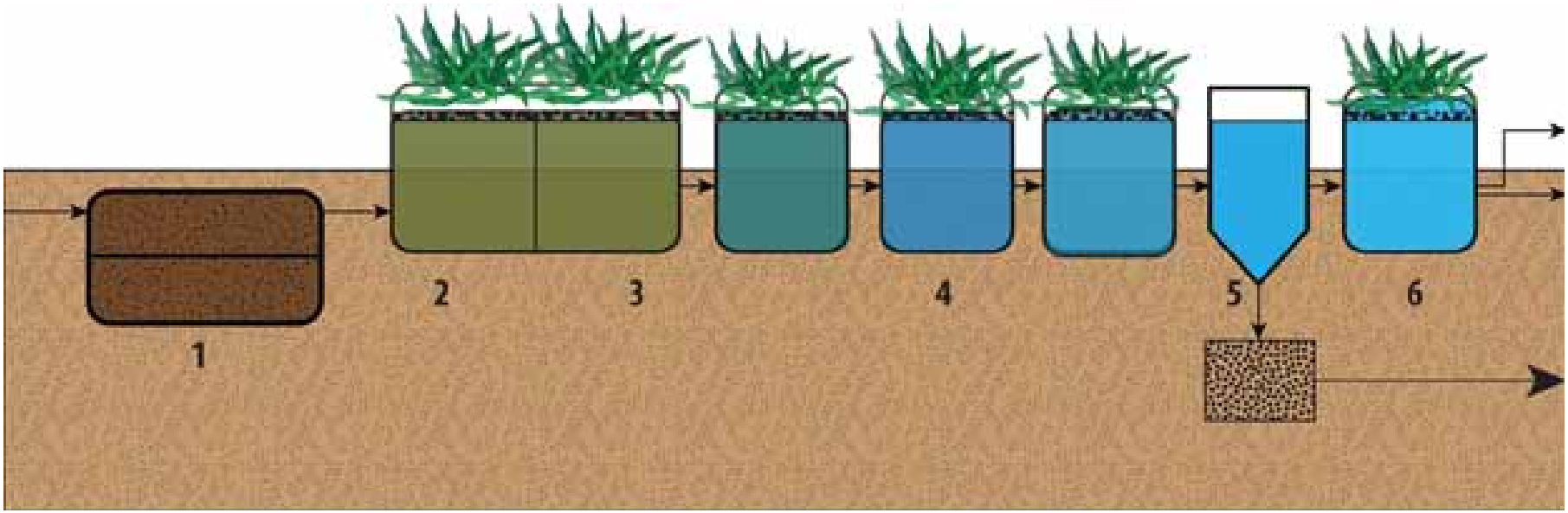


Image 18. Living machine functional diagram

bioswale, and this water can flow into an opened storm water canal or a wetland system for further purification, before being released in the river.

For a better understanding of these systems, I will give a short introduction and explanation how they systems work and how they can be applied.

The Living Machine

The Living Machine is an ecological wastewater treatment system that treats wastewater for re-use – allowing communities or institutions to locally manage wastewater, create high quality reuse water, avoid sewer hook-up fees while dramatically reducing water and energy consumption and their associated costs.

'Water is scarce and as a result, the cost of water is increasing. Rather than expend the energy and dollars to transport clean water many miles to your location, only to pump it out and send water again many miles away for sewage treatment, the Living Machine allows for onsite, local water recycling, producing fresh water for irrigation, toilet flushing, industrial processes, washing equipment or animal areas, filling landscape water features(i.e. fish ponds) and other uses. This cost-effective water reuse solution can part of a green design and water saving strategy for institutions and communities.'(The Living Machine® Wastewater Reuse Technology, Worrell Water Technologies).

The living machine consists of:

1. Anaerobic reactor -

It's the initial first step in the process. Covered and buried below ground, it reduces concentrations of BOD5 and solids in the waste water prior to other treatments of the waste water in the later treatment. This is the primary sedimentation basin which provides surface area for anaerobic bacteria colonization, which helps digest the solids. The sludge created in this basin is later removed through pipes on the bottom of the reactor.

2. Anoxic reactor -

Controlled aeration prevents anaerobic conditions to appear. It encourages growth of floc-forming and denitrifying microorganisms to remove significant levels of BOD5. This is managed by a coarse bubble diffuser which blowing bubbles of oxygen inside the reactor. The top of the reactor is covered with a 'control device' – a planted bio filter.

3. Closed aerobic reactors -

It reduces the dissolved waste water BOD5 to very low level; it removes odors and gasses and stimulates nitrification. There are bubble diffusers which provide aeration and mixing. The odor control is achieved by a bio filter on the top of the tank.

4. Open aerobic reactor

The reactor is covered by vegetation supported by racks. Aera

tion is also existent here created by bubble diffusers.

The plants provide a surface area for microbial growth, to preform nutrient uptake, and serve as habitat for beneficial insects and microorganisms. They further reduce the BOD5 levels and complete the process of nitrification.

5. Clarifier

The clarifier is a settling tank where the remained solid are separated from the treated wastewater. The solids are later being pumped back to the closed aerobic reactor or transferred to a special holding tank and later removed for disposal. The surface of the clarifier is covered with duckweed, preventing the growth of algae inside the reactor.

6. Ecological fluidized beds (EFB)

Here the final treatment of the wastewater is being done. They reduce the BOD5 to minimum so that the treated water meets the final effluent requirements. It consists of inner and outer tank, contains crushed rock, lava rock, and shaped plastic pieces. The wastewater flows in to the EFB in the annular spa ce between inner and outer tank, and it gets raised by airloft pipes to the top of the ring that contains the media.

The unit serves as a fixed bed, down flow, granular media filter and separates particles matter from the water. The microorganisms that occupy the granular media surfaces provide the final nitrification reactions. When sludge collects on EFB, it reduces its ability to filter. They will eventually clog the filter. Therefore additional aeration diffusers beneath the gravel are periodically turned on to create an up flow airlift reverses the flow direction. After all these processes, wastewater should be suitable for surface discharge or a subsurface disposal system, or reused for landscape irrigation, toilet flushing, vehicle washing and etc.

The current centralized large scale systems require a lot of energy. The water is used only once before sending it downstream and the water gets treated up to drinking standard regardless of the intended use.

The Living Machine is an ecological model of approach. It's a decentralized system with local economic and ecosystem needs local water reuse, and adaptation of ecological wastewater treatment processes. This system is suitable model for the future, considering the new upcoming issues: climate change, energy consumption and water shortages (crisis) and economic strength. This system reduces the need for long distance piping infrastructure pumping and etc. *(Living machine information extracted from: Office of Water, EPA 832-F-02-025(October 2002),Wastewater Technology Fact Sheet/The Living Machine®, United States Environmental Protection Agency, Washington, D.C. 20460 Retrieved from: http://water.epa.gov/scitech/wastetech/up load/2002-_12_13_mtb_living_machine.pdf)*

Storm water management on site

Currently in the city the storm water system is handled in two ways. Parts of the city have a separate storm water pipe network piping and in some parts it is connected with the sewage pipe network. I couldn't find the correct organization and the original layout of the storm water system, but fortunately I have relevant information regarding my site. Through the middle of my site there is an existing covered canal which collects the storm water runoff from the surrounding streets.

Image 19. is showing the current condition of the storm water canal from the point where it's uncovered and meeting the river. Due to the built of the new shopping mall, recently a part of the canal was dislocated and moved towards and underneath the nearest street. That section of the canal is rebuiltin a concrete bed 2.5m wide and 2m high. It is still collecting the storm water runoff. The canal is still opened right after the last building - the City Tower. Image 20. shows the relocation area.

Next to it there is the representation of my intention of collecting the storm water runoff from the small neighborhood streets, and cleaning it through installing a system of bioswales, which serve as biological filters. Image 21. shows the way that

Image 19. Existing open storm water canal

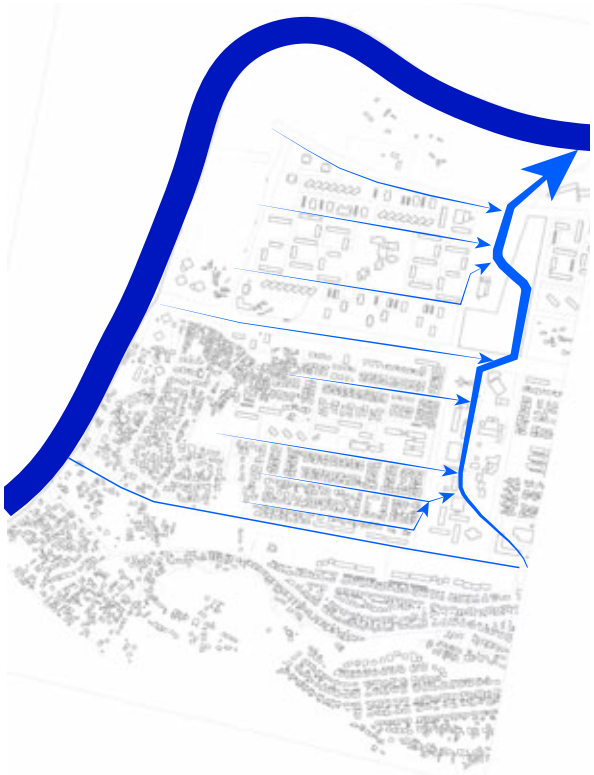


Image 20. Existing storm water canal

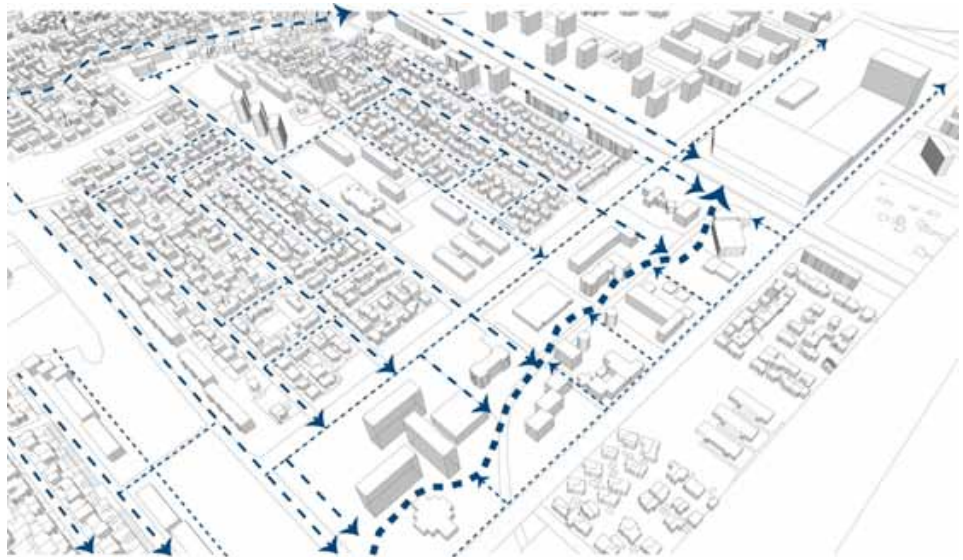


Image 21. Proposed storm water management diagram

they will spatially fit into the existing neighborhood street infrastructure. The bioswales purify the runoff by eliminating particles, biological and chemical effluents from the runoff.

My intention in the project is to reopen almost the full length of the canal which runs through the first par of my site area, up until the point when it reaches the big boulevard. This canal will be the storage for the filtratrated and transported storm water from the streets. The canal will also provide irrigation for urban farming vegetable production. The rest of the water will flow towards the river. The part under the street will stay covered. It will get reopened again right in front of the *City Tower* building, in the part where I propose the Urban Park area, which spatially continues after the street, leading directly towards the place of entrance of the canal into the river.

The Bioswale

'A bioswale is a vegetated depression that treats stormwater run-off from nearby surfaces such as roads and roof tops. Although similar in appearance to a ditch, a bioswale differs in that it is designed to convey water at a slow speed. Slowing the water enables some of it to infiltrate into the ground, and it also allows solids (dirt and pollutants) to settle out of water that does not infiltrate trough infiltration and settling of solids, a bioswale helps improve the quality of stormwater before it enters nearby streams.

The function of these open canals or dranageways is to convey stromwater runoff. They are often used as an alternative to, or an enhancement of, traditional stromwater piping. Bioswales are often integrated into parking lots and road medians and parallel to roadways to infiltrate and treat a portion of the storm water volume (http://www.cityofsalem.net/Departments/PublicWorks/Operations/StormwaterServices/Documents/sw_bio_03-bioswale-sign.pdf)

'Normally there are two types of bioswales. The dry bioswale provides quantity(volume) and quality control by facilitating stromwater infiltration. Wet swales use esidence time and natural growth to reduce peak discharge and provide water quality treatment. The wet swale typically has water tolerant vegetation permanently growing in the retained body of water. Swales are most effective when used in conjunction with other IMPs, such as bioretention basins and infiltration trenches.'(Florida Field Guide to Low Impact Development, UF, University of Florida, IFAS Extension)

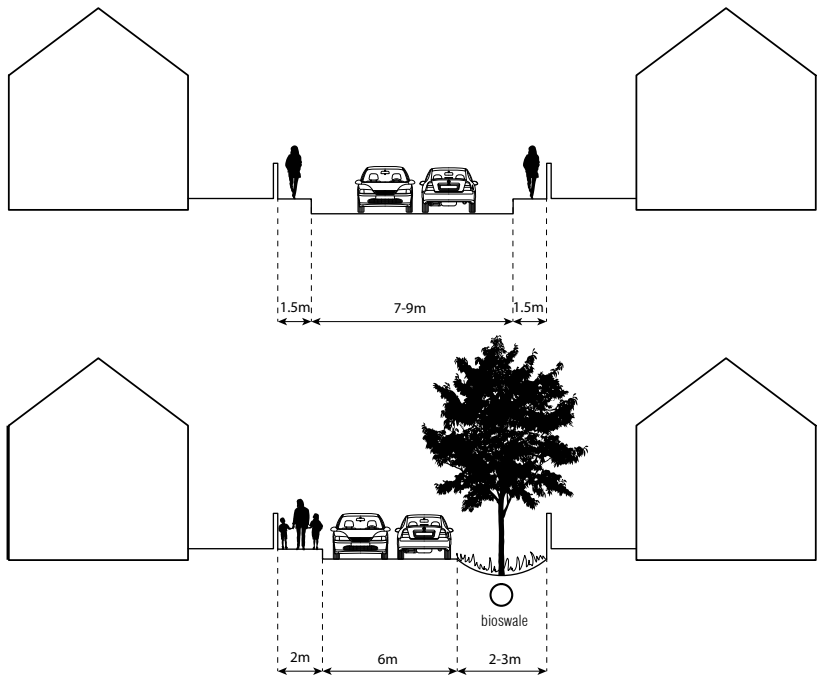


Image 22. *1.* Existing neighbourhood street profile, *2.* Proposed neighbourhood street profile

Image 23. Bioswale

Bioretention swale consists of two components. A swale component which provides a pretreatment of stormwater, and a bioretention component which removes-flters finer particulates and contaminats.

Bioretention swales filter processes:

1. Passing through the surface vegetation
2. *Percolating* through filter media (provides treatment through fine filtration, extended detention treatment and some biological uptake)
3. Disconnecting impervious areas from downstream waterways,
4. Providing protection to natural wetland systems from frequent storm events by reducing storm flow velocities when compared to pipe systems.

There are many benefits from using these stromwater treatment systems:

- They treat water quality using soil, vegetation and microbes, - they reduce the total volume of stormwater runoff (slow down storm water).
- They increase infiltration and groundwater recharge.
- They are a multifunctional conveyance system, and are an aesthetic part of the landscape and improve the biodiversity.

The residential sewage is constantly increasing the level of pollution of the river. The pressure put on the river to purify itself during its natural flow is also growing. The regulated flow also doesn't help the self-purification process. So, something has to be done in order to stop this constant pollution. The water purification is an important but very expensive process.

The conventional water purification plants are enormous energy consumers and they require vast space for water to rest and get enough oxygen. They are a large scale centralized systems and the technology used for purification is costly and chemicals are also involved. In order to provide a better solution, it is logical to propose a more fragmented(decentralized)approach and a new model which will contribute to sustainable water purification. This model will integrate with the local possibilities and will adapt on the local sewage network. It will integrate with the local economic and ecosystem needs. The model will provide water purification and reuse that can generate creation of new active landscapes within the area where it is applied.

The city positioning, the urban morphology, as well as existent built environment allows a possibility for placing and building this ecological model for treating waste storm water produced every day. The non-places, large in-between spaces, big parking lots, wide street profiles, free un-built spaces by the river become spaces of great importance and a platform where the model can be applied. They will be linked in a recognizable system, and will contain technological and functional program which will enrich the urban experience.

The street system clearly shows the positioning of the clean water distribution, sewage, storm water, and heating network. All these piping systems are organized underneath the street.
The new model for water purification that I propose classifies the streets in three categories.

1. *Transporting streets* (smaller neighborhood service streets which are used to collect and transport the sewage towards a bigger collector street od collecting tank)
2. *Collector streets* (under which collecting tanks are installed where sewage water sits and gets purified in the near surrounding ecological facilities)
3. *"Eco boulevards"* (streets which transport the purified water through a canal system towards the river)

The street positioning in relation to the river is very important. The smaller streets which run parallel to the river (this also depends of the topography), are serving as transporters, which is already their current use. The bigger (collector) streets which run perpendicular to the river, become the Eco boulevard street, which neighbor the ecological facility and transports the clean water in a newly designed canal. As an element, the canal is a new part of the street infrastructure in the city.

Image 24. Existing city street network

Image 25. Fresh water supply system

Image 26. Proposed street hierarchy

Image 27. Sewege pipe system

Images 24 and 26 show the intention how the streets can be classified on a city level. The overall city strategy depends on many factors:

1. *Topography*
2. *Street network layout*
3. *Spatial characteristics*
4. *Density*
5. *Location of site in the city*

These factors will influence the application of the general characteristics of the local model. The city is a very complex structure which consists of many functional layers, and adopting one unified strategy can often be a very difficult task. Image 30.(page 51) shows the different urban patterns developed during different periods of time, each of them having a distinct spatial organization, area, density, urban form and urban qualities. They all demand a specific research and approach which can result in different modifications in the ecological model functioning and spatial appearance. That is why I decided to choose and apply this ecological model of cleaning waste water in a specific site in the city. The site specifics will determine the original design of the model. As a result, the identical design could not be applied in a different site area. That could be the subject of a totaly different research. But that is also the beauty of it. Only the general characteristics must remain as design guidelines.

The site is located on the west side of the city center. There are three imortant street arteries cutting through the site area. Its accessible for pedestrian, car traffic and its very well covered by public transport. Several main city bus lines pass through. Recently a big shopping center elevated the importance and attractivness of the site for Skopje citizens. It's now one of the most visited locations in the city. Some of the streets were reconstructed, widened so they could sustain the expected pressure of visitors of the shopping mall. The two parallel streets which determine the site area were positioned in 1965. This piece of land was supposed to be a wind channel or air circulation channel from the mountain to the river.

Residential buildings dominate on site. Most of the buildings were built after the big earthquake in 1963. The first part was an urgent settlement, populated by people which lost their homes in the earthquake. The urgent settlement consisted of baraks, a Swedish donation for the city. Today most of them are replaced by single family houses, majority have keept the same built area within their plot.

The second part of the site was built after 1965, mainly by residential blocks and towers floating on vast green areas (modernistic approach).

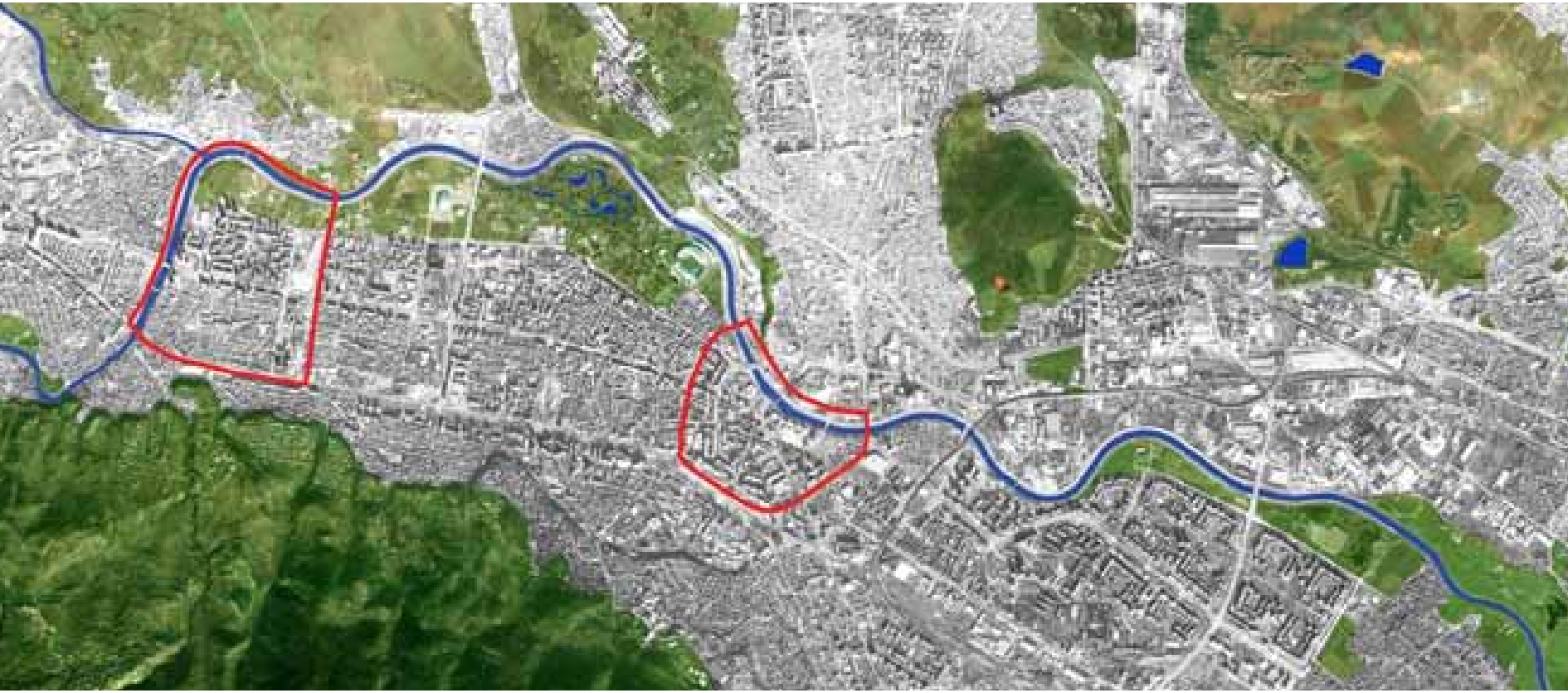


Image 28. Location of the site in the city

What is my proposal?

The water on site is mainly used by the residential users. It is used for domestic purposes like washing, cooking, toilet flushing etc. After it's used it is directly discharged and transported into the river throguh sewage collecting pipes without any prior treatment.

My proposal concentrates in the solution of widening the distance between user of fresh water and the discharge of waste water. The aim is to transform the linear short term use of fresh water into a cycled process of treatment and reuse, through which waste water gets treated, reused and released.

Main goals of the proposal:

- To stop pollution of the river from sewage waste water
- To clean waste water with installed Living Machine facilities
- Through the design proposal to intensify social life on the site
- To create biodiversity by planting more greenery, installing green walls on green houses, planting new trees and plants which will support and diversify the natural habitat(insects, birds etc)
- To create a better microclimate (reduce heat island effect) through eliminating paved sealed surfaces by proposing permeable pedestrian paths, by redefining the street profile, by applying more green surfaces and green roofs on buildings which allows activating the existing, as well as the new buildings in storm water collection. The proposal suggests more opened water surfaces which will also affect the local microclimate(air temperature, humidity).
- To encourage urban farming by proposing facilities on the flat roofs on available exiting buildings (super markets, sport halls and etc..)
- To involve students to actively participate in the process of maintenance of the food production as well as living machine green houses by getting certain benefits.
- To encourage and stregthen the local economy by making use of the living machine produced biogas, for possible production of electricity, and the additional heat by which the existing pressure on these resources will be released.

In order to provide a better solution, it is logical to propose a more fragmented approach and a new model which will contribute not only in water purification but will contribute to theclimate changes issues and the economic strength.

This model could integrate with the local possibilities and could adapt on the local network. It will try to integrate with the local economic and ecosystem needs. The model could provide water purification and reuse that can generate creation of new active landscapes within the area where I gets applied.

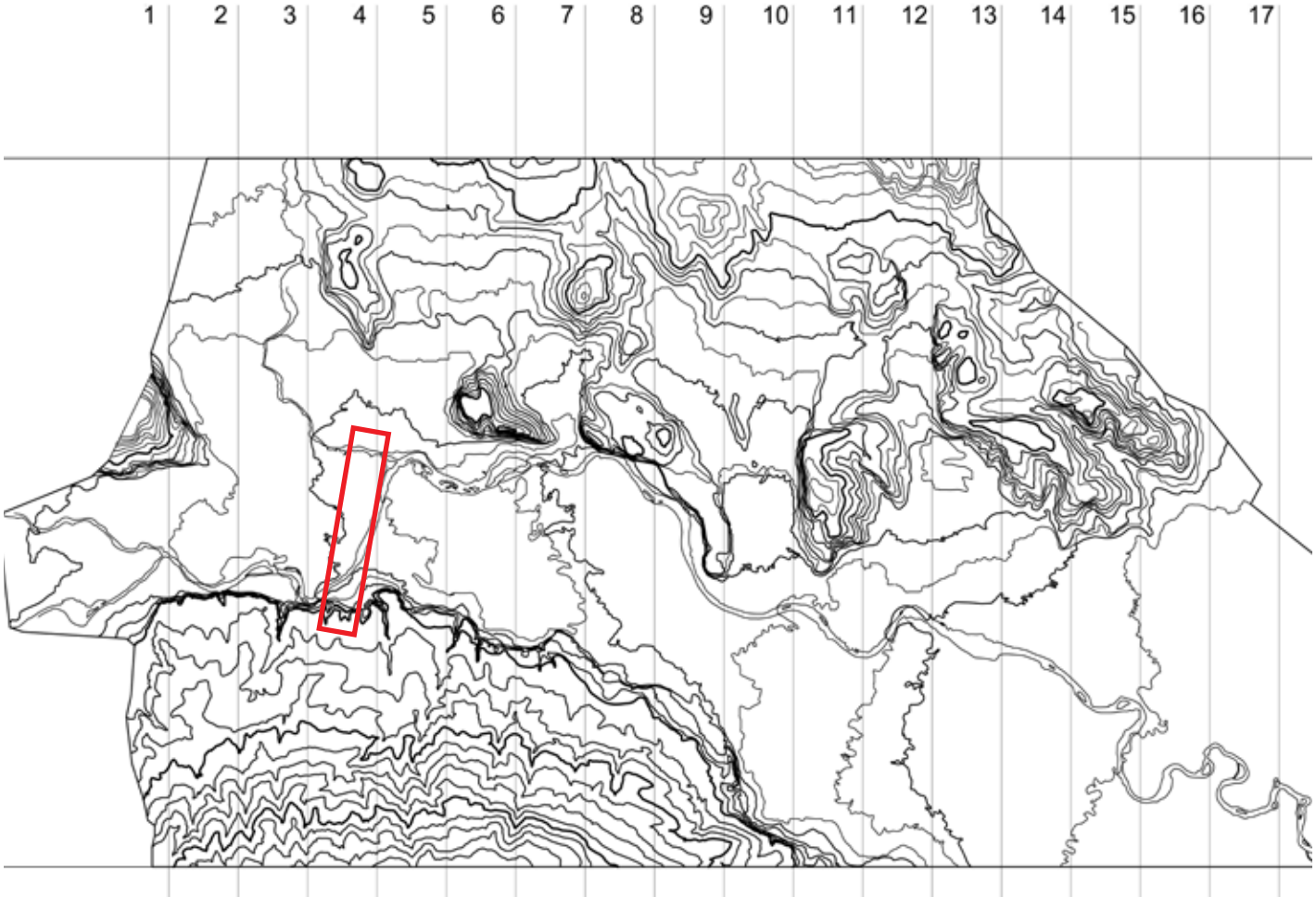


Image 29. City topography

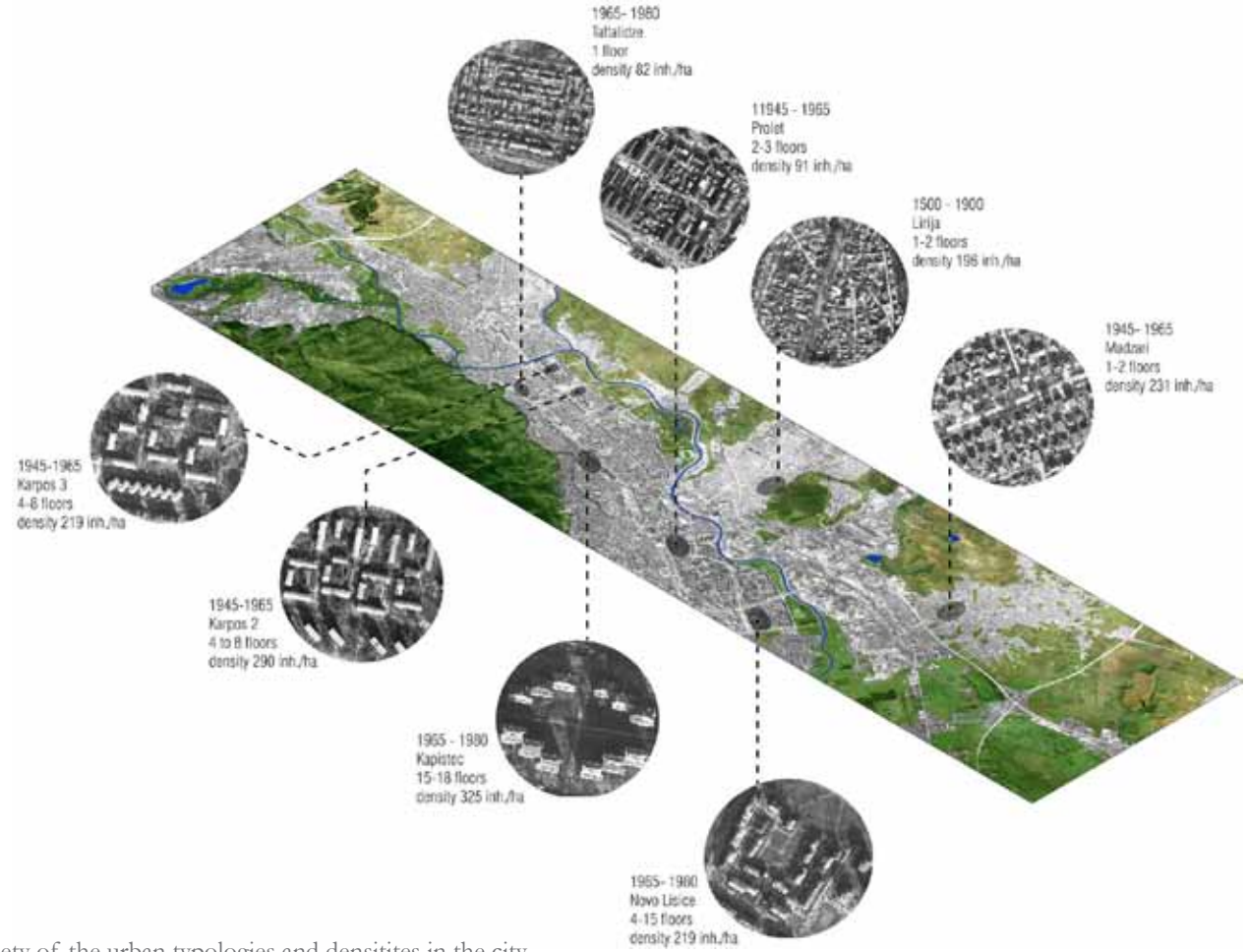


Image 30. Variety of the urban typologies and densitites in the city

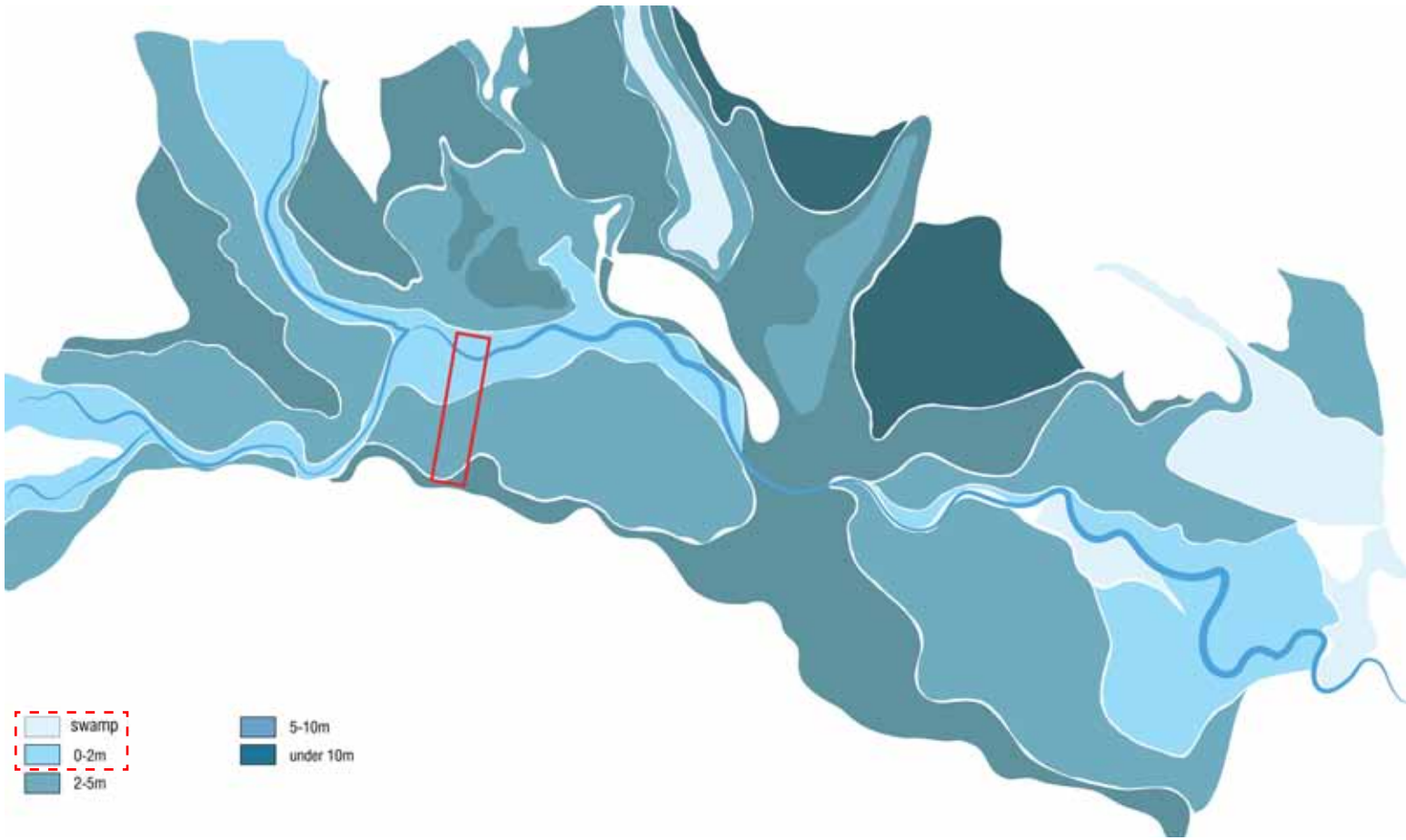


Image 31. Levels of underground water

Image 32. City startegy diagram

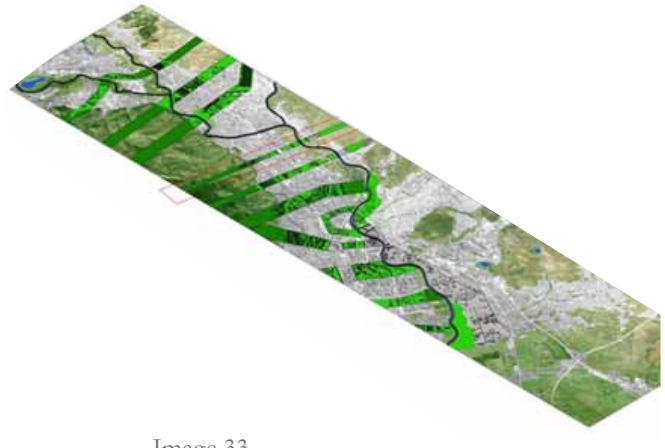


Image 33.

Image 34.

Image 35. Site layers analysis: 1.Street network 2.Pedestrian movement 3.Functions canal

4.Densities 5.bus stops 6. Storm water canal 7. Available space 8.Entrances 9.Storm water

Site photos

Image 36. Main moves in the proposal: 1.Principle 2.Street calssification 3.Availale space 4.Zoning 5,6. Proposal space definition 7. Storm water managment

Important note about my research:

The information regarding the averige daily fresh water usage quantity per person, as well as the dischage of residential sewage in Skopje varies in different literature resources that i have found. Because of it I decided to contact professionals who are familiar and work with this problematic.

Unfortunately all the officials and professionals I have contacted regarding this matter were unwilling to take any responsibility for giving any official information about the river pollution levels, and the responsible sources for the polluton. I cannot reference them here as relevant sources, although I find them and their input quite useful and helpful for my project.

In the beginning, I collected general information about the river pollution levles in Macedonia from the 'The study of Integrated Water resources Development and Management Masterplan in the Former Yugoslav Republic of Macedonia', made by the Japan International Cooperation Agency, thanks to the professor Petko Pelivanoski who unseflishly shared it with me.

I privetly knew a person who had worked in 'Vodovod i Kanalizacii'-Skopje, company in charge of providing and maintenance of the freshwater and sewage infrastrucutures in the city. She gave me information about the daily water usage per person in Skopje. I decided to use that information as relevant for the calculations which were crucial for dimensioning the capacity of the proposed water treatment system.

The information about the river pollution levels thorugh the city I have extracted mainly from the book 'Vardar River through Skopje' by Zhivko Shoklevski , dating from the year 2000. That indicates that the current situation is most probably different. It is good to give an indication about the liability of the infromation that I have used in my project. I decided that I would rateher use information that has been offcially published, than information that has been provided over the phone by a person who is not willing to be referenced. Part of the information about the fresh water users and the number public sewage users I extracted form the 'State environmental statistical report' from 2011. Althooguh there was precise data on the industrial water usage and industrial water discharge, they were unable to include the information regarding the situation on the residetial sewage quantity, treatment and areas of discharge.

It was important to mention the sources which denied to be referenced but were relevant for the research, as well as the decisions I made about how to calculate the quantities of sewage water produced on site. So, finally I took an averige number as relevant for the calculations. Based on that I beleve that my proposal provides the required capacity for the sewage treatment for the site area.

At this point I cannot reference the historical maps and old city plans, since the person who provided them to me prefered not to be referenced as the source from which they originate.

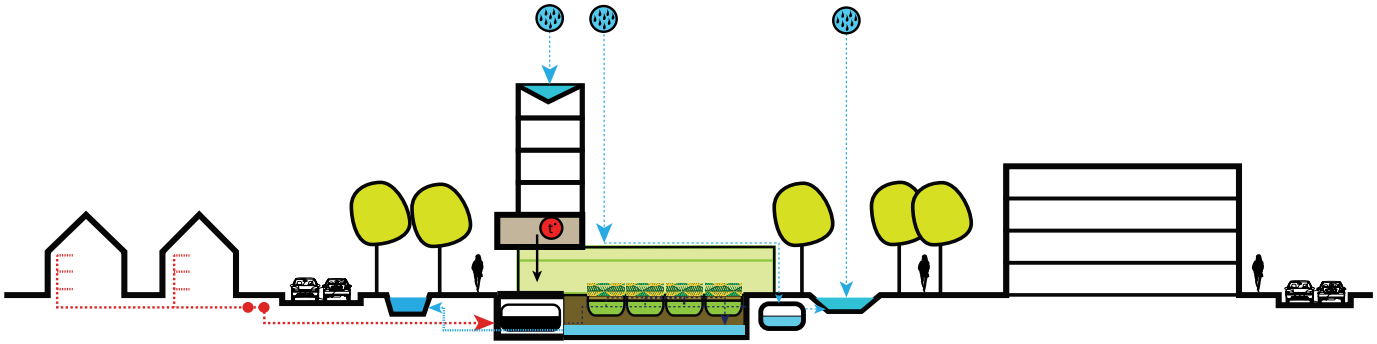


Image 37. Section principle

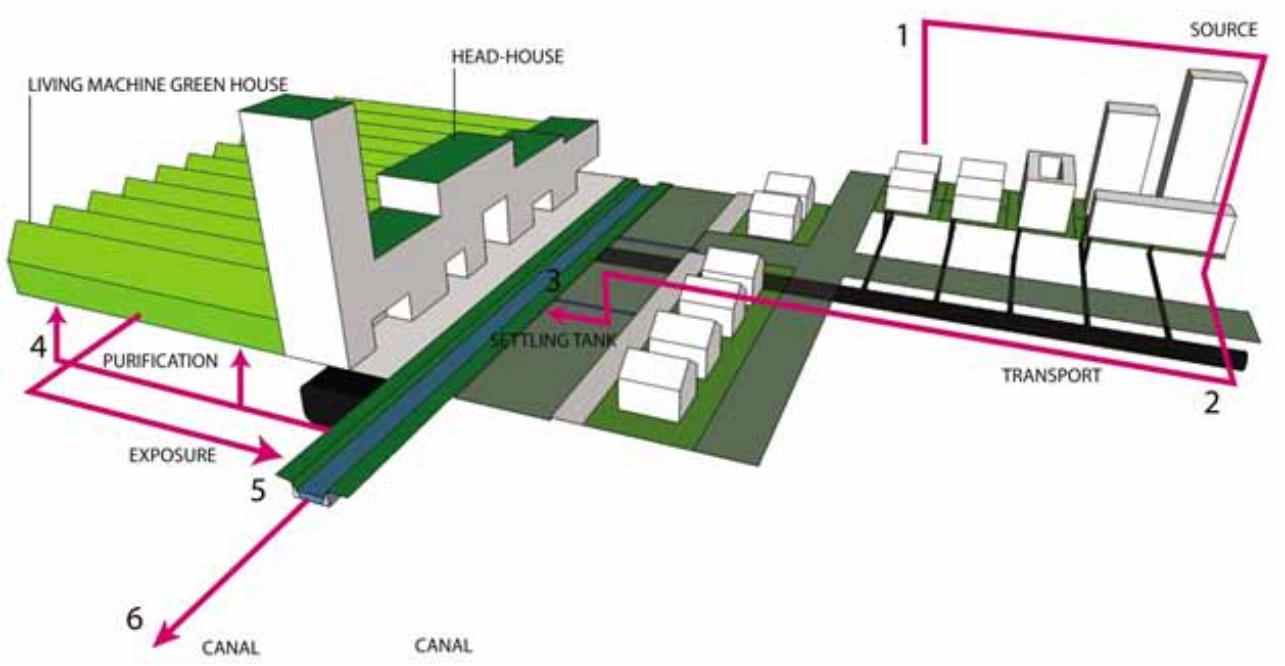


Image 38. System componnts diagram

Proposal - How do i do it?

First I identify the source of sewage water and the possible place for the installation of treatment facilities – living machines (figure1, page58). Then I classify the streets which will collect and transport sewage water, and the streets which will deliver treated water towards the river (figure2, page 58). It is very important to see how much space is available in relation to the existing buildings; so that I make sure I have enough space to import the new treatment facilities (figure 3, page 58).

I divide the site in separate strips, each of them carrying different functional purpose (figure 4, page 58). The first strip becomes the space for the installation of collecting settling tanks. Second strip is treatment (living machines), third is the uncovered storm canal area, being transformed into a nice urban park area, the connective thread through the site.

And the last strip is where it is possible to densify, accommodate underground parking facilities, which will be needed in order to make available space for living machines installations. The current parking space areas on ground levels will be transferred in underground parking facilities in this last strip of the site.

How does the system function?

Technical components of proposed waste water treatment system on site:

1. *Source* - Sewage water producer, areas where the waste water originates from.
2. *Transport and collection* - Collecting pipes and tanks for sewage water (under head house).
3. *Treatment* - Areas available for landscape or building facilities for treatment of sewage water (living machine greenhouses)
4. *Reuse* – Grey water and irrigation (cycled process).
5. *Exsposal* – Possible areas for exposure of treated waste water on open air (opened canals and ponds)
6. *Discharge* – Areas of discharge of cleansed water (river)

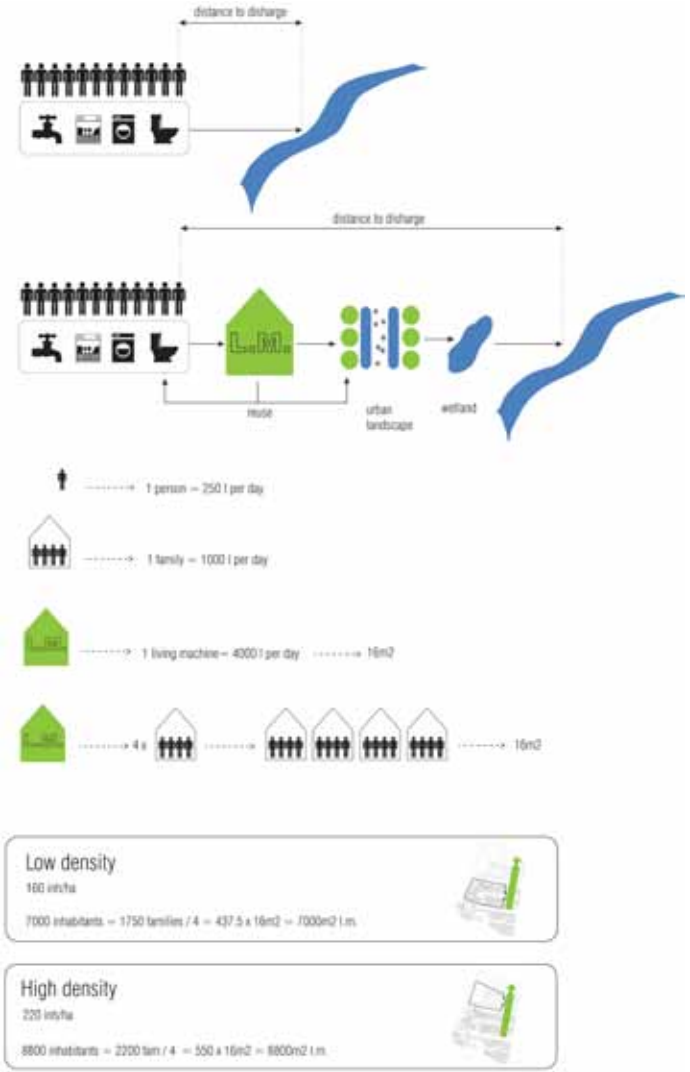


Image 39. Calculations for dimensioning the system capacity

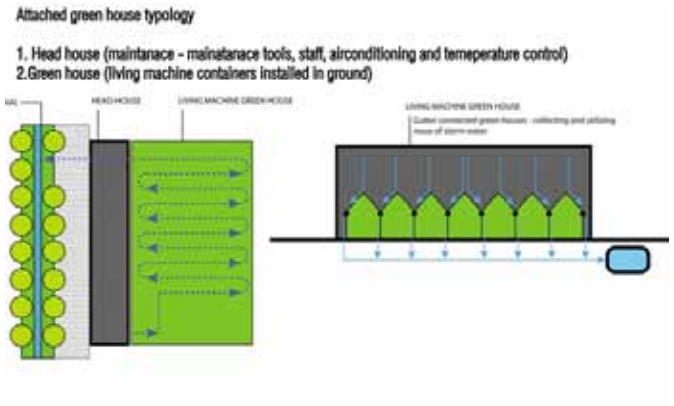


Image 40. Proposed green house typology

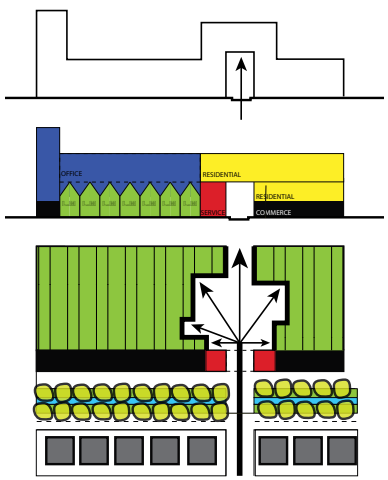


Image 41. Formation of activated landscapes

The three main system elements are :

1. *Head house:* A long building which stretches through the whole length of the site, the building offering space for the maintenance facilities providing the needed power for air conditioning the green houses. It is also a mix-use building which forms a continous but vibrant street façade.
2. *Living machine Green houses:* Skopje has a very drastic temperature changes during the seasons: summers are extremely hot, temperatures can get up to 45 degrees. As for the winter period, the temperatures sometimes drop to minus 25 degrees. For this reason, I place the living machine tanks in air conditioned green houses, where temperature is maintained in desirable level at all times. The green houses are attached to the head building, at times visible through the opened ground floor of the head building, so that people can actually see the cleaning process. They are also publicly accessible facilities. In cases they can get attached to an existing building, making sure that they don't block an entrance or a opening in the façade. Their height, as well as spatial composition might change.
3. *Opened canal:* This represents a new element in the street infrastructure. The canal takes the cleaned water from the living machine, and using the topography of the terrain, the water flows through it towards the final destination – the river. At the end of the site, just before the canal. A system of opened wetlands is installed in the free space beteween the existing boulevard, and the existing pedestrian path by the river. This is the final step in the purification process where the water is getting more oxygen before flowing into Vardar.

Treatment and Design

The sewage water from the collecting tanks installed under the head house is pumped to the living machine tanks which are placed in the ground of the available existing landscape. The cleaned water than gets released in two places. One part goes to the canal which takes it to the wetlands and then to the river, and other part of the water remains for reuse purposes.

The green houses are supposed to adapt between the existing buildigs on site. They are going to be installed in a way that they do not block movement, enclose certain areas as spaces where part of the living machine water will be exposed and stored for irrigation purposes. These openings coincide with the direction from the existing neighborhood streets perpendicular to the site. The openings lead to spaces which are a natural continuation of the movement from the streets whichlead towards the site and are allowing a passage through to the other side of the site. The openings serve as gates to the active landscape "pub-

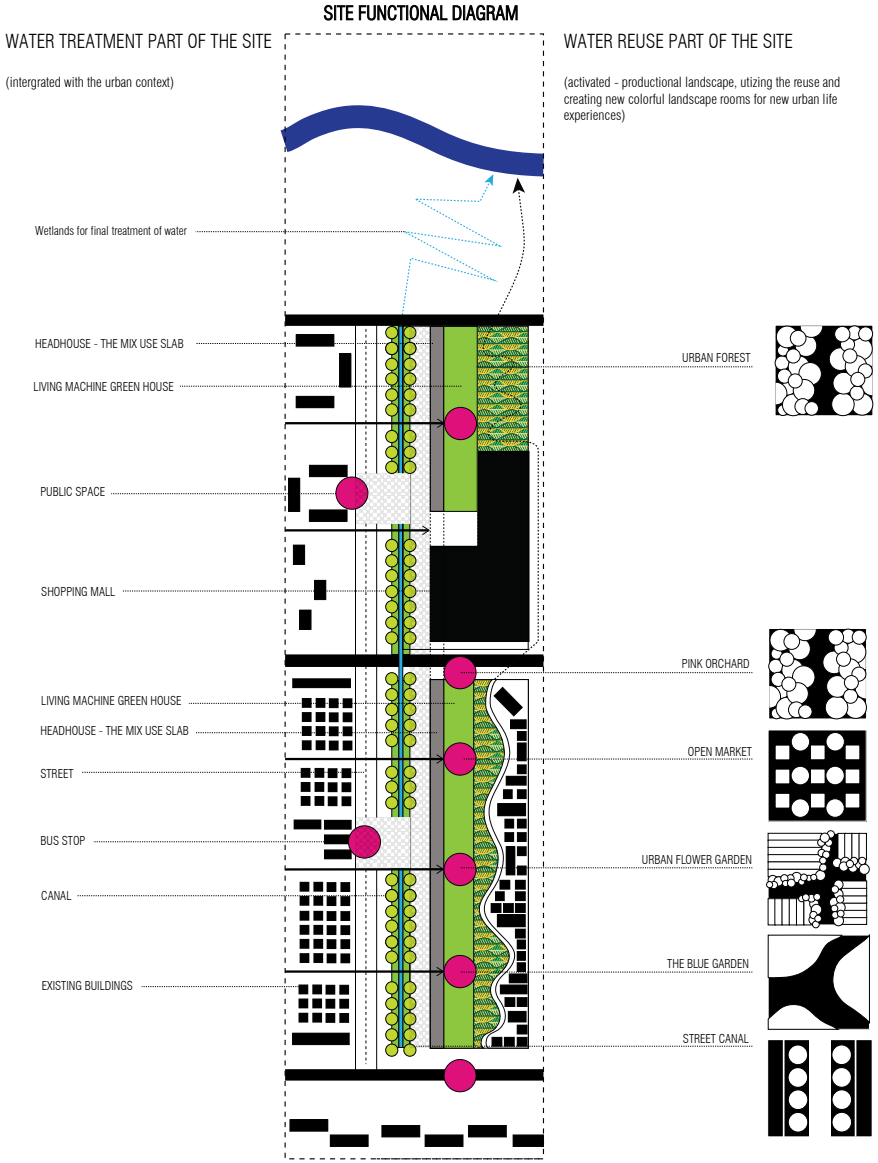


Image 42. Functional site plan diagram

Image 43. Added layers - site plan diagram

lic 'rooms' which create a distinct atmosphere much different from the usual street has to offer. These active landscape rooms accommodate different species of plants and trees, enriching the local biodiversity. Part of the water which is released from the living machines is filling the small ponds which serve as treated water storage for irrigating the greenery.

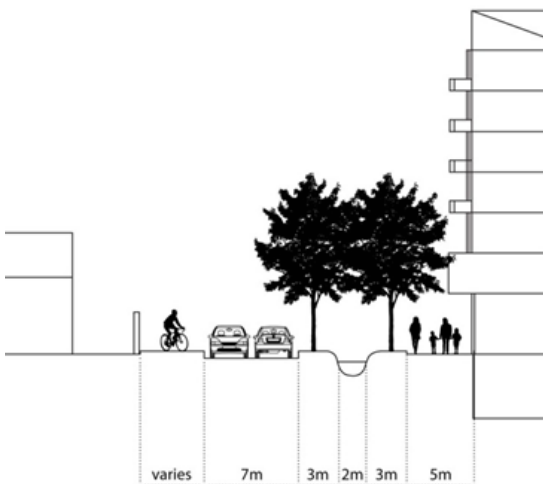


Image 44. Proposed street section- open canal integration in the street

Image 42. is a diagram showing all of the functional layers on site and how they relate to each other. The design proposal is illustrated in the followin pages, showing the specific design elements as well as the important details of the project.

Project consists of the following illustrations:

- Masterplan 1:2000 (with masterplan layers)
- Site detail 1: 500
- Site details showing water and pedestrian movement
- Long section - 1:500
- Cross sections - 1:500
- Illustrations
- Areal view

Conclusions

The project tries to work with many layers:
1. *Urban planning and design* – by ncorporating new urban typologies which adapt and add a new layer in the existing context.

2 *Spatial solution and adaptation* of the new water treatment system in the existing context.

3. *Ecological solution* and prevention of a devastating river pollution problem.

4. *Economic model* – possibility for new job opportunities (building and maintenanceof living machine green houses), as well as efficient reuse of water and biogas (byproduct of the treatment process) for producing electricity or fuel for public transport vehicles.

5. *Social* –through the attempt to propose more livable and active social meeting points within the area of the concept implementation. It is reating spaces for local inhabitants and visitors.
Promotion of urban farming by proposing productionl green houses and prooviding opportunitites for social activities and interaction between people from different age groups.

Benefits and possibilities

Bringing people together through communal activities

Irrigating the existing and the newly developed green areas is only a part of the proposal. The project also focuses on the development of an efficient storm water system, through introducing bioswales which efficiently filter and clean the rain runoff. The storm water gets properly cleaned and reused for irrigating the proposed productional green houses where urban farming will take place. Community urban farming is one of the main social activities which will bring the people of the neighborhood together. It will happen on the available roofs of the existing super market and sport facilities buildings, taking advantage and reusing the heat, saving the energy for air-conditioning and maintaining the needed temperature.

Reuse of water- production and social generator

The clash between the quiet neighborhood life, the isolated student facilities and dominant commercial activities are obvious on the site. People feel as if they lack places where they can meet, relax and have a quiet afternoon or evening with the kids or their close friends. The lack of playgrounds, small neighbor

hoodparks and recreational greenary are apparent. The streets are staggered with parking, preventing normal pedestrian access to desired points, homes, shop, restaurants. Huge building setbacks from the streets allow for appearance for a lot of unused green spaces and informal parking's to appear.

That resulted in the idea that my project will be an attempt to generate neighborhood life and activities through applying an ecological model of cleaning the waste water in these inactive and unused areas. It also has the intention create better pedestrian accessibility and movement and active landscape areas. These landscapes appear between the existing buildings and the proposed green houses where the living machines will be placed. These are the places which offer the desirable quiet atmosphere, that will generate the social activities in the production process (urban farming), and offer open water exposal (ponds) which will contribute to the local microclimate. The uncovered storm water canal, allows the for mation of the park which offers a different quality to the site. It is connecting two important bus nodes(one infront of the student housing and the one next to the city archive building), as well as reconnecting the student housing with the rest of the site and allows small playgrounds and leisure areas to appear.

Urban Water is an innovative idea where testing could show the real potential of the project. There is a possibility to test the relity of the project. By applying the treatment system on a small part of the site (small scale), and evaluating the liability and effectiveness of that part, could show the possibility and direction for the future realization. Testing the concept in different stages will give the maximum effectiveness and also show the real problems and threats. The real threats come from the condition of the existing pipe network and its adaptation to the newly proposed infrastructure. The adaptation could slow down and prove to be too expensive.

What about the activated landscape rooms?

In the beginning they could be used just as storage for the treated water, and allow reuse with irrigating the new emerging high greenery in the storm water park. The actual function and realization of the activated landscapes could come after their real potential is tested by the users: connection to the surrounding, dimension of the space, frequency of visits, how the users move an experience in the space, the microclimate condi tions (need for shadows or more insolation) and etc. For example, the *Urban Flower Garden* could emerge in theirst stages. The garden is placed on an empty asphalted area next to the existing su-

permarket building. In the project i propose that the walls from the existing building will be covered with vertical active green walls for growing flowers. The asphalt from the ground is supposed to be removed and covered with fertile soil for flower production. The flowers growing on the vertical walls and on the ground will be irrigated with the treated water coming from the living machines installed in front of the supermarket entrance area, currently used for parking. The parking could be reorganized in an underground parking space which is available on the opposite side of the site. A nursery for the flower garden is planned to be righ behind the supermarket building, in an attached gren house building, irrigated with the water coming from the storm water canal.

The biogas, by-product from the water treatment process, could be reused for producing power for the pumping stations which pump the sewage water from the settling tanks in the living machines, or for cooling/heating the green houses in the summer/winter period.

Testing and activating this part of the site, will show people the effectiveness and the benefits from the project. It will also encourage and allow the possibility for implementation.

*

The work on the idea, research and the design of this project was one of the most inspiring periods of time in my life. I wanted to create a unique concept which will become a base for my future exploration in this topic.

Being a part of Lund University and the Sustainable Urban Design Program, has a crucial importance for this achivement. I have been inspired by my amazing colleagues, teachers, lecturers, study trips, workshops and conferences that the university and this program have organized.

My project is a result of my passion, imagination, previous experience as architect, and of a two year adventure in this incerdible program where architecture, urban design and sustainibility are tought as one unified discipline. It was a great pleasure and I feel very honored to have been a part of this amazing family.

I believe that we as future designers will be held responsible for the creation of many projects which will help this beautiful planet survive the agression of our 'modern' way of living and existance which we impose on it.

Our projects can change the world!

Illustrations

Image 45. Masterplan

Image 46. Masterplan layers

existing buildings

living machine
green houses

proposed build-
ings

bioswales and
storm water park

exposed water

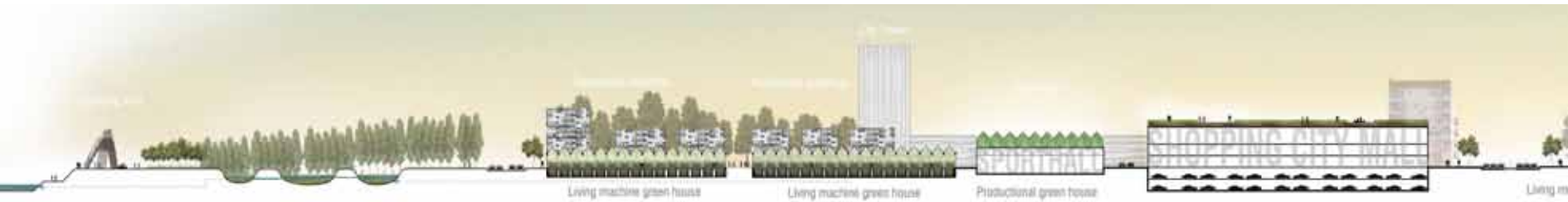


Image 47. Long section- showing the integrated living machine green houses in the existing built context


Pink Orchard
Market
Urban flower garden
Blue water garden
achine green house
Living machine green house
Living machine green house
Living machine green house
Productional green house
Living machine green house
Productional green house
Living machine green house
Living machine green house

A B C D

Detail

A B C D

Image 48. Detail

Image 49. Section A-A

Image 50 Section C-C

Image 51. Section D-D

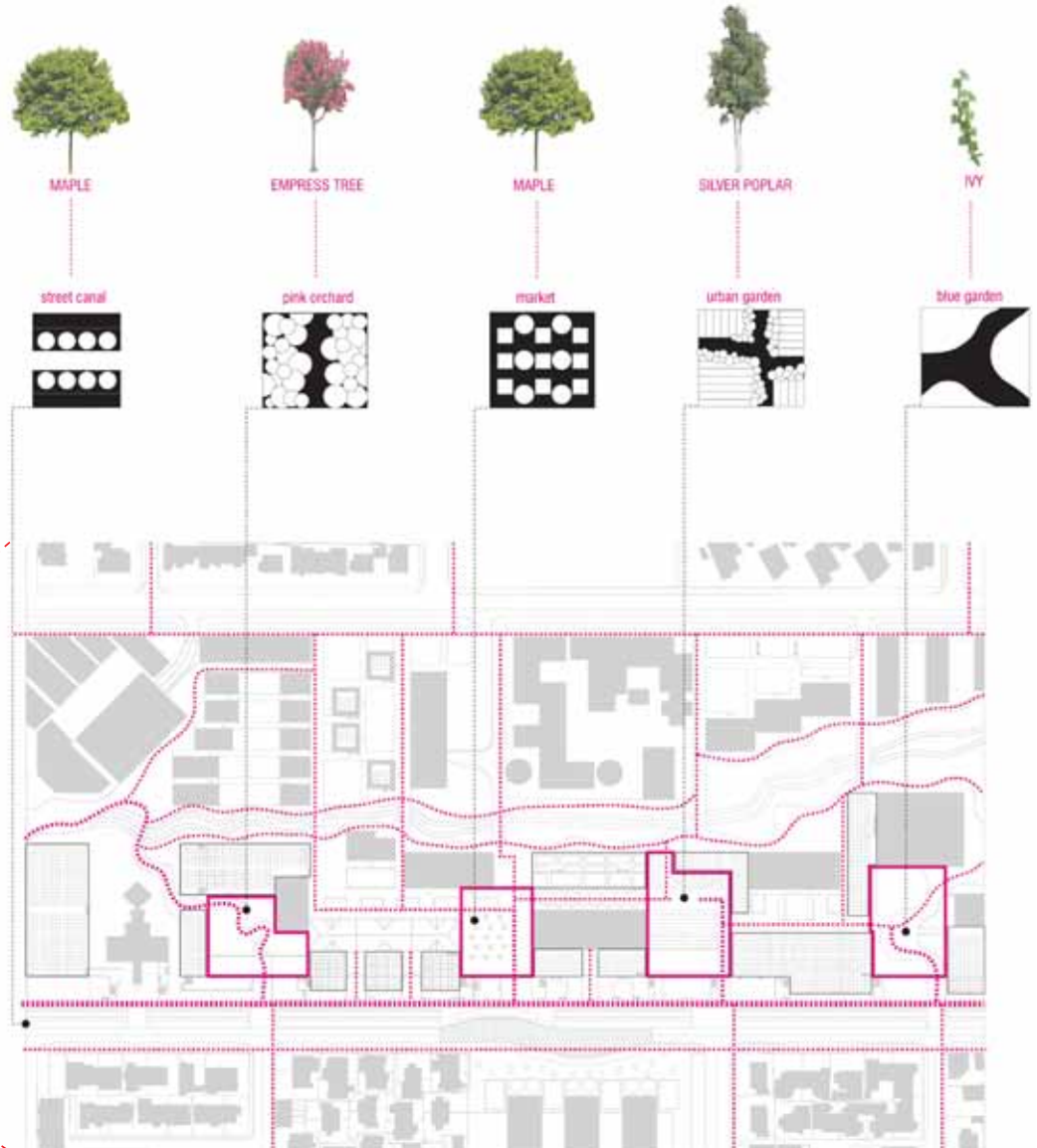
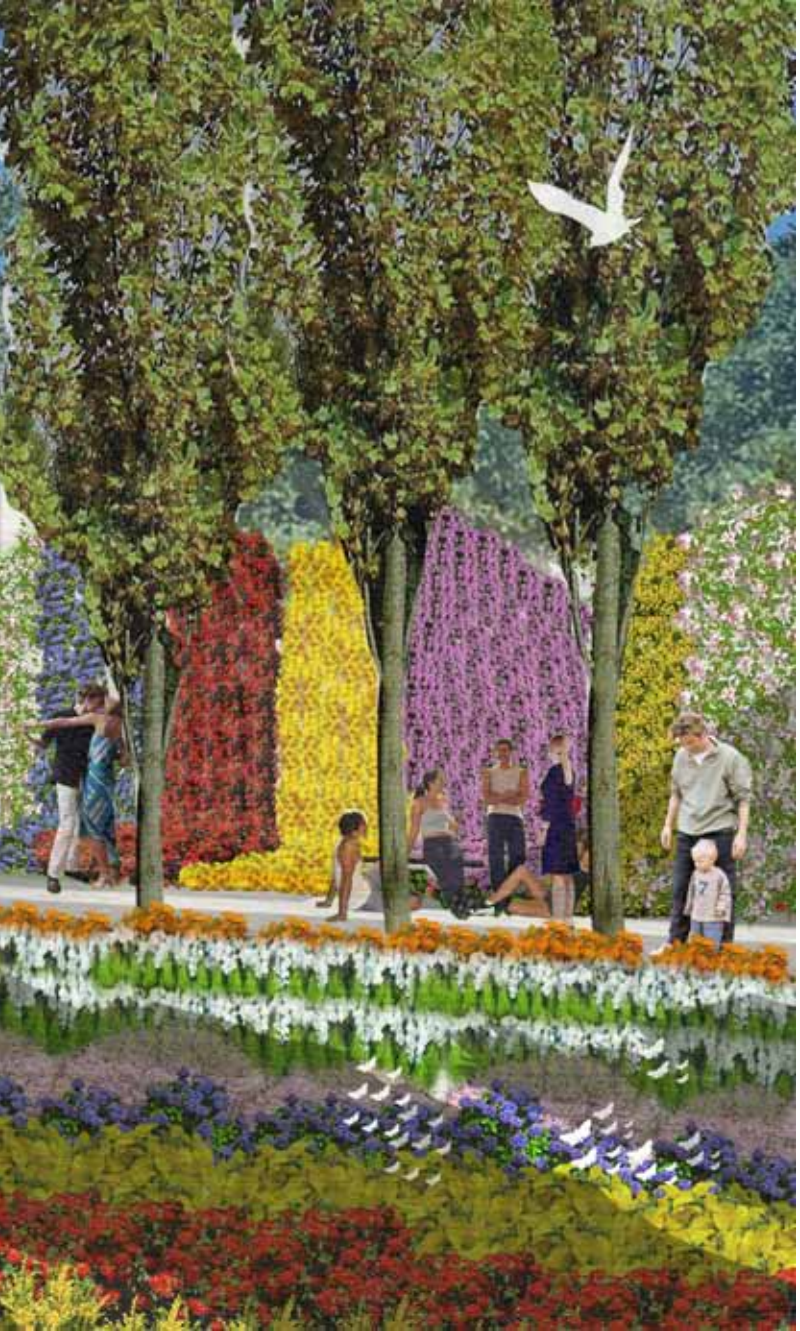


Image 52. Pedestrian movement

Image 53. Water movement



Urban flower garden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