Flowscape

Landscape Architecture Graduation studio

Photo Credit: Reuters/Andy Clark

FROM INPUT TO OUTPUT

Urban Agriculture as a method to
Eco-efficient Urban landscape

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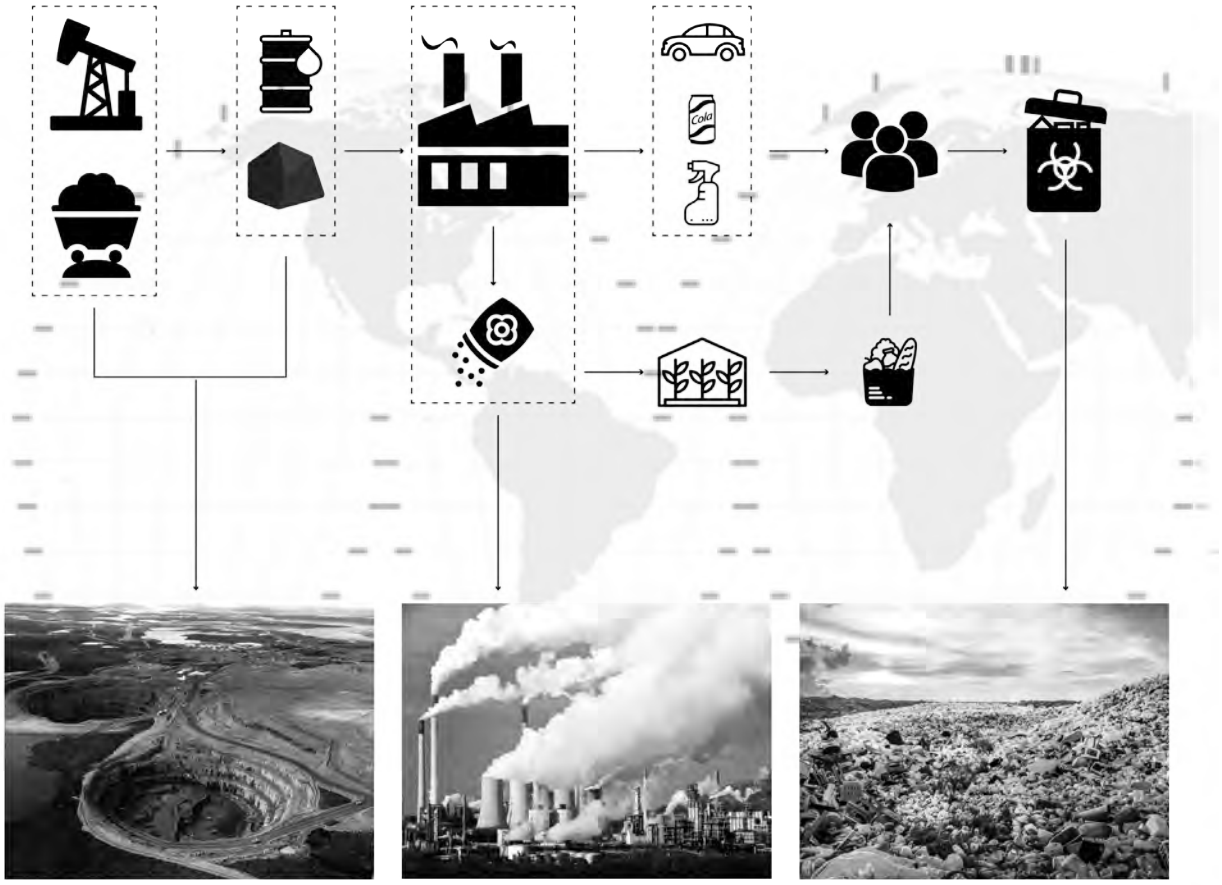
1.1 Fascination

My fascination started from debate about urban agriculture with my friends. At first it was believed to me that the urban agriculture is unnecessary, because the need of human beings seems to be fulfilled by the modern agriculture, and the urban agriculture is not very efficient and has a lot of problem such as management. However, my friends came with an interesting opinion that even though the urban agriculture is inefficient in the food production, but it helps in reshaping the defective lifestyle we have nowadays.

The contemporary lifestyles of human beings are deeply influence by the industry, and most of the living environment are involved into this kind of industrialized system. This kind of system has brought us a lot of benefits, such as abundant of foods to eat, various product to use, more convenient transportation and better living condition to live in. However, this system has also brought us great amount of problems. The industrial system we have today is a linear structure, we extract resource and energy from nature, and turn them into the products we need. And after we using or consuming them, the products become useless, or garbages.

1.1 Fascination



But our planet is closed system, all the materials create in this system cannot go anywhere but to stay in the planet, so the useless things or garbages we throw away will just “go away” and disappear, they have to stay in some place in our planet earth. So we have to put them into landfill and incinerator, which occupy a great amount of our land resource and create more problem.

This kind of lifestyle is not sustainable, because our population is expected to grow, and more land and natural resource will be needed for support our living. That will cause great damage of our natural environment, and eventually the collages of our Eco-system.

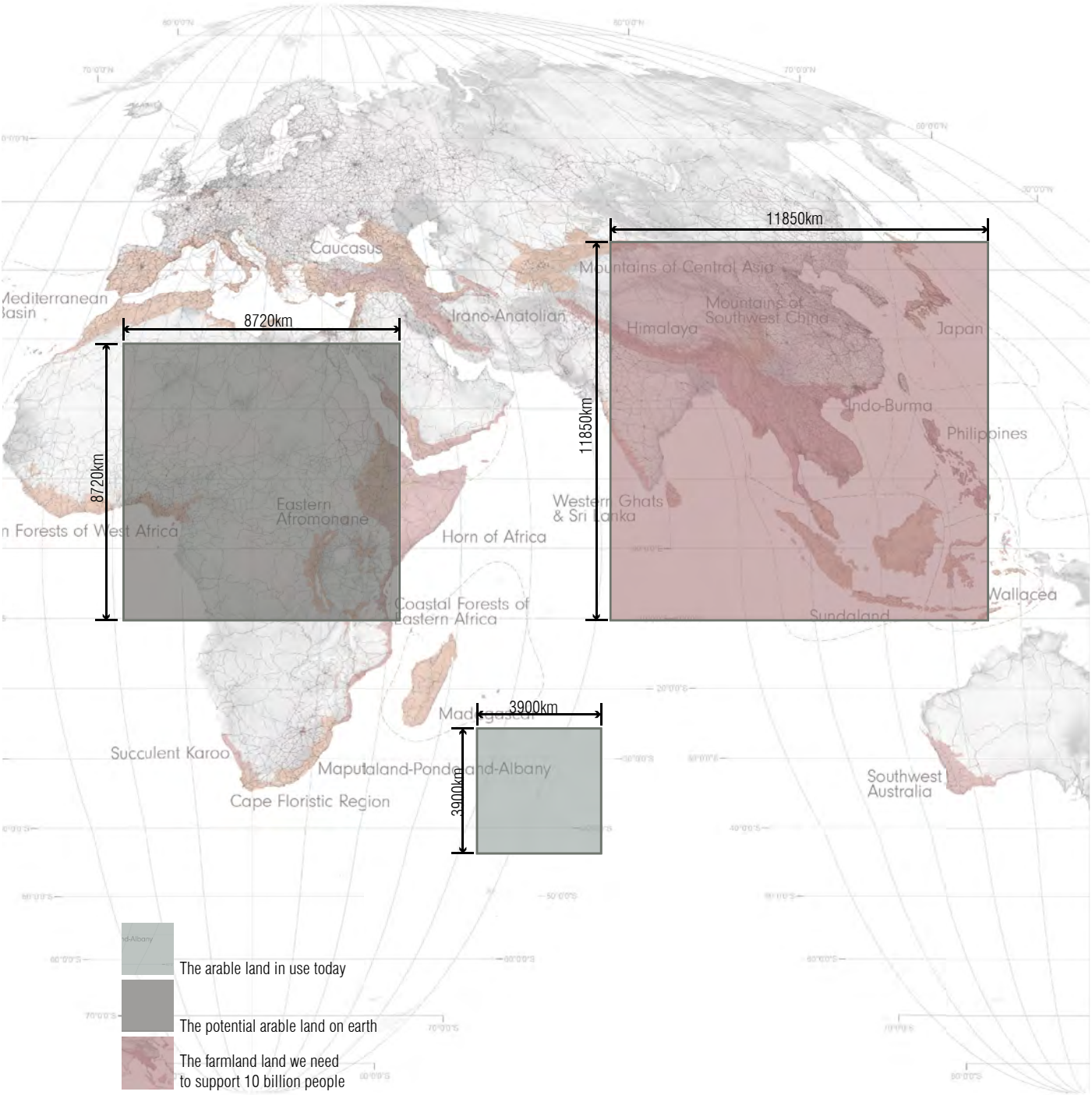
To face all these challenges, the idea of Eco-efficient, which suggest that the way we produce and consume the products and energy should not only be efficient in economic, but also be Eco-friendly, was brought out.(McDonough, W. and Braungart, M. ,2009).and the environment we live in.

1.1 Fascination

Rotterdam was chosen as my project site to search about the idea of Eco-efficient urban landscape because the urban environment is the physical reflection of our ways of living, and the Rotterdam city is a complex of problems and potentials. Differs from other Dutch cities, the industrial upgrading leads to the relocation or re-planning of the harbor area, which is the largest in Europe, meanings there is much more place for the Rotterdam city to design and plan the future urban environment. And the government of the Rotterdam city has also made a great deal of plan to stimulate urban agriculture in and around Rotterdam.

But the plan that the city government made still focuses more on the safety and sustainability of food production itself and the social effect of the urban agriculture, the connection between urban agriculture and Eco-efficient urban environment is neglected. It is interesting for me research about how urban agriculture can influence the flows of the nutrient, energy and material, and what kind of Eco-efficient design can improve the spatial quality of urban environment and what kind of future can we provide for the people who live their lives in the Rotterdam city. In the social context, this problem will also be important for me to take account of.

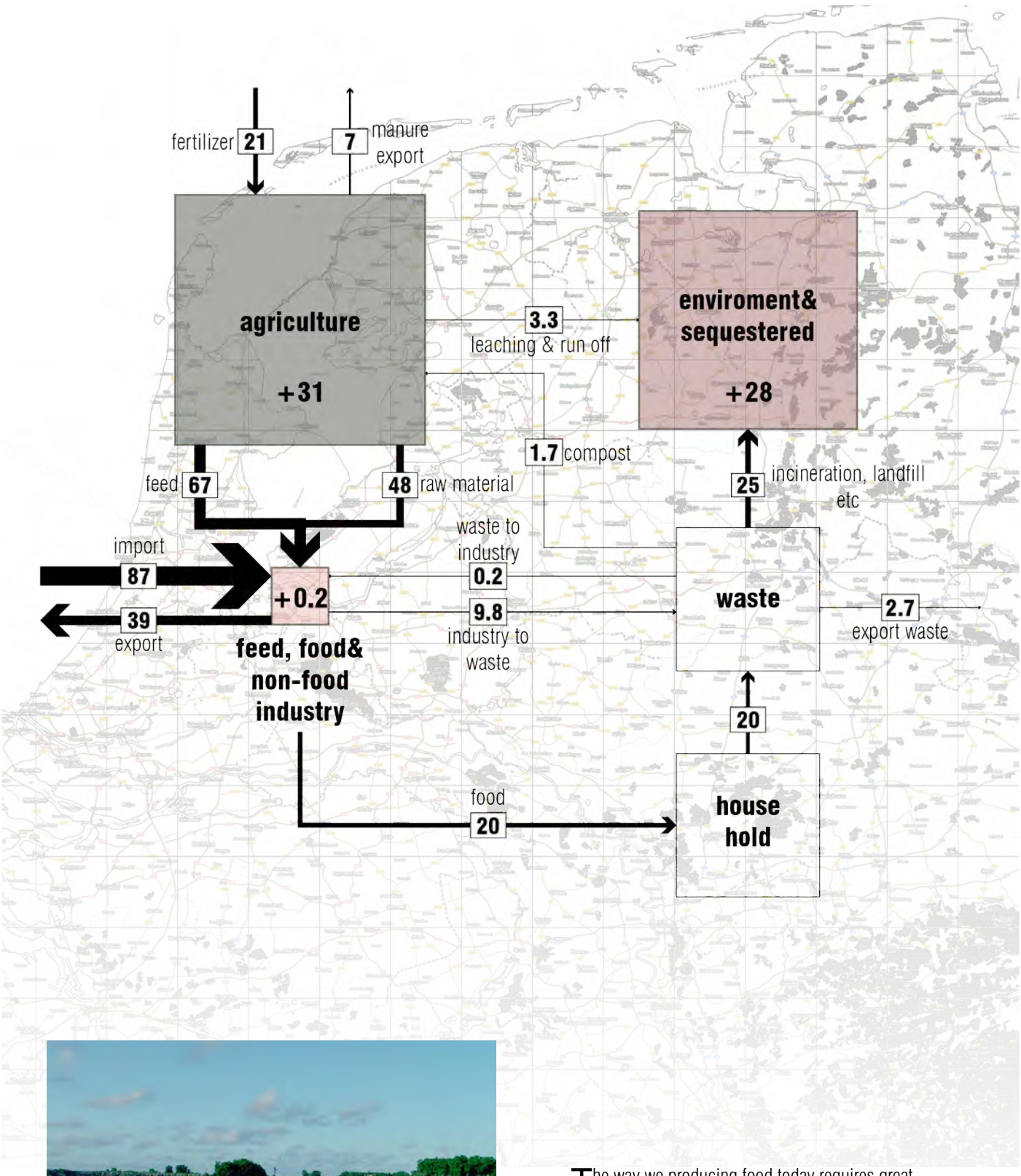
1.2 The study of the food production and its global impact



Growing need of food, but the way of producing food nowadays requires a lot of land, which is becoming more and more scarce.

Source: Richard J. Weller, "Précis" in Richard J. Weller, Claire Hoch, and Chieh Huang, Atlas for the End of the World (2017), http://atlas-for-the-end-of-the-world.com.

1.2 The study of the food production and its global impact

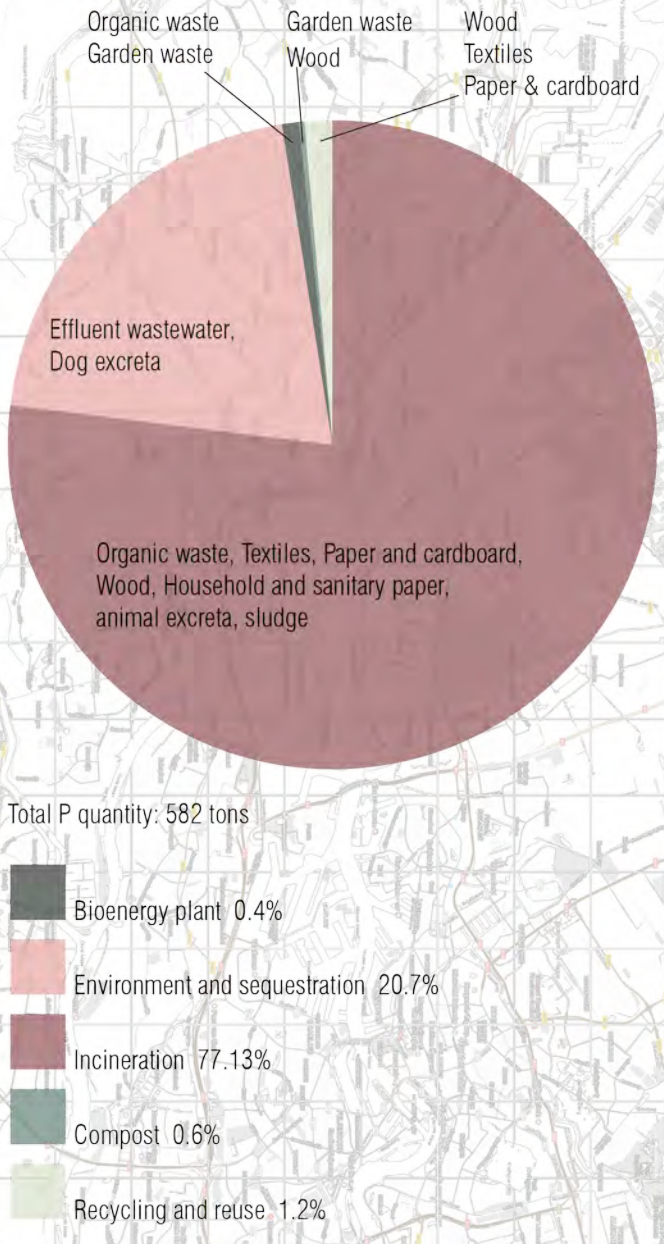


The way we producing food today requires great amount of artificial fertilizer, which lead to the shortage of phosphate minings. And the mining of the phosphate will also lead to serious loss of soil and pollution to the water.

Source: Nico Tillie, Kerli Kirsimaa ,Andy van de Dobbelsteen, Dirk Sijmons, Urban Agriculture in Rotterdam: potentials for a liveable, low carbon city and sustainable phosphorus flows

1.4.2 Phosphorous demand of Rotterdam

Phosphorus (P) outflux [tons P/year] from Rotterdam urban households



Source: Nico Tillie, Kerli Kirsimaa ,Andy van de Dobbelsteen, Dirk Sijmons, Urban Agriculture in Rotterdam: potentials for a liveable, low carbon city and sustainable phosphorus flows

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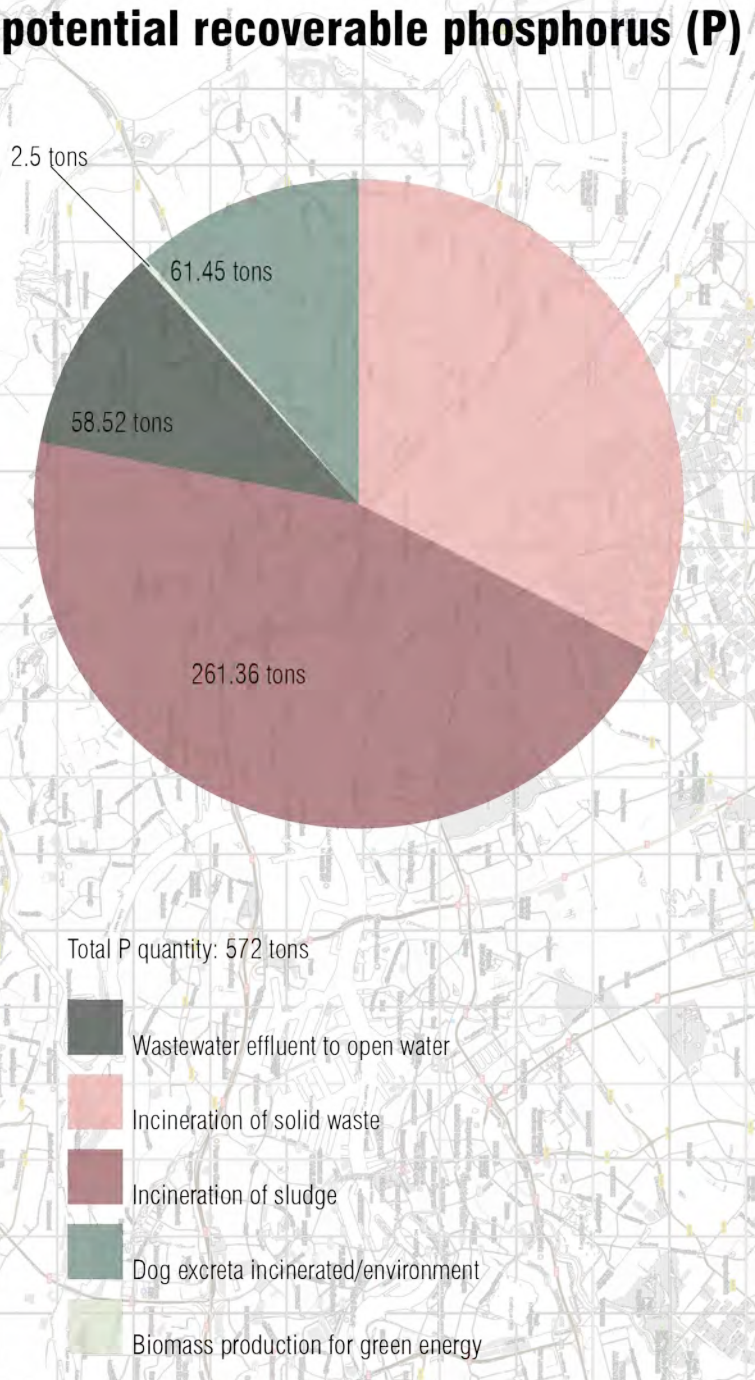
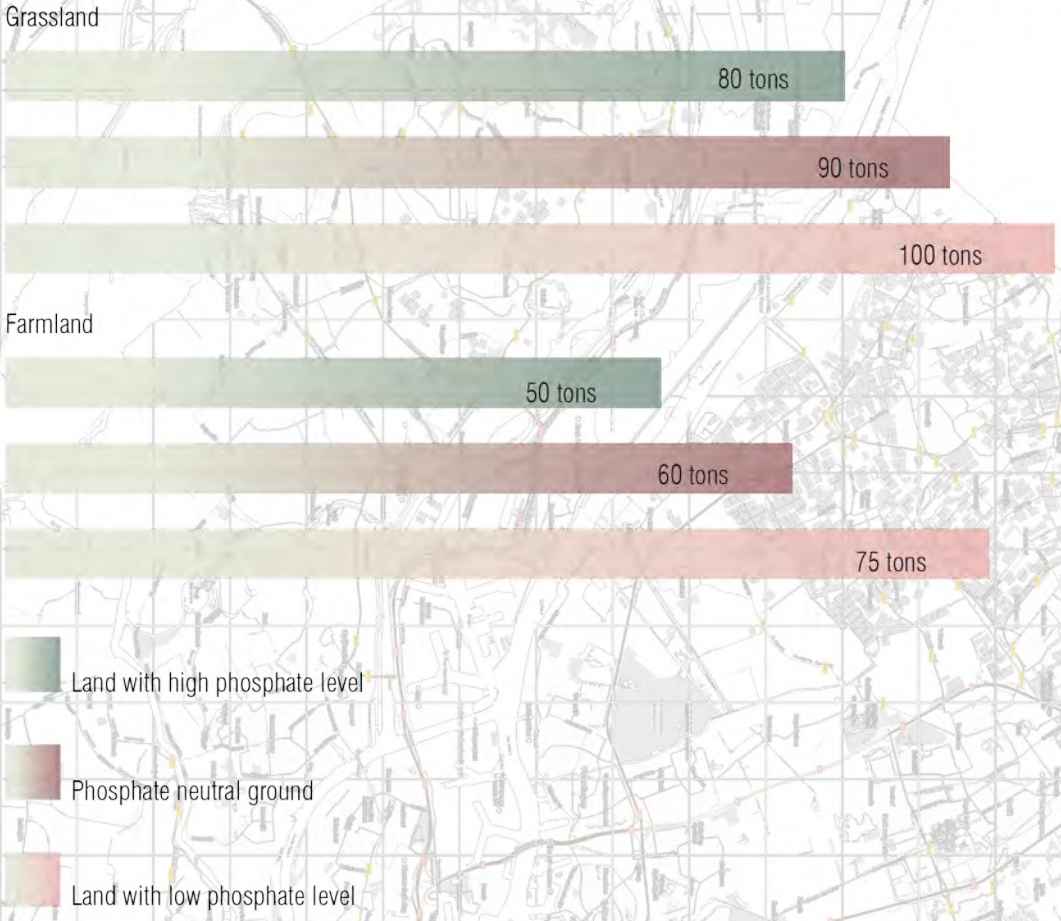


The same situation is happening in Rotterdam too. The daily-life-used chemical products (detergent mostly) and the organic food or kitchen waste contain great amount of phosphate which can be recycle. But in the traditional ways, they were just simply throw away or burn in the incinerator. That not only leads to the great loss of resources, but will also cause serious environmental problems. The phosphate on the water could be poisonous and lead to the eutrophication, which will destroy the ecology of the river.

Source: Nico Tillie, Kerli Kirsimaa ,Andy van de Dobbelsteen, Dirk Sijmons, Urban Agriculture in Rotterdam: potentials for a liveable, low carbon city and sustainable phosphorus flows

1.4.2 Phosphorous demand of Rotterdam

Application of phosphorus for different soil P statuses.



Demand of Phosphorus

Field beans: 1.24 tons

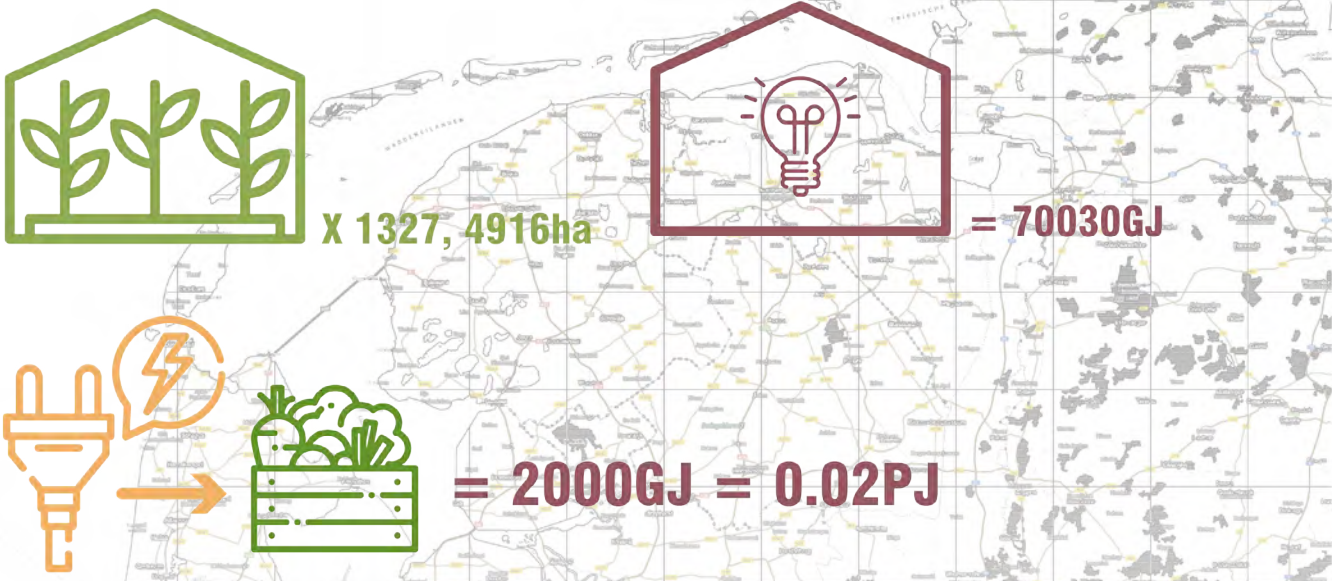
Broccoli: 0.16 tons

Grain crops: 0.56 tons

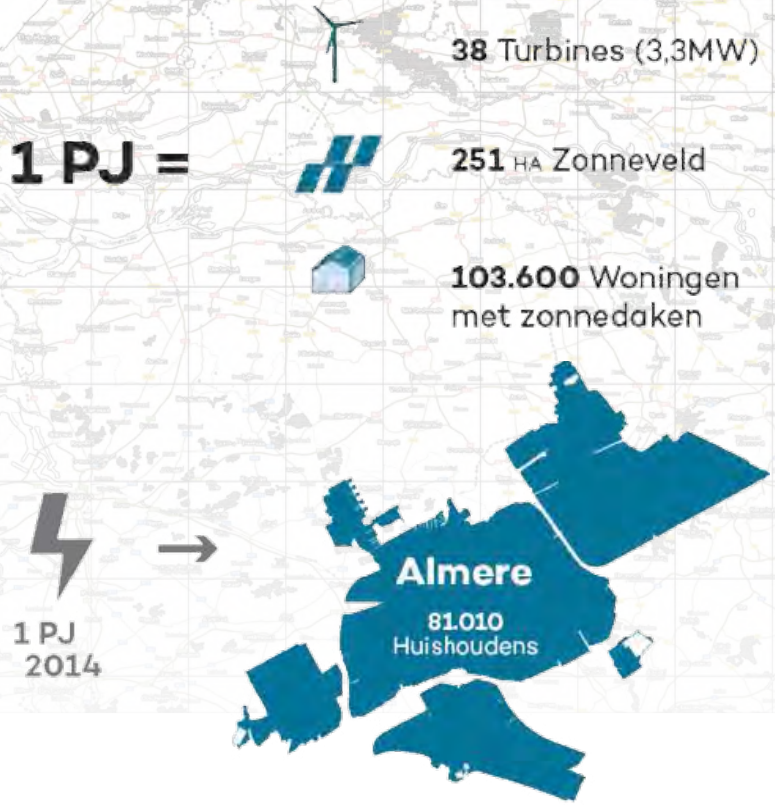
The phosphate contained in the waste produced in daily life is already enough to meet the need of different types crops and farm lands. This data is really provoking, if we can fully use all the phosphorus resources in the waste, we no longer need to import new phosphate resource.

Source: Nico Tillie, Kerli Kirsimaa ,Andy van de Dobbelsteen, Dirk Sijmons, Urban Agriculture in Rotterdam: potentials for a liveable, low carbon city and sustainable phosphorus flows

1.2 The study of the food production and its global impact



Source: Wageningen University & Research, https://www.wur.nl/nl/Onderzoek-Resultaten/Onderzoeksinstituten/Economic-Research/Themas/Data-Insights-1/Land-en-tuinbouwcijfers-1.htm

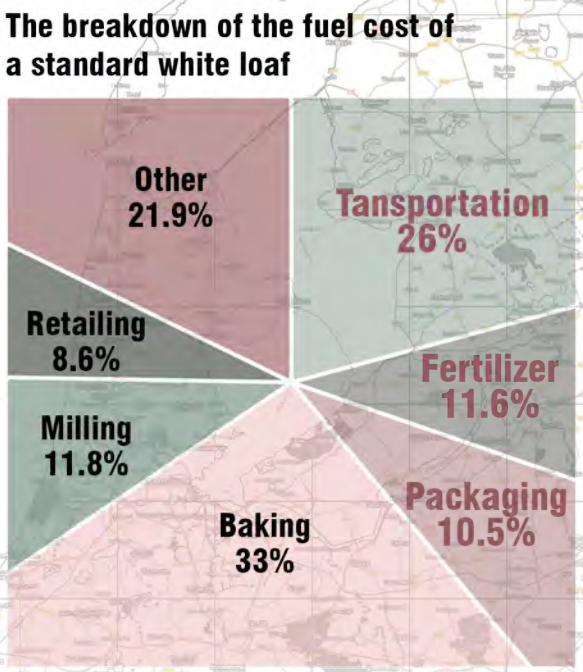


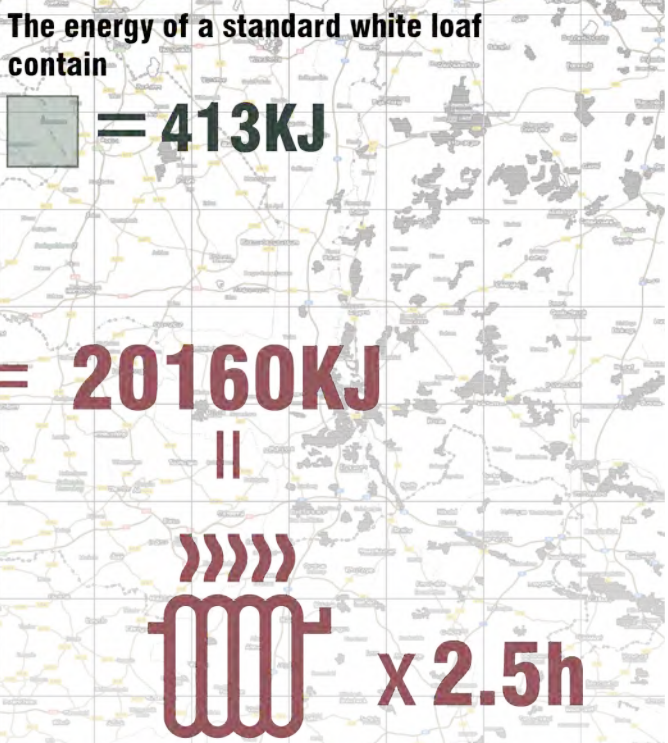
There are 1327 greenhouses growing vegetables in Netherlands in 2017, the total area is 4916ha, and the average energy need per greenhouse for one year is 70030GJ. That means each hectare greenhouse for growing vegetables in Netherlands will need 2000GJ, which as much as 0.02PJ energy for lighting and heating every year.

But how much does 1PJ means? In 2014, 1PJ is enough for 81010 houses using for one year. And it is the energy that need 38 windmills, or 251ha of solar panels to work one year to create. So it takes great deal of energy to growing foods in the greenhouse.

Source: PBL www.pbl.nl/21infographics

1.2 The study of the food production and its global impact





Also, a lot more energy was used in producing food than the food itself contains, and great mount of green house gas generated during this process. The majority of the energy waste happens in the process of transporting and packing. If we could reduce the distance of the transportation of the food, the greenhouse gas emission and energy waste in food production will decrease significantly. That is the reason why it is important to have local food production facilities within the major city.

Source: Nico Tillie, Kerli Kirsimaa ,Andy van de Dobbelsteen, Dirk Sijmons, Urban Agriculture in Rotterdam: potentials for a liveable, low carbon city and sustainable phosphorus flows

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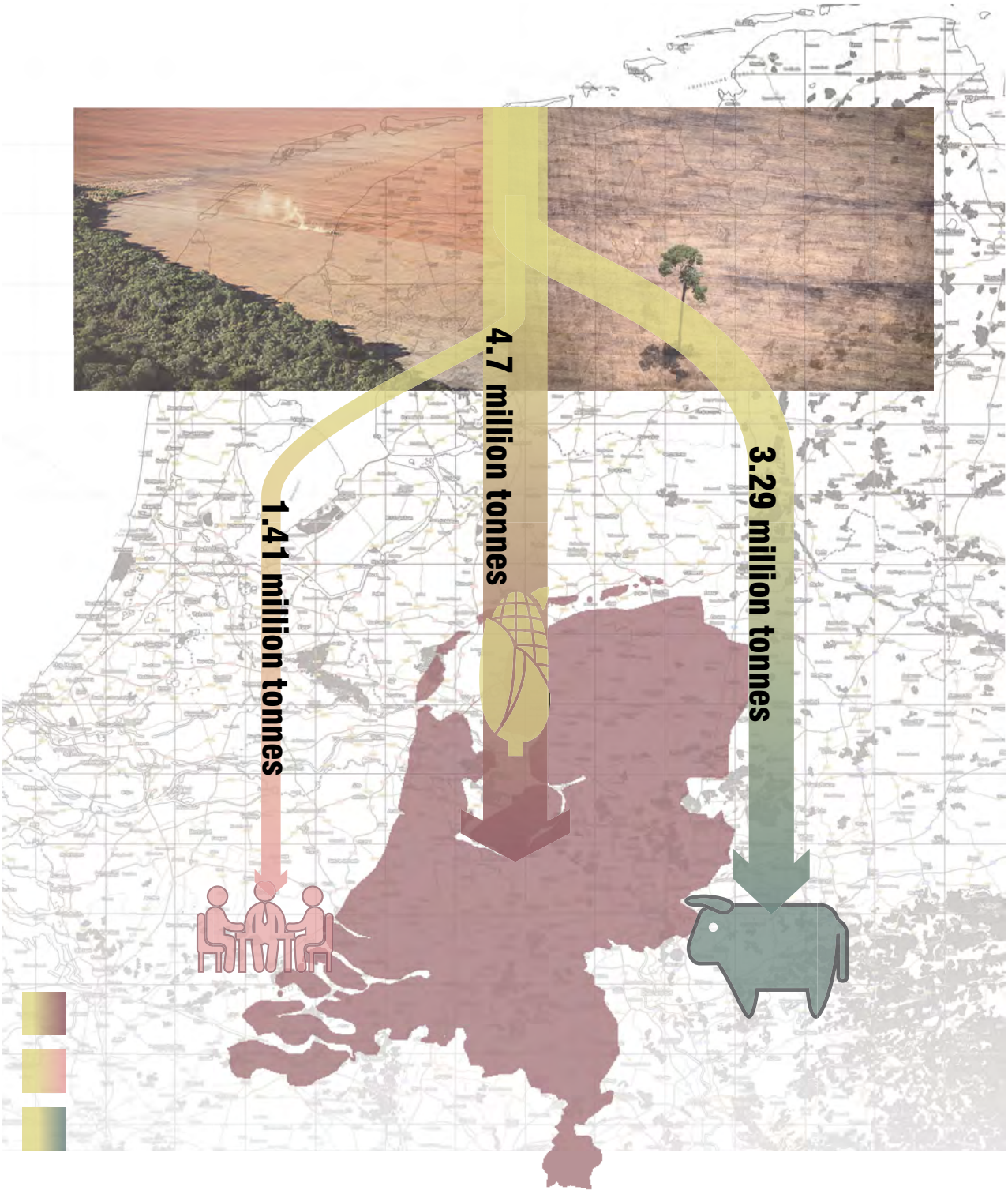


Since the globalization of the industrialization, the food production of a region or country will also has its global impaction. Take the import of the corns as an example, there were 4.7 millions tons of corns of the corns being imported in Netherlands in 2016, and most of them are used for feeding the animals for meet production. Brazil is the second largest corns export country in the world, and because of the increases of the exportation of them, the farmer of Brazil have to burn down more forests to meet the need.

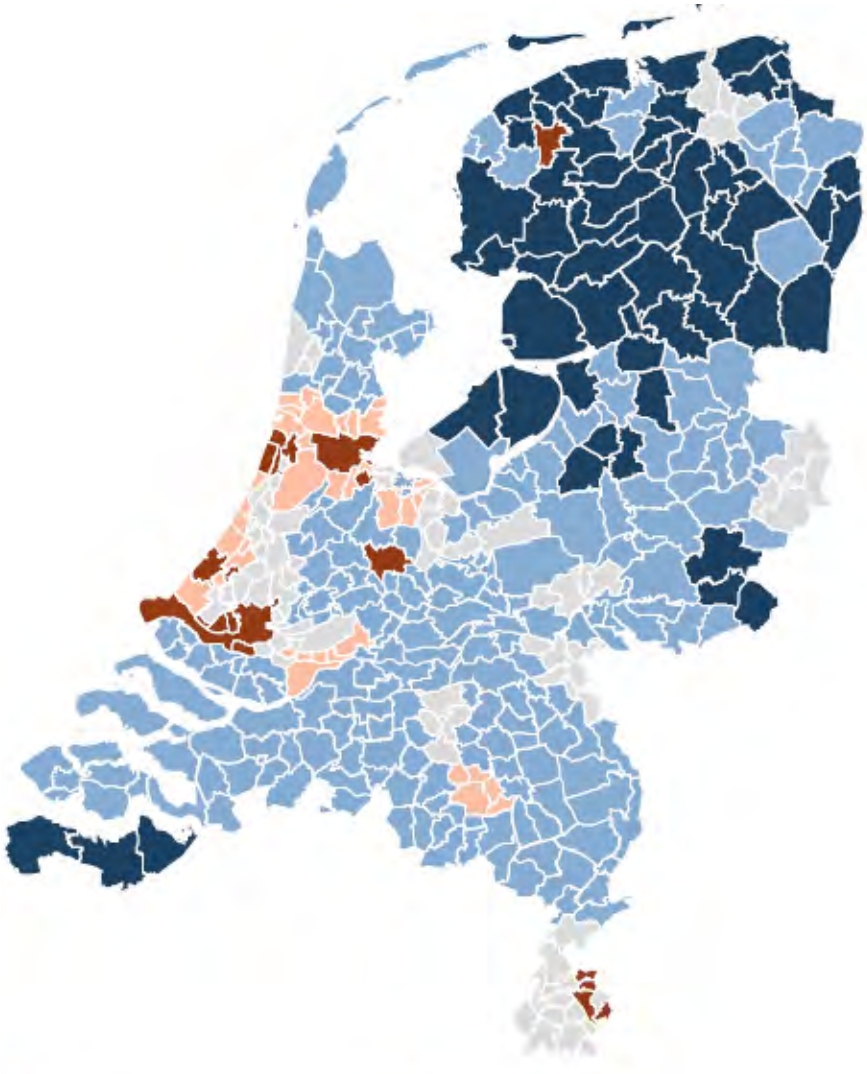
Source: https://www.rabobank.com

1.3 The inefficiency of urban space planning

Population growth and causes of Rotterdam over the years

Source: Statistics Netherlands

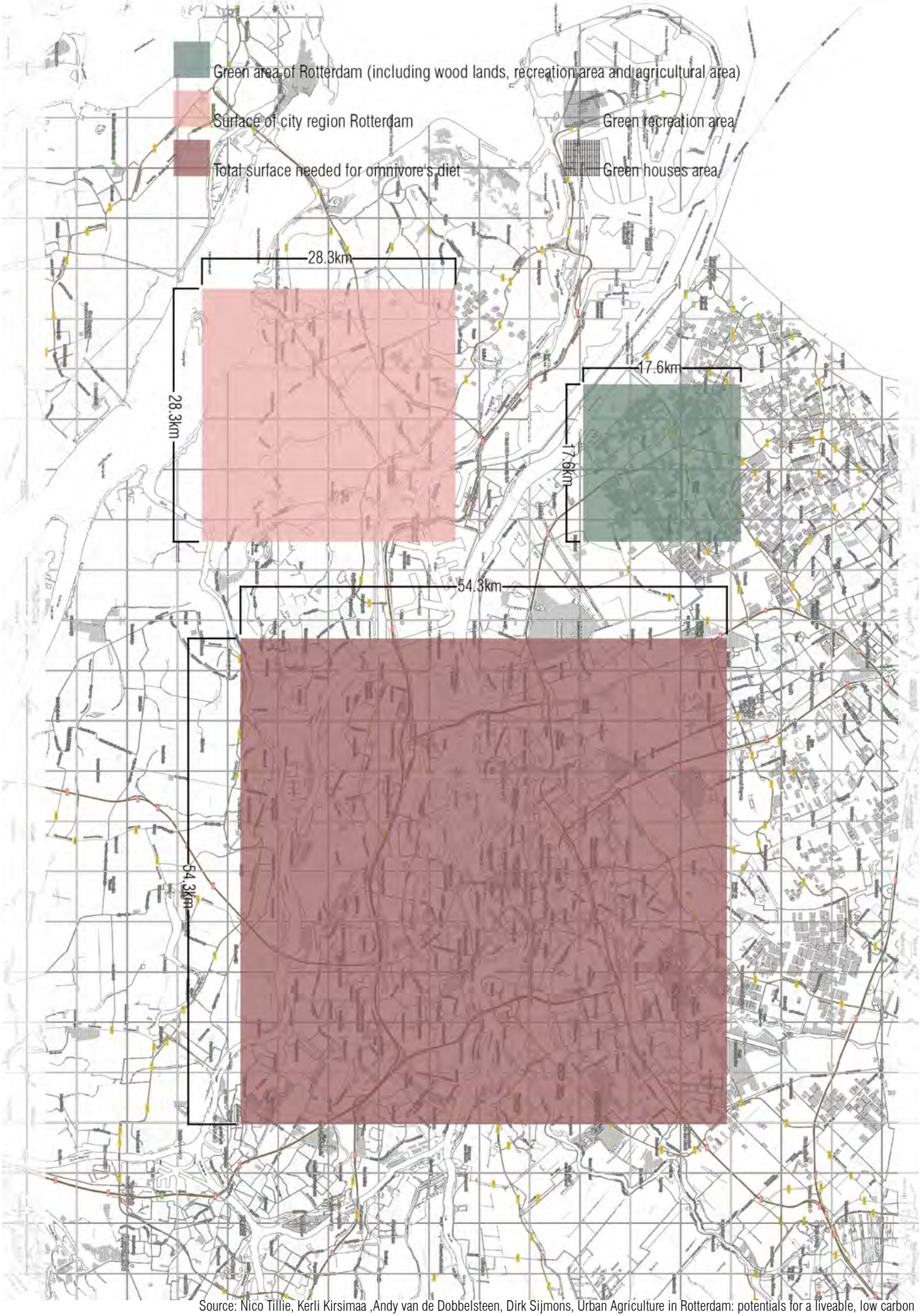
Share of developed land area



Source: Van Dijk et al. (2016).

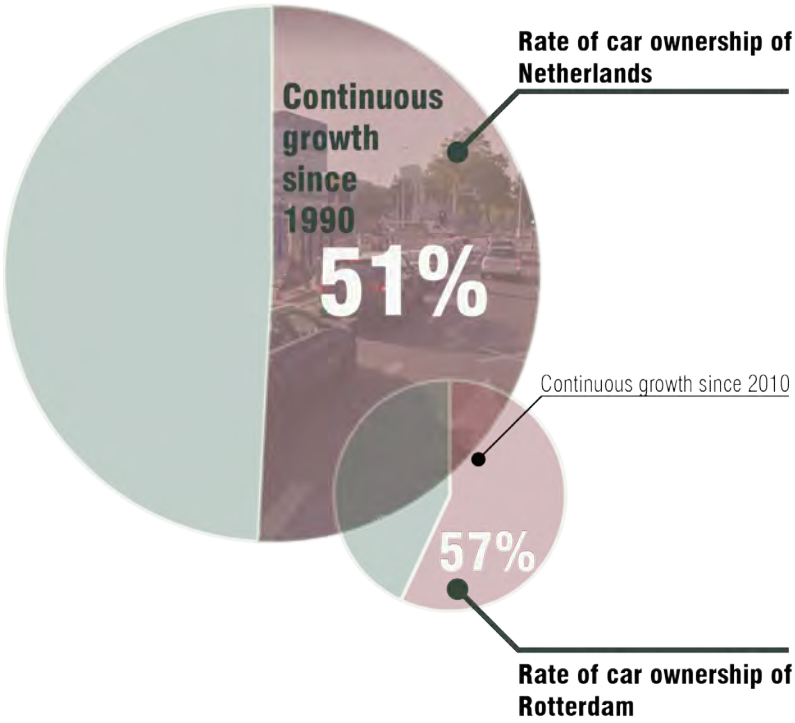
Beside the phosphate resources, another factor that very important to food production is also in shortage, that is land. In Rotterdam, the population experiencing a continuing growing since 2012 (Statistics Netherlands), and the need for new houses is also growing. However, as one of the mostly built area in Netherlands, Rotterdam is short at suitable lands for new residential area (see the chart on the left). That means the Rotterdam city have to raise more people with fewer land, and that leads to more import foods and more greenhouse gas emissions during the production and consumption of the food.

1.3 The inefficiency of urban space planning

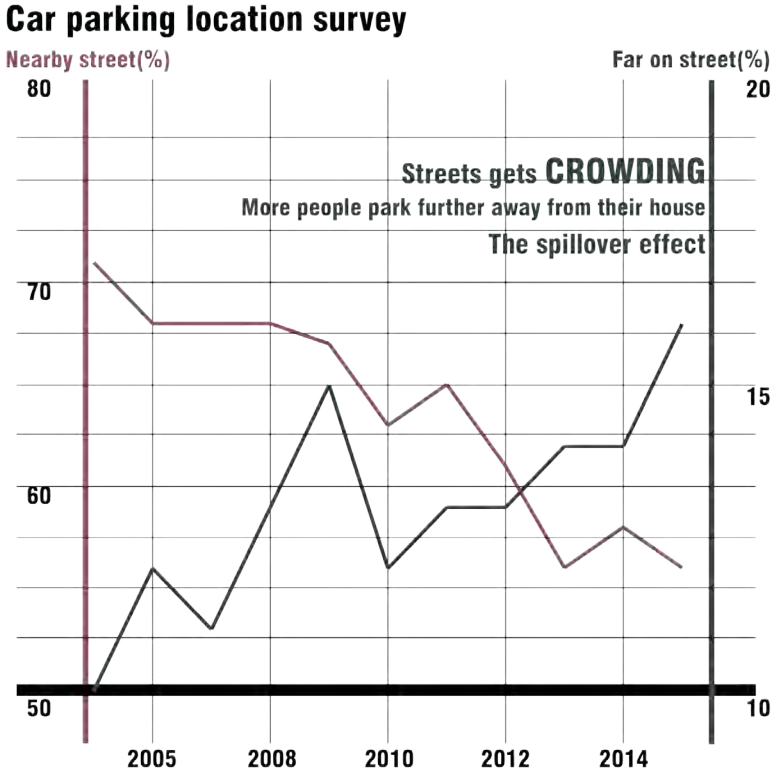


Source: Nico Tillie, Kerli Kirsimaa ,Andy van de Dobbelsteen, Dirk Sijmons, Urban Agriculture in Rotterdam: potentials for a liveable, low carbon city and sustainable phosphorus flows

1.3 The inefficiency of urban space planning



On the one hand the land for food production is scarce, on the other hand we have to put our land resource into some inefficient usage, such as car-parking. The ownerships of cars have experienced a continuous growth since the past two decades, and the data of Rotterdam is also growing, which means we need more and more place for parking our car, and the streets will get crowding too.



With the growing of the car ownership, the diversion of places where people parking there cars has also changed. There are growing number of peoples have to parking their car in the streets far away from their home, which means the parking places in the streets is no longer enough for the growing needs of car-parking.

Source: Wageningen University & Research, https://www.wur.nl/

1.3 The inefficiency of urban space planning

If this kind of situation continue, in 2025, because of the growing number of population and car ownerships of Rotterdam, there will be around 44610 new parking place on the streets will be needed to fulfill the gap. Which means there will be around 81 hectares of the urban public space will need to transfer into the parking space.

This kind of situation will no doubts make the shortage of land for cultivating food more serious, and that will lead to Rotterdam more rely on the importation of food from all over the world, which cause more greenhouse gas emission and the waste of more energy and materials. A better spatial and transportation planning will be needed for Rotterdam.

Source: Wageningen University & Research, https://www.wur.nl/

1.5 Problem Statement

As what mentioned in the above study, we can learn that there are a lot to improve in the way of food production. And now these kinds of problems could be solved with the design of the Eco-efficient urban landscape which can be achieved by urban agriculture. Because of the upgrading of the industry, a lot of former harbor area will need to play a new role in the urban environment of Rotterdam and the government of the city is also making plan for the upcoming opportunity to renew the urban mechanism. The transfer of the harbor area needs the investment of the social forces and the occupation of the new industry, and the key of the attracting the investment and new industry will be the good quality of environment. The concept of Eco-efficient urban landscape offers us a vision of a circular and Eco-friendly urban environment, which supported by the urban agriculture. It is an opportunity but also a challenge, and I would like to have a further study about it.

1.6 Research Objectives

To design a Eco-efficient urban landscape in the former harbor area by re-planning the urban spatial structure and designing the new landscape infrastructure is the research objective.

Through this research, what is expected to be learned is the principles of designing a Eco-efficient urban landscape project that more systematically connected to the urban environment, and helping the citizens to transfer to a waste-less lifestyles. Also, this research also try to study how to improve the urban metabolism to a more Eco-efficient way, and reduce the damage of the built environment do to the natural Eco-system.

1.7 Research Questions

In order to achieve the objectives, the following questions will need to be answered during the research:

1. How do the nutrition and energy flow of the urban area of Rotterdam work?

2. How could the Eco-efficient urban landscape affect the energy and nutrition flows of the urban area of Rotterdam?

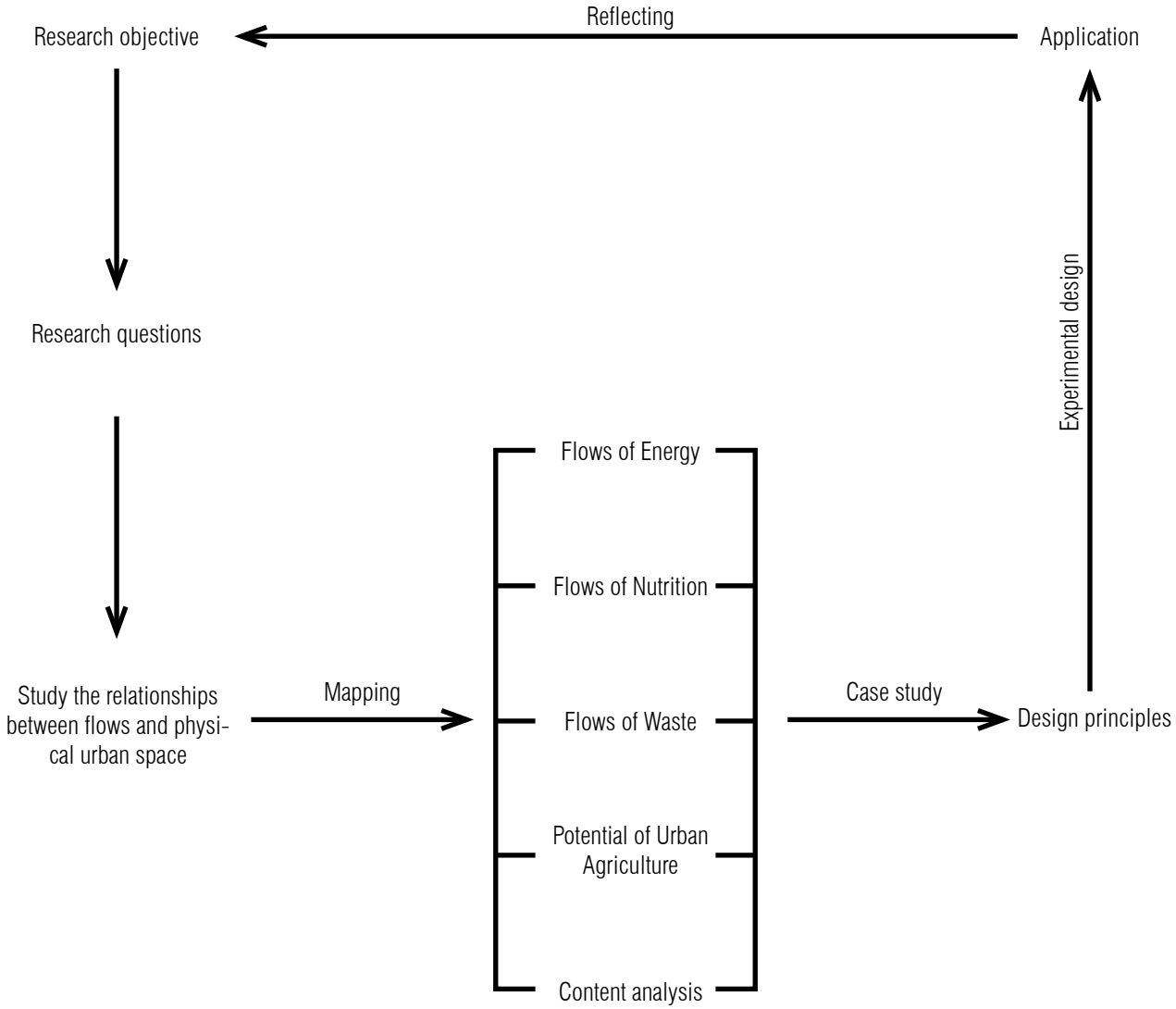
3. What is the existing principles of applying Eco-efficient urban landscape in urban area?

4. How could the principles be translated in a spatial design for harbor area?

5. What lessons are learned from the spatial design and how does it solve the problems ?

2. Methodology Framework

2.1 Research Framework



Research Field

New possibilities in food production system in urbanized area.

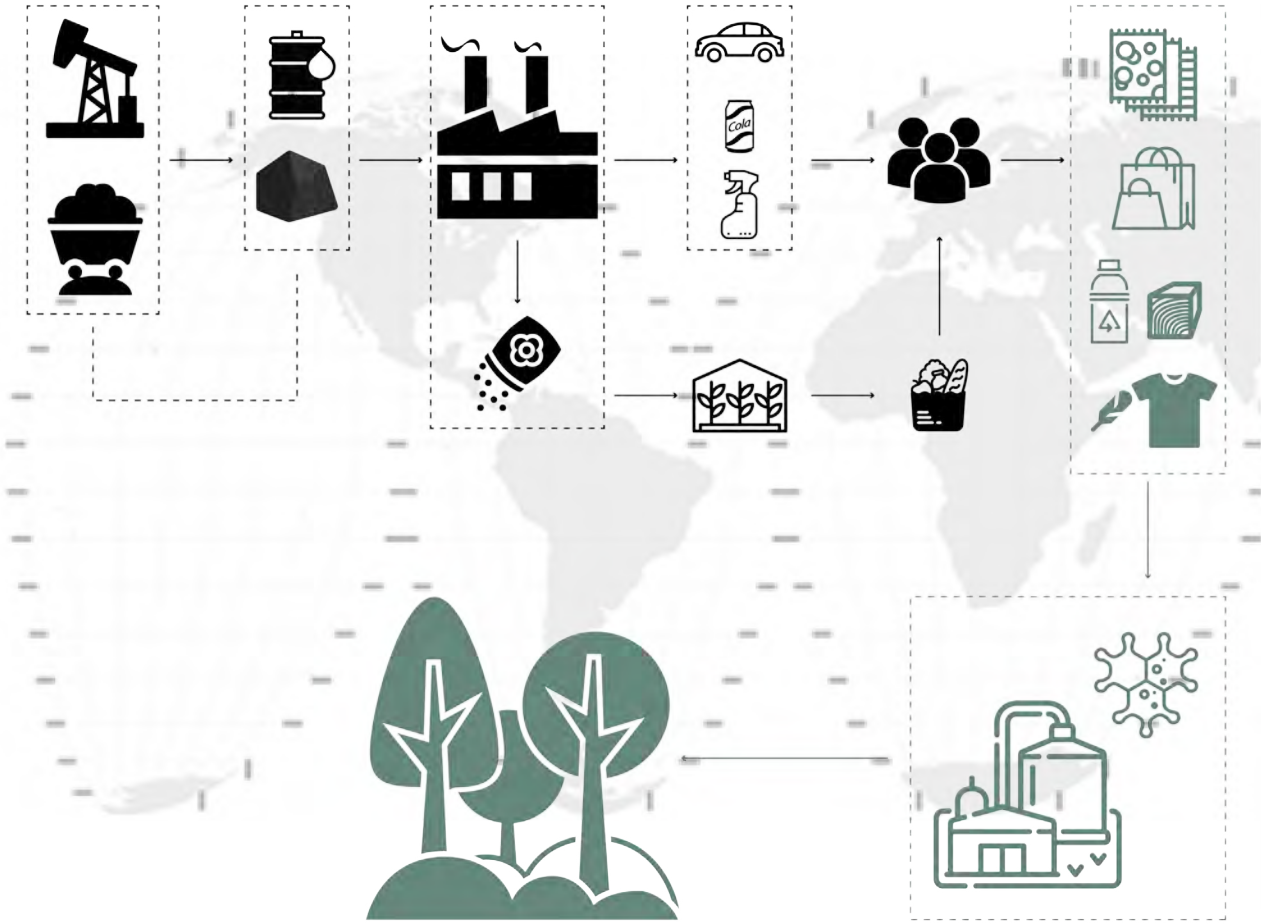
The modern food production system in the urban region is facing all kind challenges, the lack of resource, the abuse of artificial fertilizer and the waste of energy, this system is vulnerable and unsustainable. The largest and fastest growing metropolitan are facing the problem of controlling the greenhouse gas emission and at the same time feed their large population, a new possibility of food production system is needed to establish. Also, with the climate changing, the frequency of extreme weather is also increasing, and that is anther threat to the food productivities. A new food production system should be more efficient at energy consuming, nutrient using and extreme weather resistive. The new system should also be a part of the natural metabolism of material and nutrient, and use the force of nature, for the long term development and coexist with the nature.

2.2 Theoretical scheme

Cradle to cradle

To develop the concept of Eco-efficient further, the idea of the Cradle to cradle Eco-efficient circulation system was developed by Michael Braungart and William McDonough(2009). There are two kinds of circulation evolved in this system, the first one is the technical circulation, which the used products can be the raw materials for new products, and the quality of the products will not damage in the process of circulation. The second type pf circulation is the Biological metabolism, which the used products can be harmless or even nutritious to the natural environment, so that they can go back to the natural circulation again.

2.2 Theoretical scheme

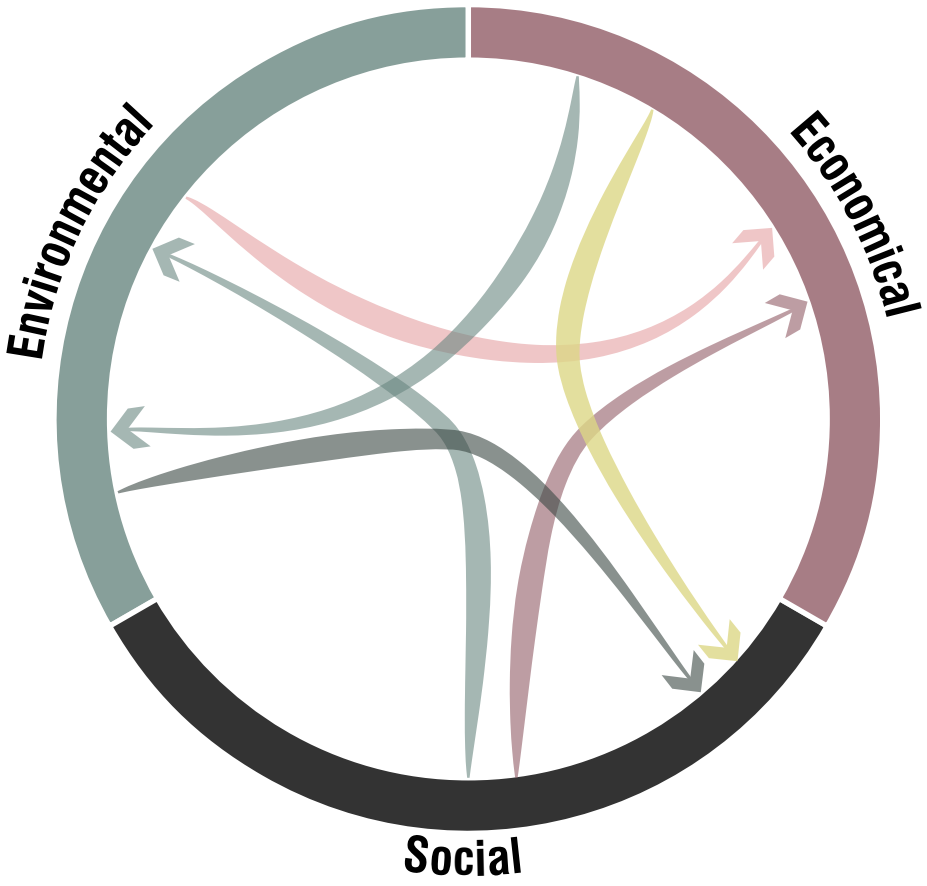


The biological metabolism

The urban environment is the physical reflection of our lifestyles and deeply influenced by the way we producing and consuming. Inevitable the urban environment also suffer from the same problem brought by the system we have now, but the Eco-efficient concept offer us an opportunity to rethink the way we live and the environment we live in.

The Eco-efficient urban landscape will be needed in order to shape a Eco-efficient way of living, and the urban agriculture can play an important role in building up the Eco-efficient urban landscape. As designer, what will be this kind of landscape look like and how the urban agriculture work in such a landscape will be my special interest. Also, the perspective of the new way of living for people is my consideration.

2.2 Theoretical scheme



Urban farming

Recreation

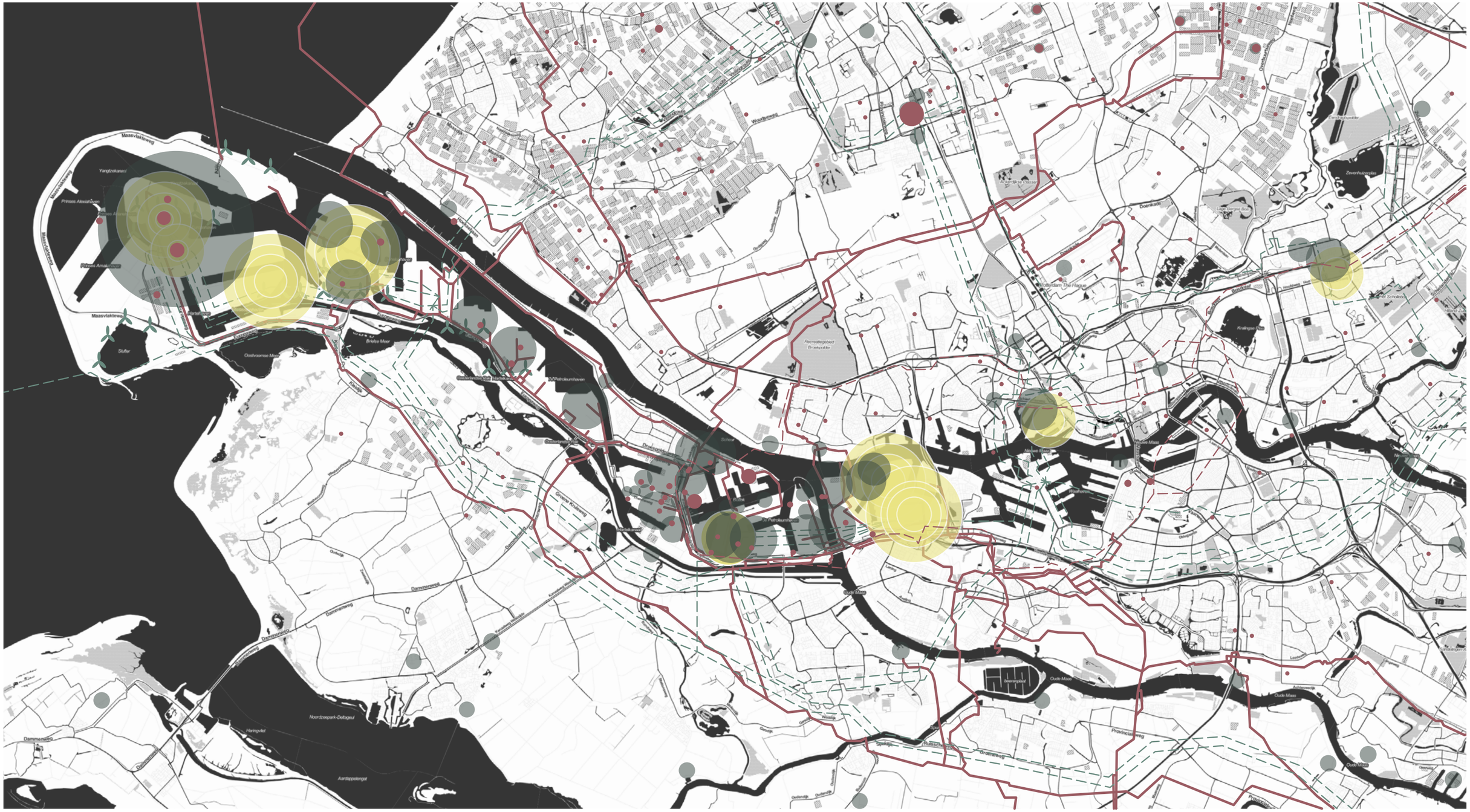
Residential

Commercial

New high-tech industry

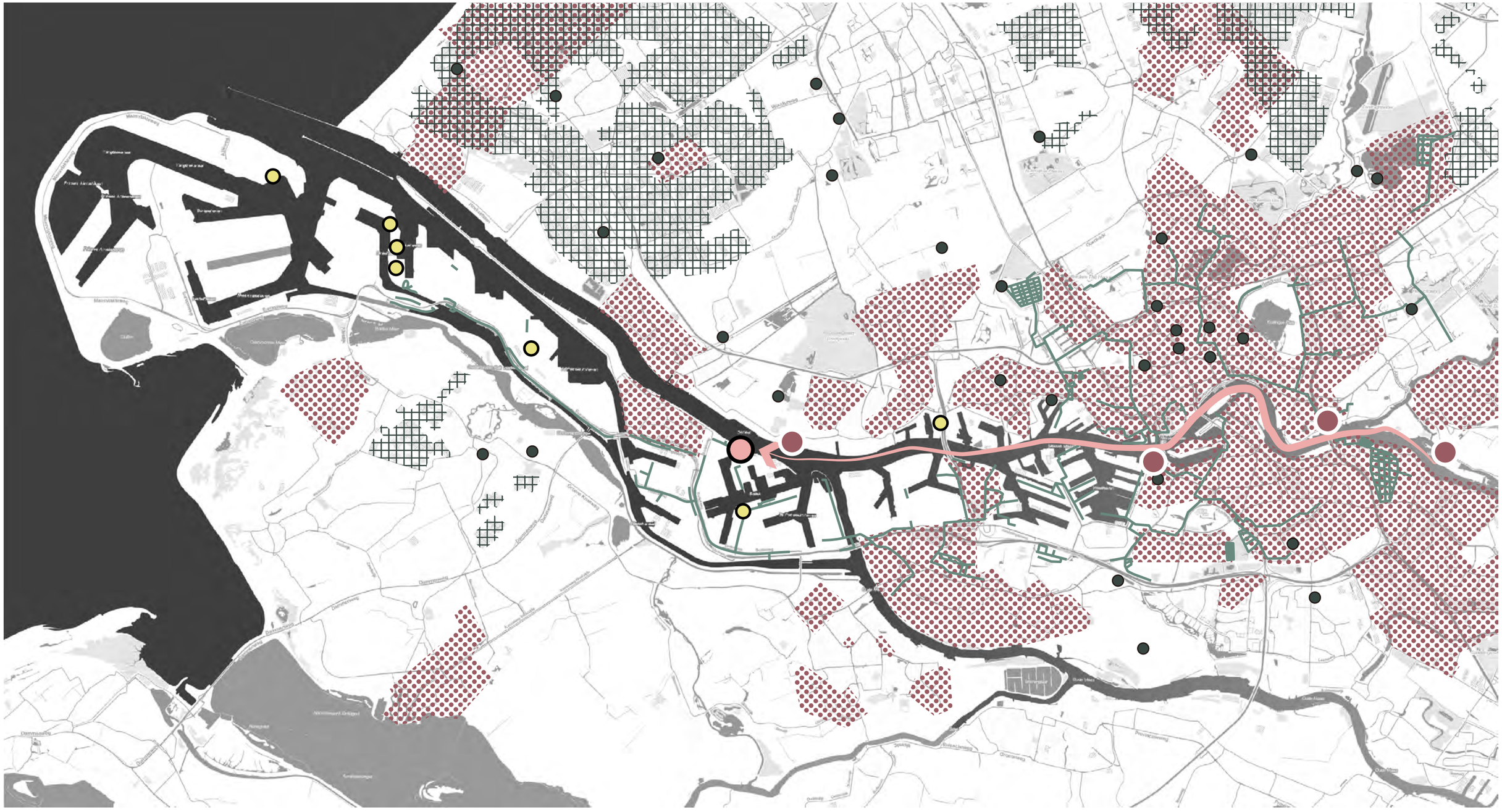
My design concept is based on the "Cradle to cradle" theory. In this scheme model, multi-function possibilities will be provided, and in the end function as a whole to help the transition in harbor area. In this scheme, it also shows the possibility of combing different functions to solve the existing problems from this three aspect. The landscape here function as an integrated system providing different conditions for the urban, economic and natural development in a long term. In the end an adaptive landscape where residential, recreation, commercial, local production coexist will be the goal with the help of the transformation of former harbor area to a circular Eco-efficient urban environment.

3. Context analysis



Source: Nico Tilly, Olv Klijn, Judith Borsboom, Martin Looije (ed), (2014), URBAN METABOLISM: SUSTAINABLE DEVELOPMENT OF ROTTERDAM. IABR, Rotterdam
Port of Rotterdam, NASA, Studio Marco Vermeulen, Agentschap NL

3.1.2 Flows of nutrient



Greenhouse Agriculture

High phosphate lost neighborhoods

Nutrient loss in river

Wastewater treatment plant

Incineration plant

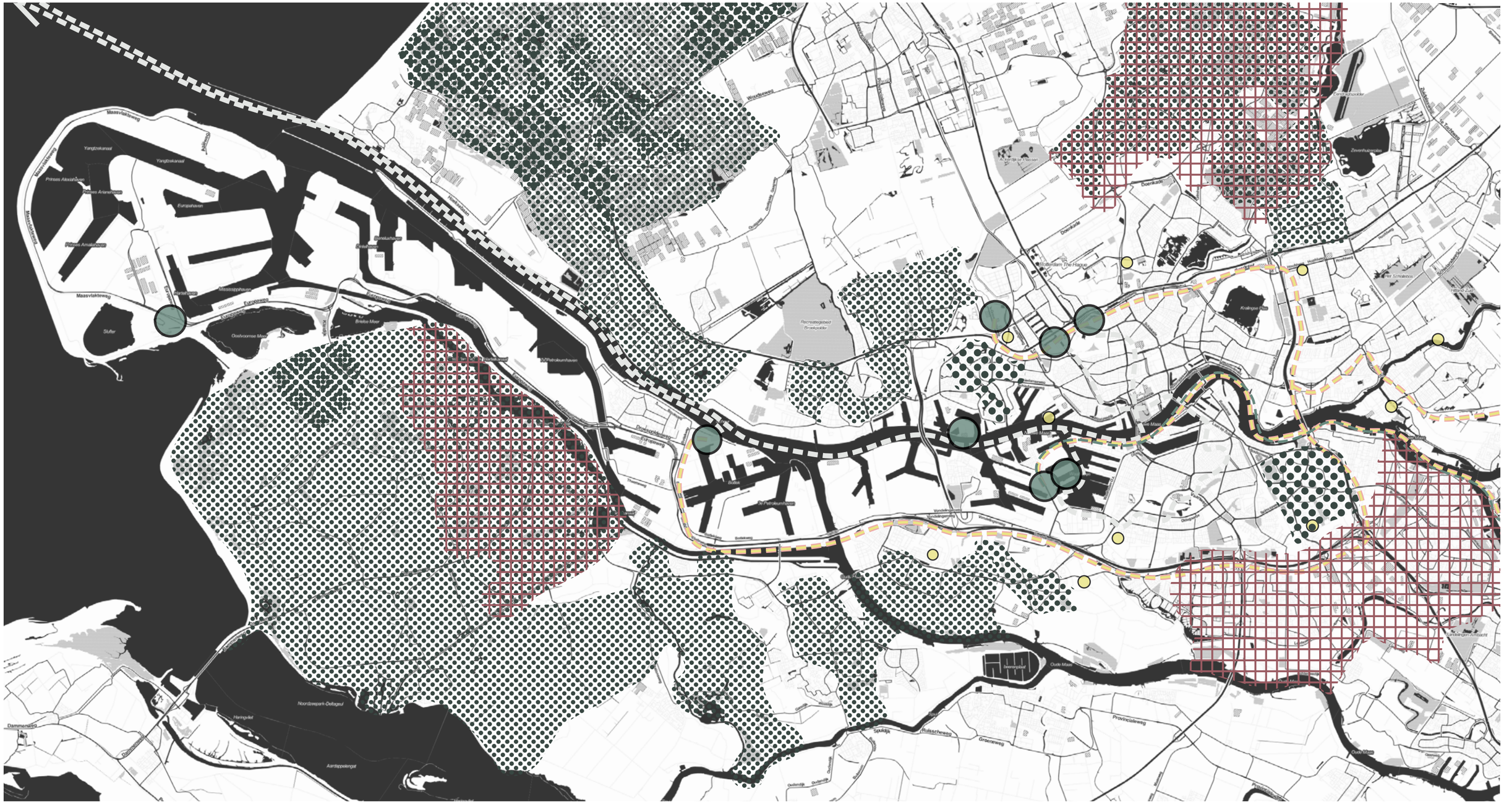
Soy and edible oils

Urban agriculture

Food remain waste

Source: Nico Tilly, Olv Klijn, Judith Borsboom, Martin Looije (ed), (2014), URBAN METABOLISM: SUSTAINABLE DEVELOPMENT OF ROTTERDAM. IABR, Rotterdam
COS (Centrum voor Onderzoek en Statistiek), Agentschap NL, http://rtb.container-beheer.nl/burgerkaart.php, Roteb

3.1.3 Flows of waste



Neighbourhood with high recircle rate of organic waste

Neighbourhood with high production of organic waste

Wood

Coarse garden waste

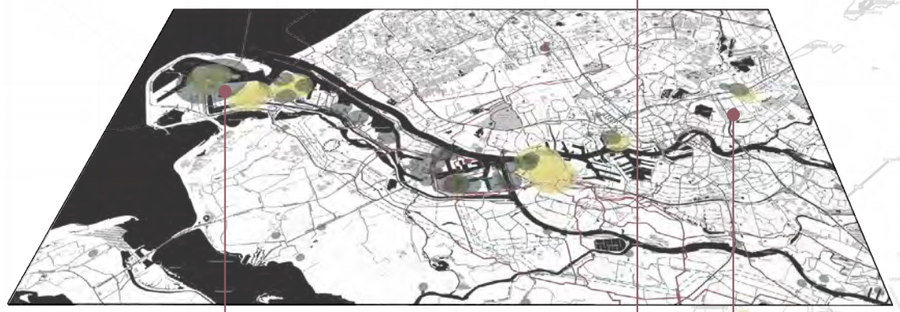
Residual household waste

Old paper and cardboard

Containers

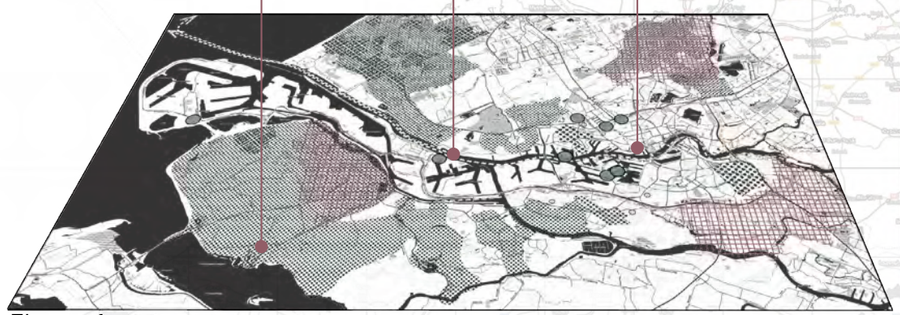
Source: Nico Tilly, Olv Klijn, Judith Borsboom, Martin Looije (ed), (2014), URBAN METABOLISM: SUSTAINABLE DEVELOPMENT OF ROTTERDAM. IABR, Rotterdam
http://waagsociety.github.io/mansholt/map, http://www.portofrotterdam.com, http://changeyourperspective.com, http://www.planetware.com, http://www.ah.nl, http://www.nationsencyclopedia.com, http://www.rotterdamseoogst.nl/home, http://www.eetbaarrotterdam.nl, http://nl.sireh.com/co/r/rotterdam_companies, TNO

3.2 Conclusion of mappings



Flows of energy

Flows of nutrition



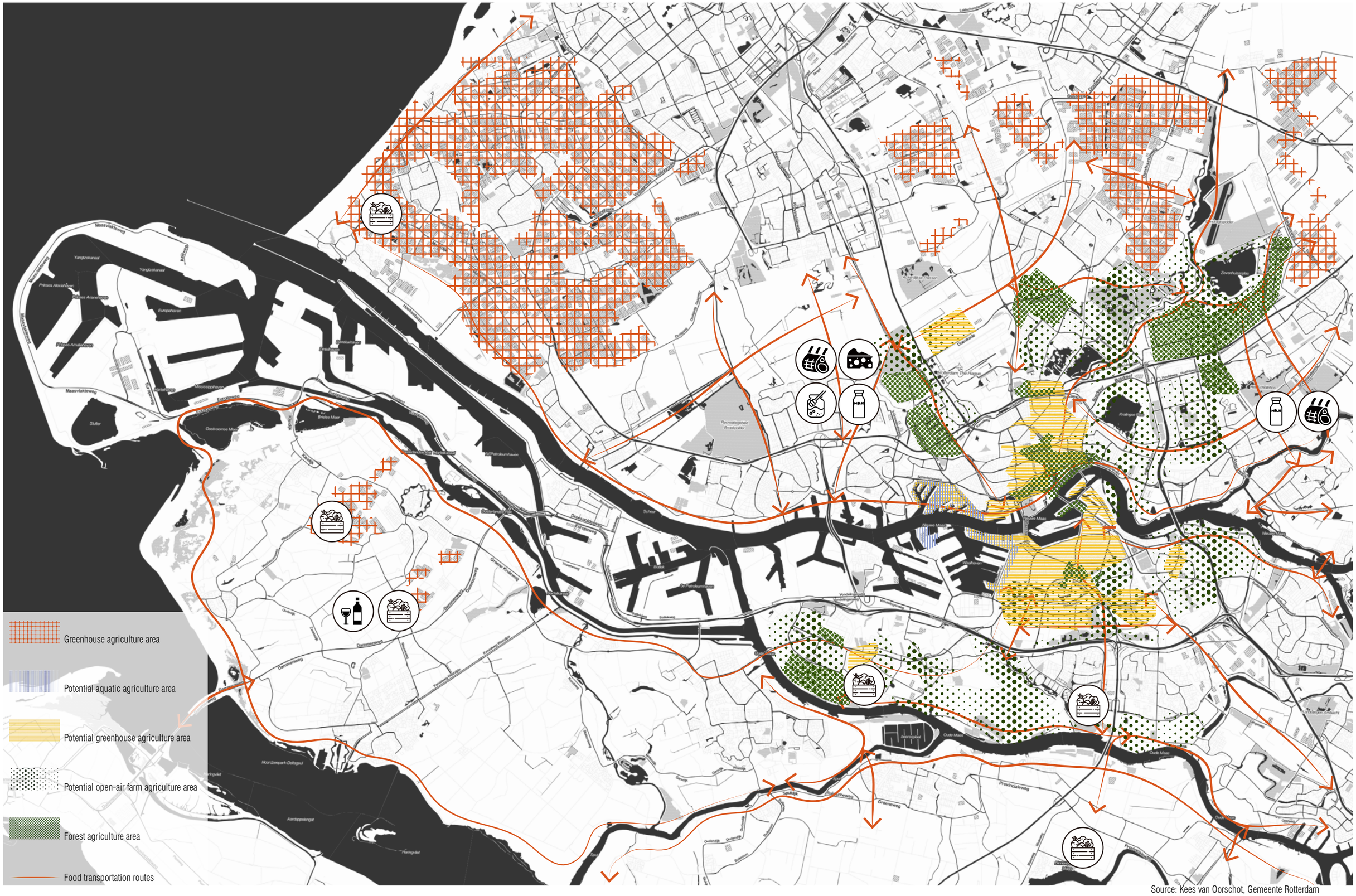
Flows of waste

Photo of M4H area

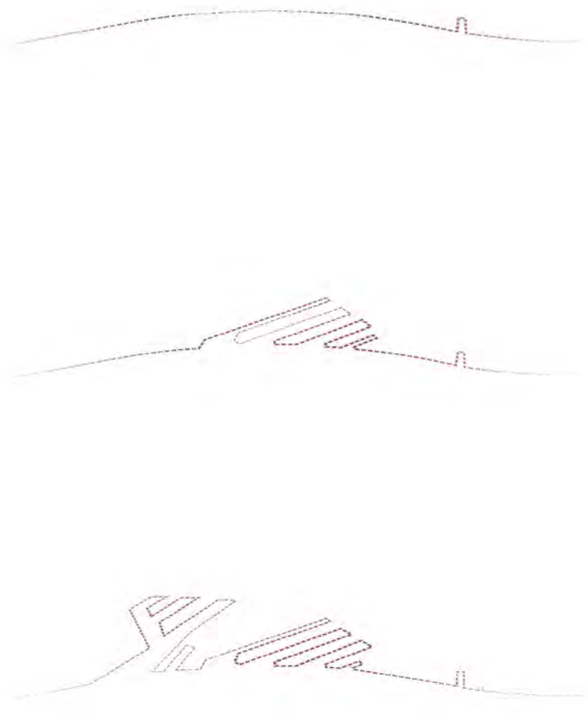
After mapping the flows of the Rotterdam city, a smaller site was chosen to the site of my research, the M4H area(Merwe-Vierhavens). It is a interesting site, now it serve as port especially for importing the fruits and vegetables from all over the world. Because of the upgrade of the industries, the government of the Rotterdam city wants to turn this area into a part of the Innovative Area of the Rotterdam city, which aims at turning the old harbor function area to a more innovative and creative industry area, not only help to upgrade the industrial system of the city, but also provide a more sustainable mode of development for the future.

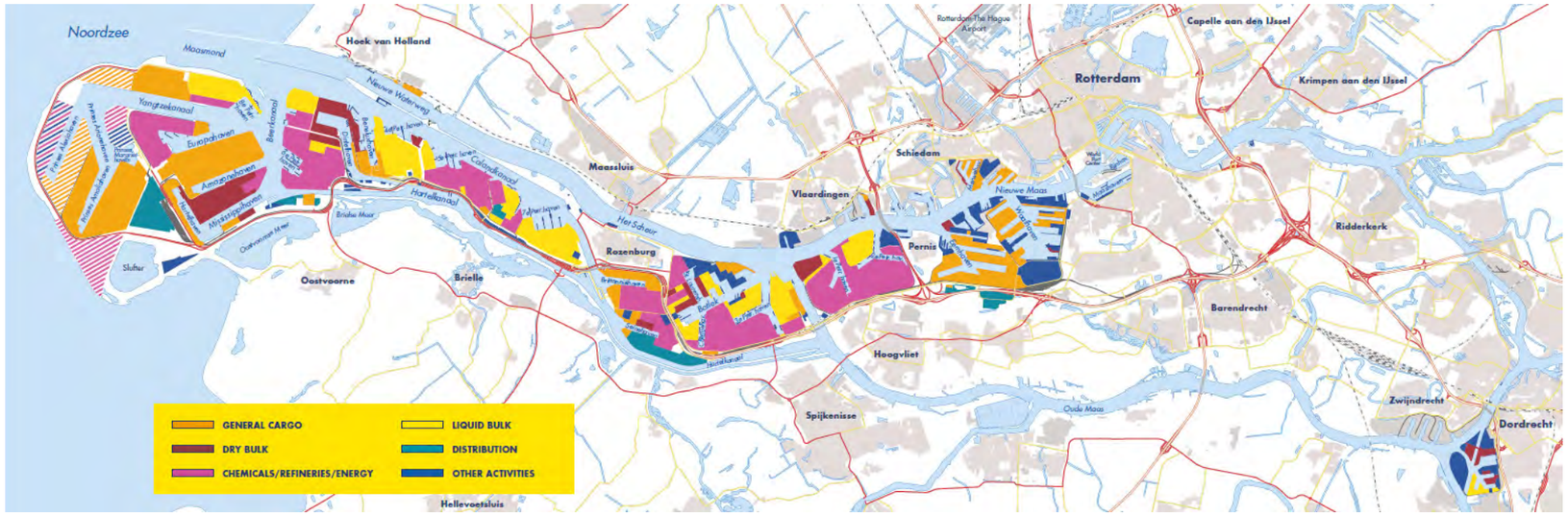
The transformation of the harbor needs a lot of investment and flows of people. A better quality of the urban environment is needed for the further study. That gives the M4H area a chance to get rid of the image of a industrialized port and turn into a more Eco-friendly urban environment, and also offer me a chance to practice the idea of the Eco-efficient urban landscape.

3.1.3 Potential of Urban landscape



Source: Kees van Oorschot, Gemeente Rotterdam
Eetbaar Rotterdam, Gemeente Rotterdam Ingenieursbureau





The Merwe-Vierhaven (M4H) is an old city harbor in the city of Rotterdam, The Netherlands. It is located on the North bank of the river Maas, close to the center of the city Schiedam.

HISTORY

The history of the M4H area is highly connected to the history of the Rotterdam city. The Rotterdam city was firstly being habited since year 800, and with the closed off the river Rotte in 1270, the city finally got its original shape. (Gemeente Rotterdam) The city was developed as dam and harbors because of its location along the river, and all kind of goods were trade here. In the 16th century, a movement of constructing new harbors have begun and last until today. The Rotterdam Harbor nowadays is still expanding westward, which can be seen on the image above. Instead of digging new harbors, new land was created in the sea, and that kind of movement leads to the renewal of the old harbor, and Merwehavens is one of them. It was constructed in the beginning of 20th century, and a few decades later it were developed into the shape it has nowadays. The function of the harbors is also changing during these few decades, first it was used the transshipment of gas, oil, tomatoes and fruits. And with years gone by the companies in the harbor became more fruits related, and makes the M4H area known ad the fruit-port

PRESENT

The M4H still functions as the fruit-port of Rotterdam. Businesses as HIWA, OptiCool, Citronas and Hillfresh import fruits and transfer them in order to be transported to the hinterland. But there are not only fruit businesses to be found in the harbor.
There are some small scale companies, as ateliers, restaurants and commercial businesses. Then there is also a large scale company, the energy producer EON.
The harbor has a very recognizable landmarks, the three large towers in the north, the Marconitowers. Nowadays the municipality office and a school are located here, but the municipality is moving out, which means two of the three towers need a new function and usage.

FUTURE

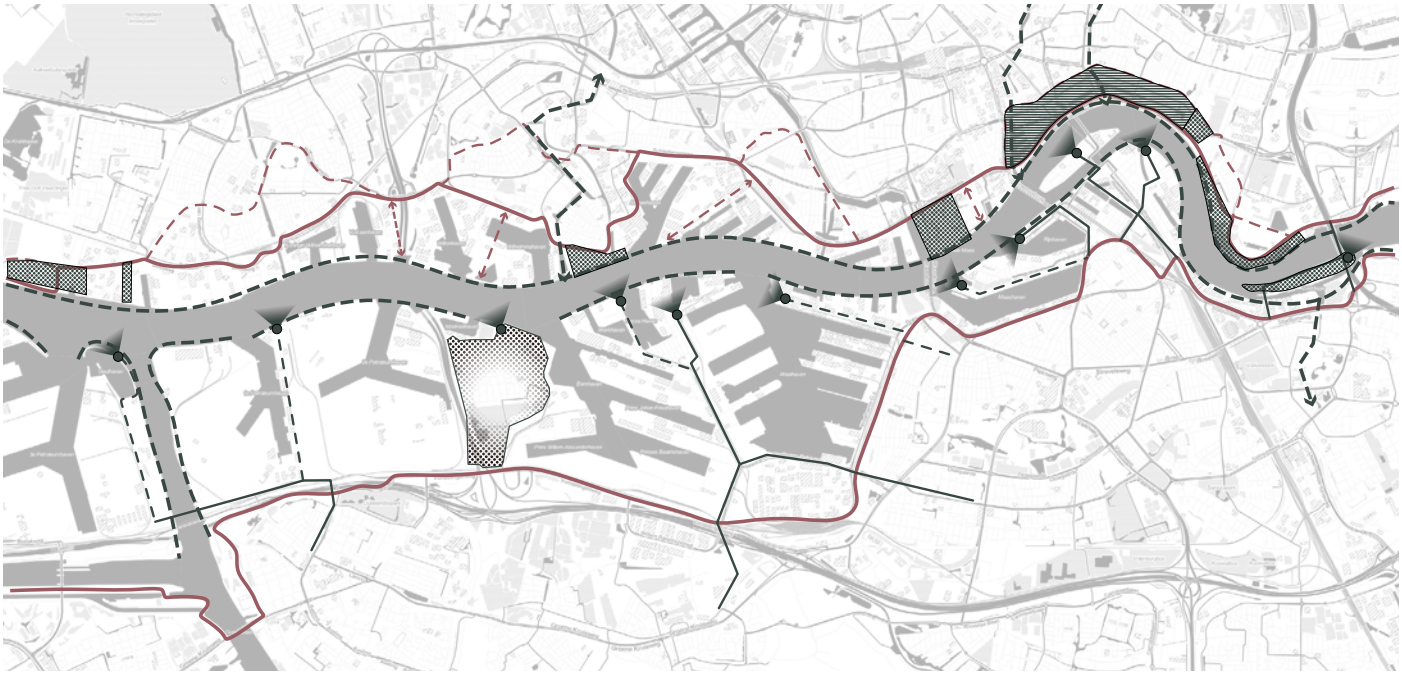
The fact that the municipality is moving out of the area is contrasting with their ambitions; making this area an innovative work-living environment. (Stadshavens Rotterdam, 2011) Due to the fact that more companies will be moving out, because of better/bigger harbours more to the west, space will be available for housing. In their vision the municipality focuses on the following themes:
* Re-inventing delta technology
* Volume & value
* Crossing borders
* Floating communities
* Sustainable mobility

But there is more than just creating a new innovative work-living environment. The harbor is outer-dike area, which is not high enough to be safe from future flooding due to sea level rise.

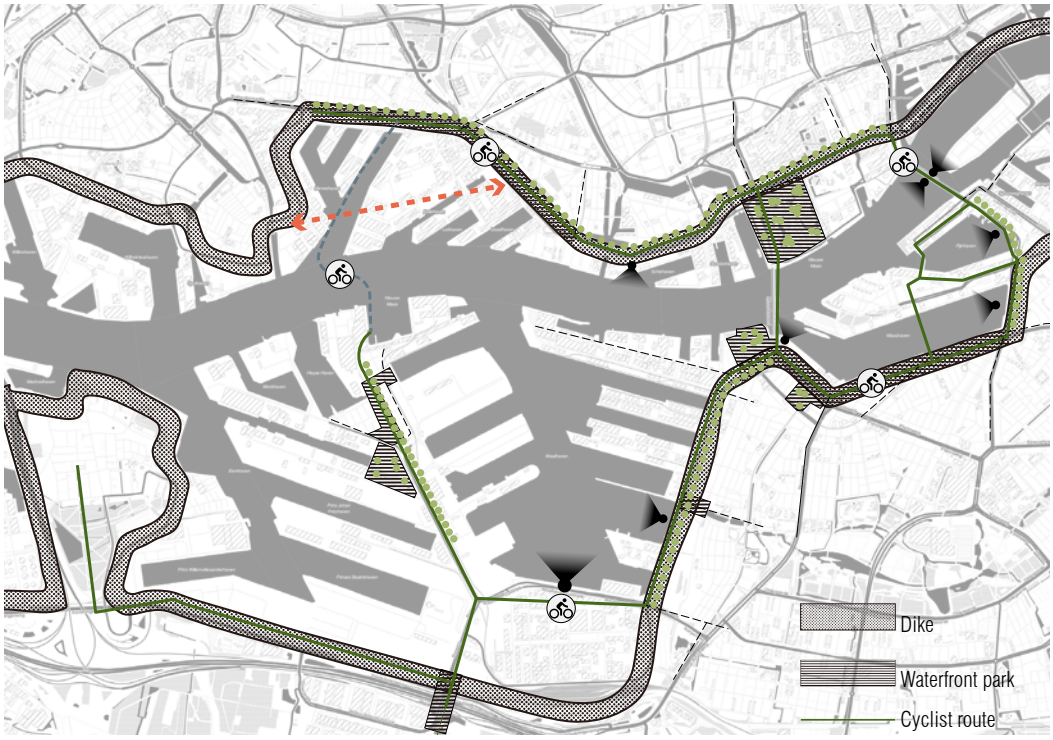
Source: Gemeente Rotterdam
https://www.portofrotterdam.com/en

3.4 Green infrastructure study

3.4.1 Structure of green infrastructure

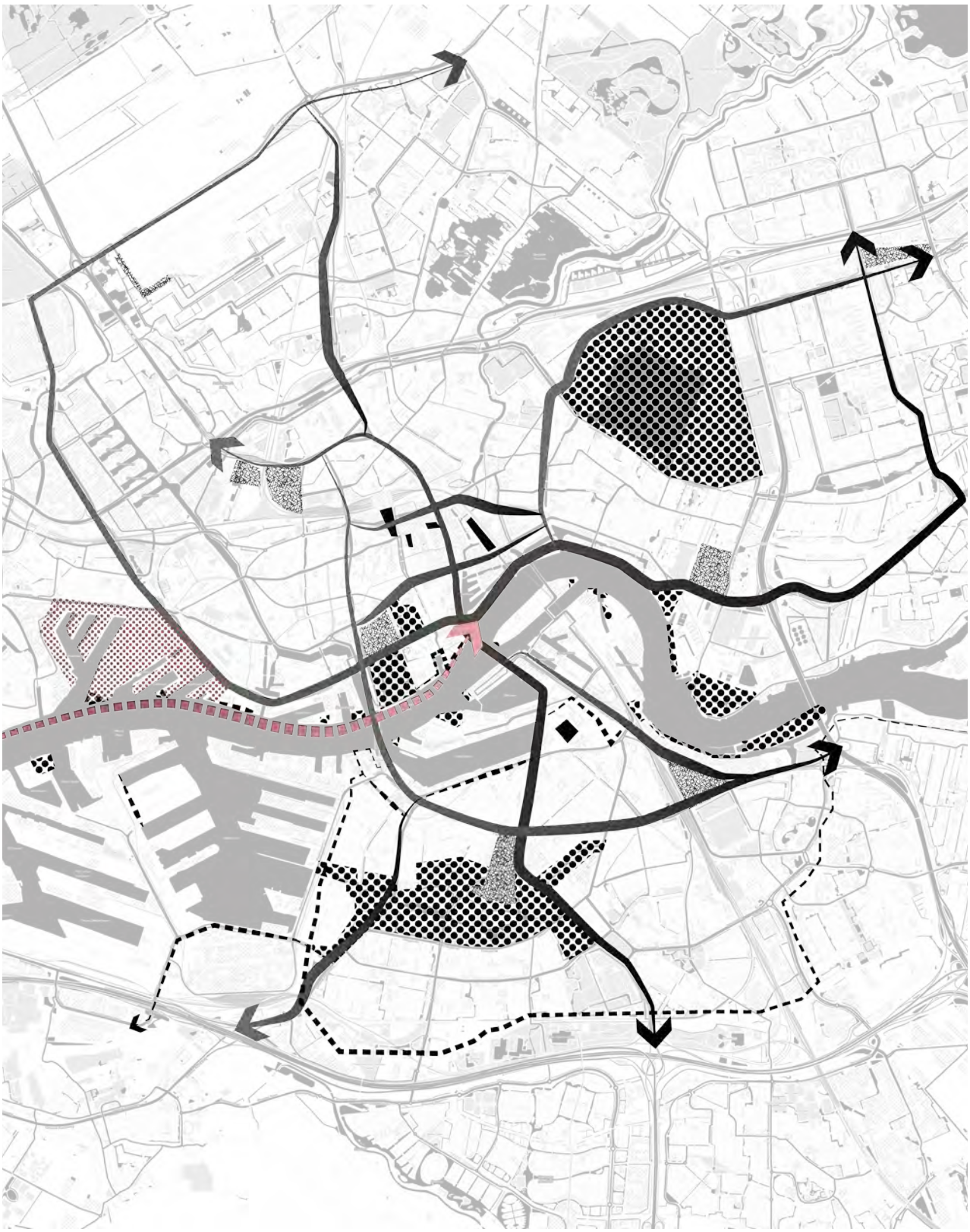


Existing park
Inner dike recreational area
Natural habitat
Canal
Recreational route (future)
Recreational route
Dike
Old dike remain
Water front



After marking the green infrastructure of Rotterdam and Schiedam, a conclusion can be found that the structure of the green land of the two cities is mainly spread along the New Maas River and the major canal of the city. And also because of this kind of structure, there is almost no connection between the green infrastructure of the two city. With the removing of the harbor function, the M4H area will have more room for green infrastructure, and there is a chance to connect the green system of the two city. That will help to improve the ecological vitality of this region.

3.4.2 Typology of green infrastructure



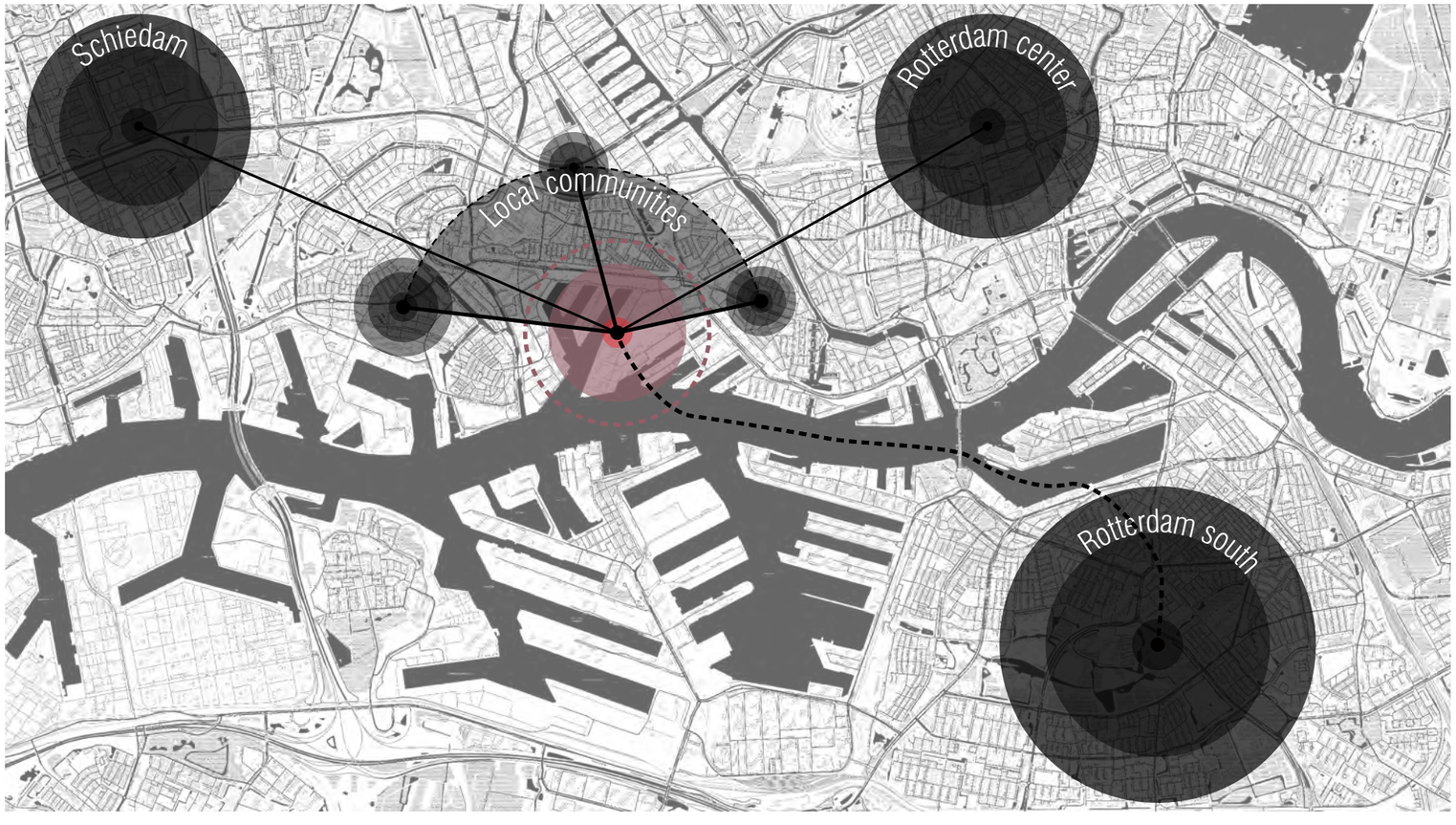
With closer study, we can find that the M4H area has the potential to be an important node of the green infrastructure corridor along the north bank of the New Maas River. As it showed in the map, there are some existing parks along the bank of the river, and the continuous structure is cut by the harbor. The future development of the M4H area could restore this corridor, and create a high quality water-front public space for the citizens. The improvement of the living spatial quality could attract more people to be willing to live their lives in this area.

3.5.1 Public transportation system

Source: Gemeente Rotterdam
https://www.portofrotterdam.com/en

3.5.2 Intercity highway transportation system

Source: Gemeente Rotterdam
https://www.portofrotterdam.com/en



The study of the public transportation is showed on the map, and what can be seen is that the out-skirt of the site is well connected to the public transportation, but inside the harbor area, there are not public transportation there. That is because there are no residential housings inside the harbor area and the major form of the transportation is the trucks carrying the cargoes, therefore there is no need for the planning of the public transportation. That leaves a lot of space for the future public transportation planning of the design.

On the other hand, the high way transportation system is very well connected to the harbor area since the cargoes need to be transported to the other parts of the city by truck. But it also means that the roads inside the harbor area is relatively wider and the spatial quality is not very ideal for living. This is the situation need to be improved in the future design.

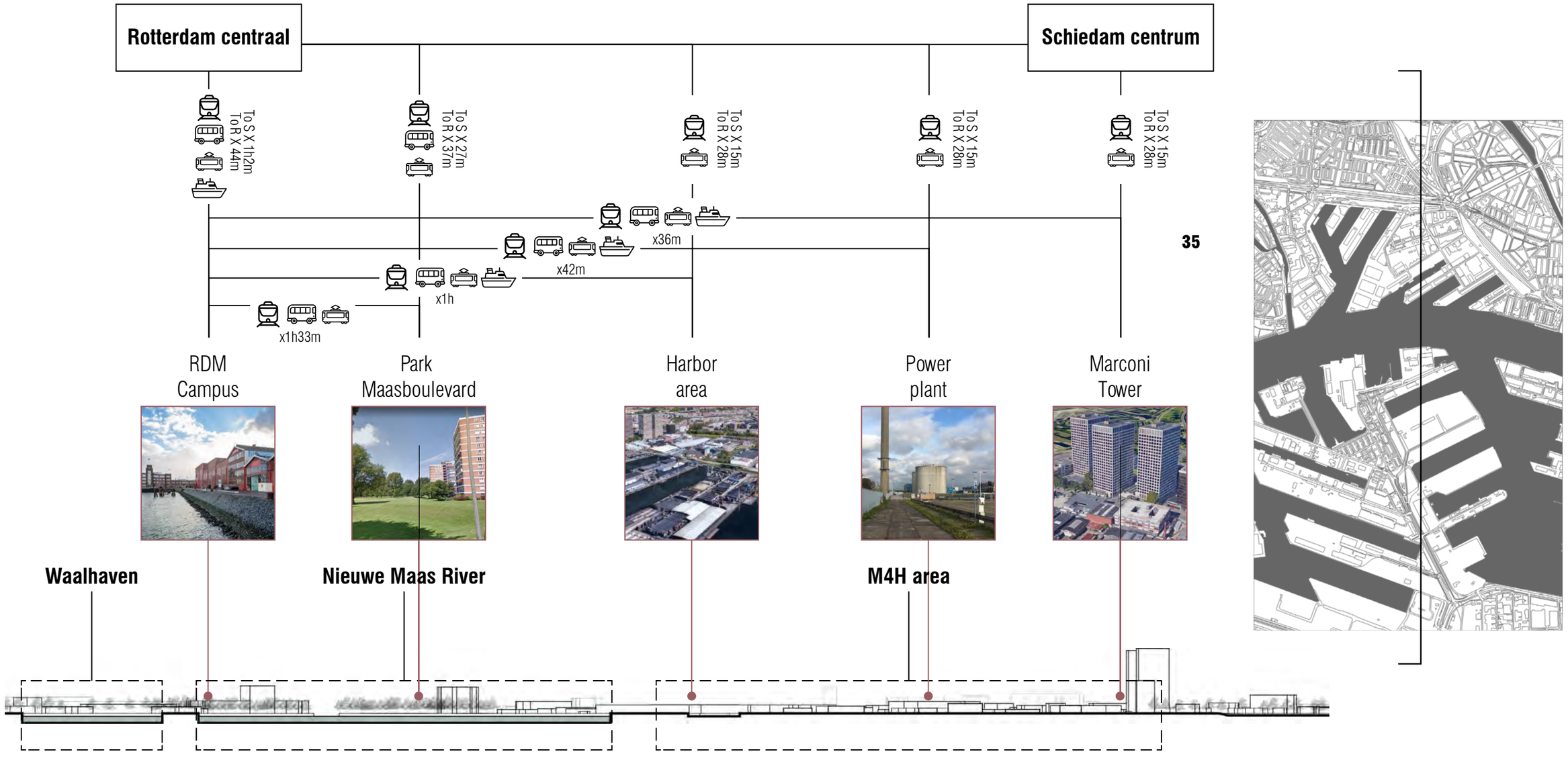
A conclusion can be draw that the site has good connection with the other part of the city, but in perspective of efficient public transportation, it has a lot to improved. The good connection with the city can brings more flows of people and investment into the construction of the new harbor area, which means a better spatial quality need to be provided for the citizens of the surrounding and future residents live in the area.

3.6 Section

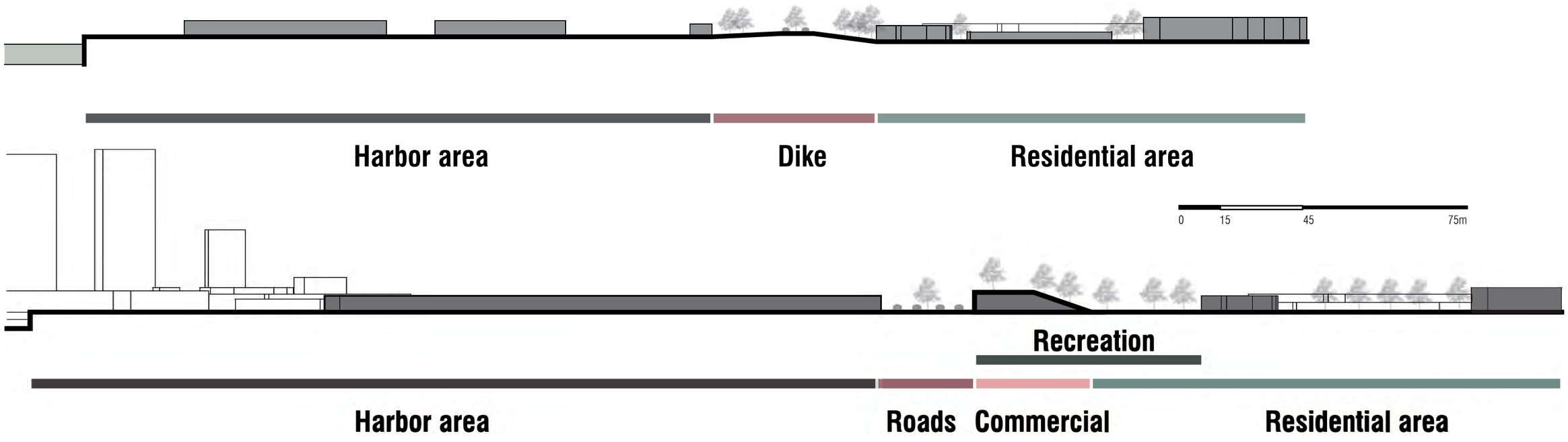
From this section some interesting mis-match of the physical distance and commuter time can be found. It can be seen that the Park Maasboulvard and the RDM campus is close to each other physically, but it takes the most of the time to travel in between by public transportation. But the other area, like the Marconi Tower, is much further from the campus, taking much less time to travel to there. Thats because the setting of public transportation stops. Even if the Park Maasboulevard is much closer to the campus, it is not a public transportation hot-zone, which means there are not too much public transportation stops being set there and the option of forms of transportation is relatively limited. Also, the frequency of the public transportation is relative low so the routes of the transportation has to cover as much as area as possible, which means it takes more time to travel.

From this point of view, the coverage of the public transportation of the M4H area is not very even, some area of the site has a better connection with the other part (especially the south park) of the city, but for the other area it is not a very efficient choice to travel with public transportation. A better coverage of the public transportation system is needed for the further development of the M4H area, and the efficiency of the public transportation need to be improved.

Another interesting can be found in this section is the commuter time to the center area of the city. Even though the jurisdiction belongs to the government of the city Rotterdam, but actually it is much closer to the Schiedam city center. But thanks to the high efficiency of the subway system, it dose not take to much time to travel to the center area of the Rotterdam city. Again, the uneven of the coverage of the public transportation system shows up and some area needs more time to travel to the central area. But in general the M4H area has an efficient transportation system although it has room to improve.



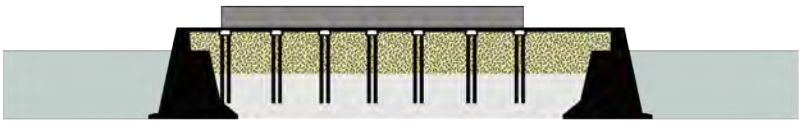
3.6 Section



Further study with smaller scale sections, what can be found is that even though there are great amount of residential buildings and communities around the M4H area, but the spatial connection between the harbor area and the residential area is not very strong. From the section, it can be seen that the north side of the M4H area(section A-A) is separated by the dike, and the height difference between the dike and the residential communities is around 3 meters, and that is quite a physical barrier. The dike is crucial for security of the communities, but is also a element we have to deal with if we want to connect the harbor area and residential area.

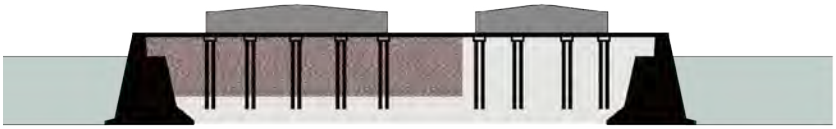
On the east side of the M4H area(section B-B), the connection is also not very ideal. There is a artificial terrace serve as recreational park and commercial buildings, even though it is a good quality public space for citizens, but it also serve as a barrier for the harbor area. To keep the good quality of the park and commercial area at the same time connecting the harbor is a good challenge

3.6 Section



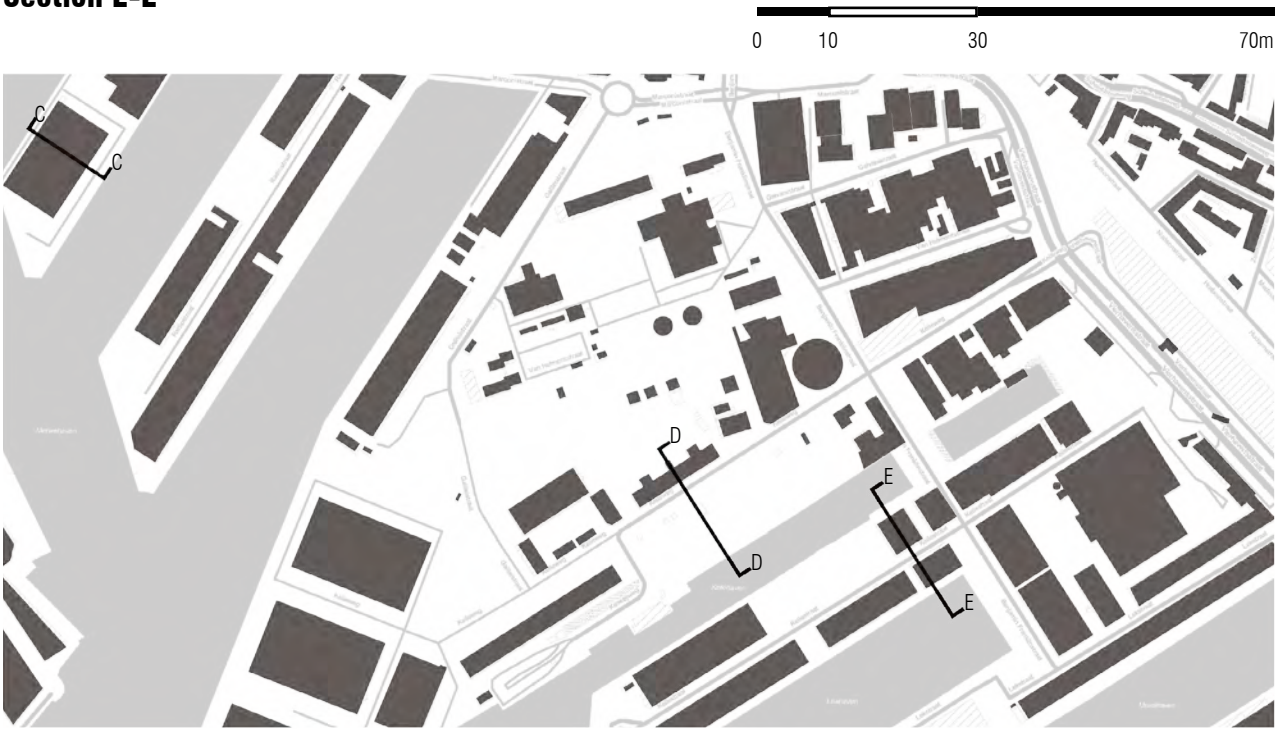
Section C-C

Section D-D



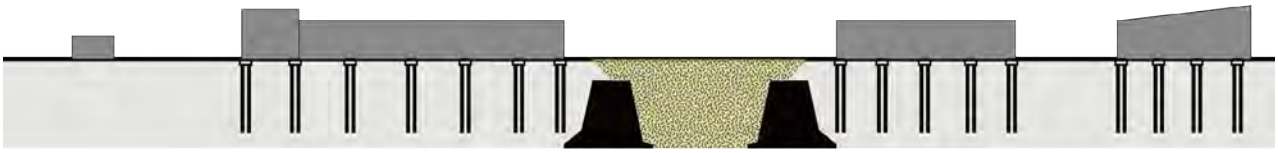
Section E-E

To zoom in much smaller scale study, the much more detail information can be found. Some of the harbor area were filled with sandy soil, and because of the power plants, there are some polluted soil under the buildings. And due to the transformation of the harbor, there is also some old walls of the old harbor. That is part of the history of the area, and it is a point that should be paid attention to .



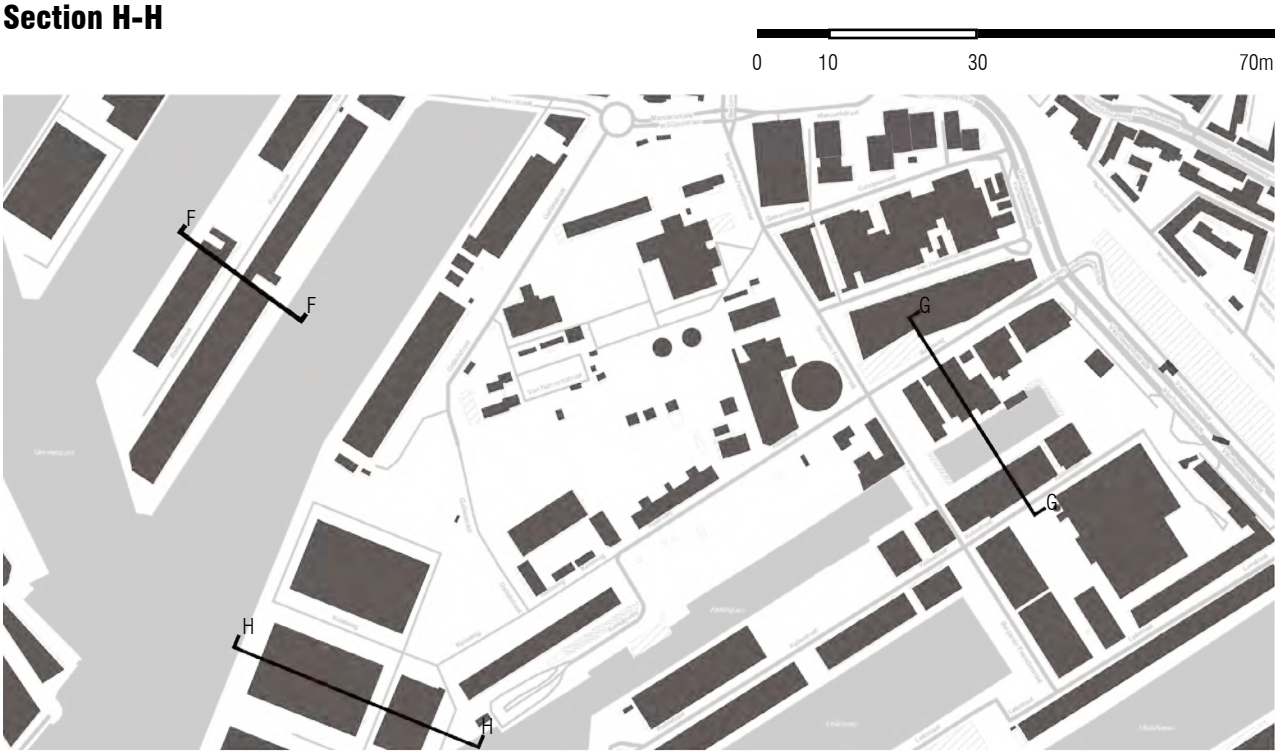
3.6 Section

Section F-F



Section G-G

Section H-H



3.7 Flood risk

Water levels Rotterdam (Nieuwe Maas)

Rotterdam (Nieuwe Maas)

Slotgemiddelden 1998.0

Algemene gegevens	
1813	Aanvang waarnemingen
1 sep 1874	Peilschrijver geplaatst
23 jun 1987	DNM geplaatst

Gemiddelde waterstanden bij gemiddelde afvoer (2200 m^3/s)			
type tij	HW-stand in cm + NAP	LW-stand in cm + NAP	tijverschil in cm
gemiddeld tij	132	-39	171
springtij	148	-38	186
doodtij	112	-38	150
gemiddelde waterstand		24	

Source: Rijkswaterstaat
Chart made by: Sanne Mooij

The M4H area has the high possibility to be flooded since it located in the outer dike area. The history of the water level changes of the Nieuwe Maas river was studied in order to understand how big is the risk is.

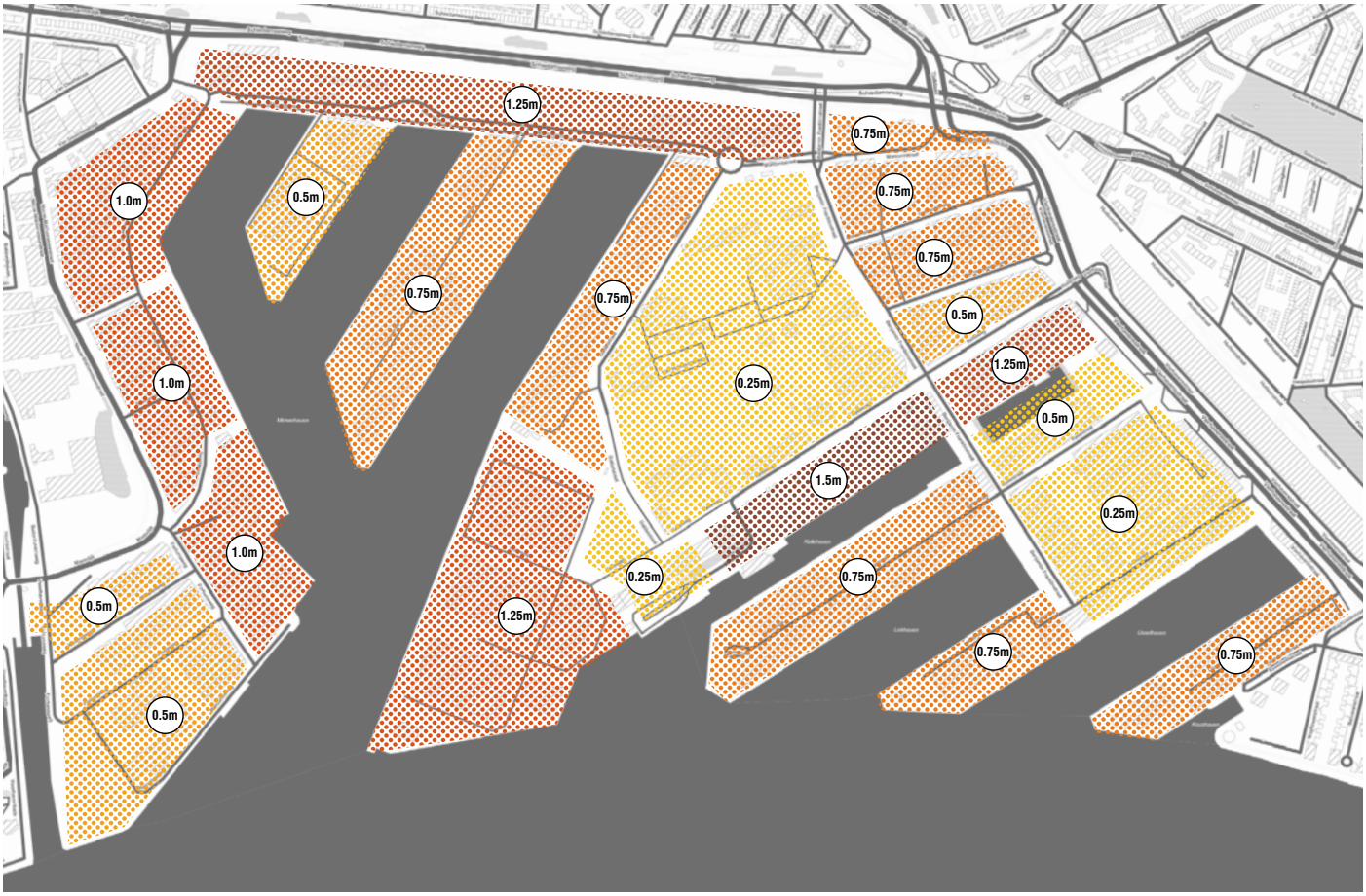
According to the data provided by the Rijswaterstaat, the river has an average high from NAP-0.39 to NAP+1.32 due to tidal change. But in some extreme weather, the water can be pushed up to a higher level.

As it is being showed in the graph on the left, the quays of the M4H area have an average height of NAP+3.40, but some parts are less than NAP+2.80. The lower quays could not survive the flood during the storms,because the water level will reach the level of NAP+2.70. Also, the sea level is predicted to rise 30 to 40cm in the next few decades, this quays will be at the bottom of the water at that time.

Also, because of the climate changes, the frequency of the extreme weather is also estimated to be more often. That means the M4H area is actually more dangerous than the situation right now. If nothing going to be done, the whole area will be under the water as it showed in the graph in the right.

3.7 Flood risk

Height of the water every 2000 years



Gemiddelde havengetallen bij gemiddelde afvoer (2200 m^3/s)

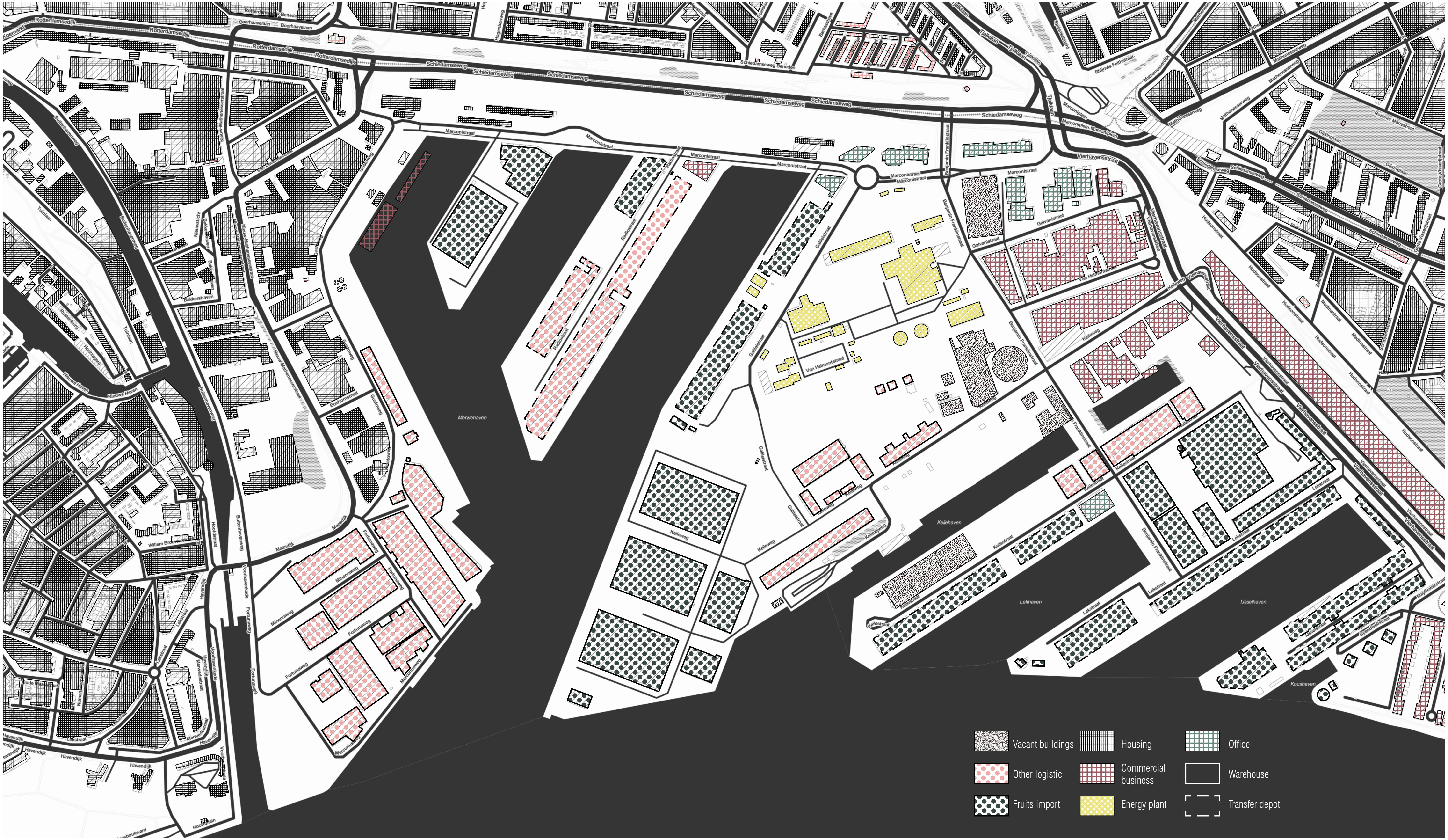
Gemiddelde over- en onderschrijdings frequentie per jaar

overschrijding hoogwaterstanden		onderschrijding laagwaterstanden	
frequentie	stand in cm	frequentie	stand in cm + NAP
1x per 10.000 jaar	358	1x per 10 jaar	-120
1x per 4.000 jaar	351	1 x per jaar	-100
1x per 1.000 jaar	342		
1x per 100 jaar	326	OLW 1991.0	-65
1x per 10 jaar	299		
1x per 2 jaar (grenspeil)	268		
1x per jaar	256		
Maatgevende waarde (Schieland, 1 x per 10.000 jaar)	360		
Maatgevende waarde (IJsselmonde, 1 x per 4.000 jaar)	350		

Source: Rijkswaterstaat
Chart made by: Sanne Mooij

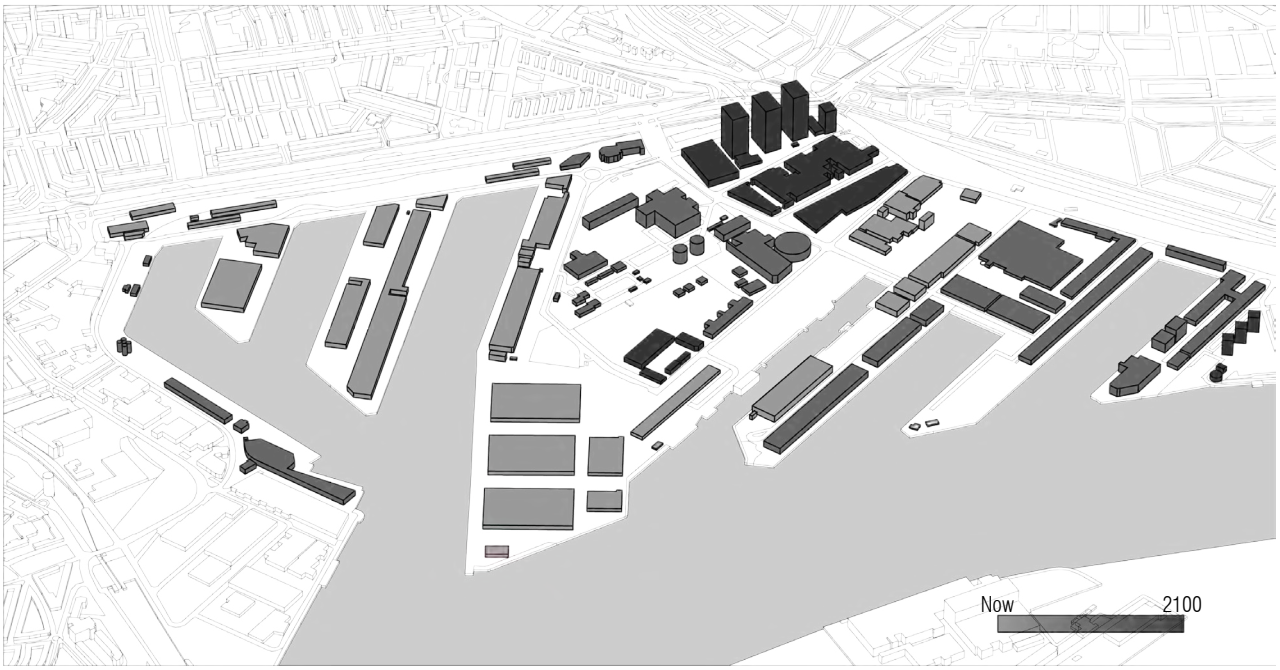
Luckily, the Measlantkering (flood defense of river Maas) will be closed while the water level reach a dangerous height (around NAP+3.0),which means the M4H area should be safe. But action should be taken to face the risk of the failure of Measlantkering and the challenges of the future.

3.7 Buildings typology study(function)

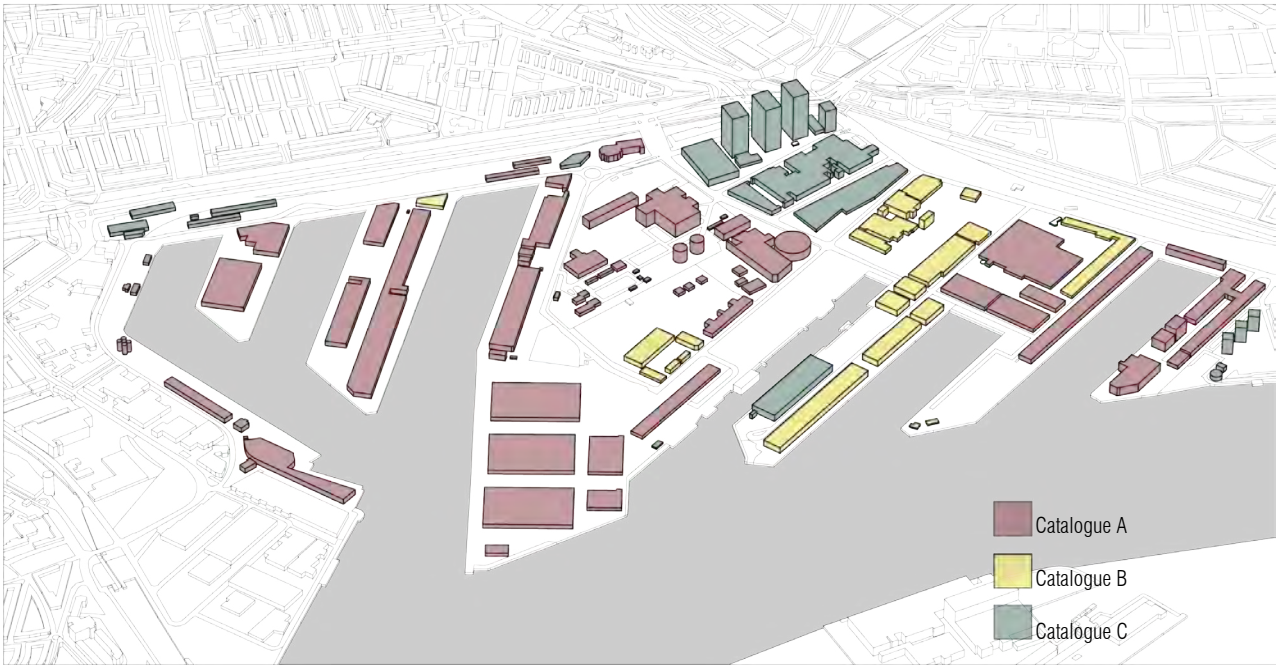


3.7 Building typology study

Ground lease contracts

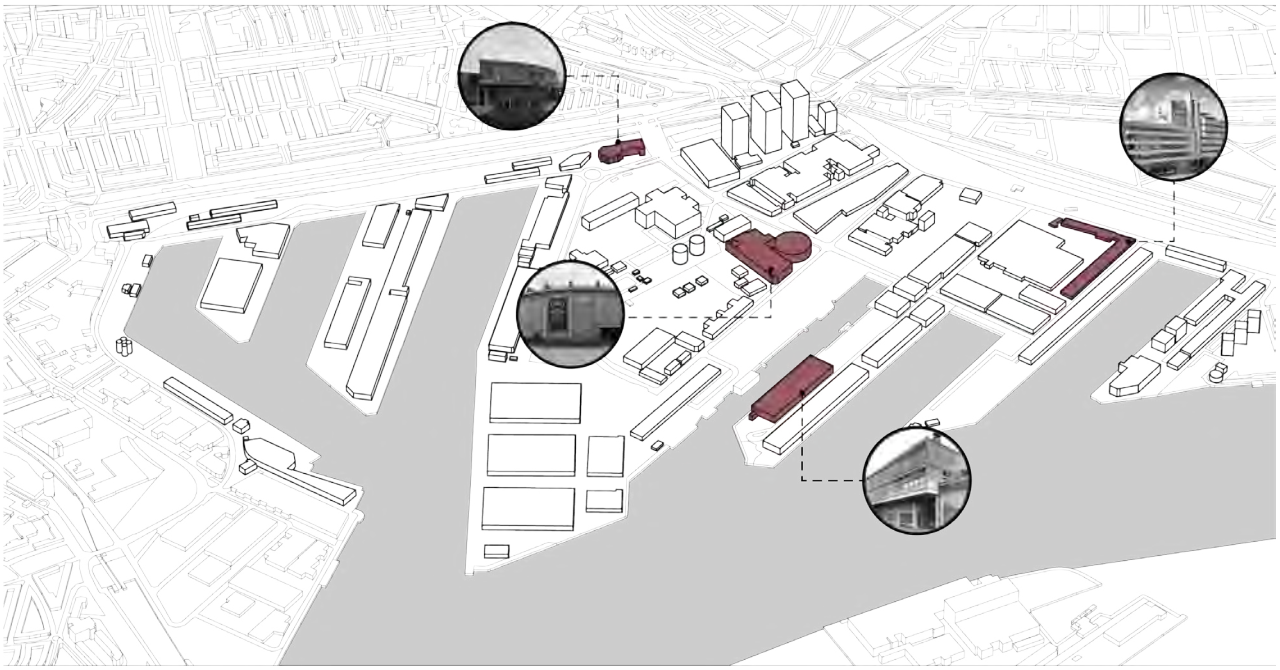


Environmental impact

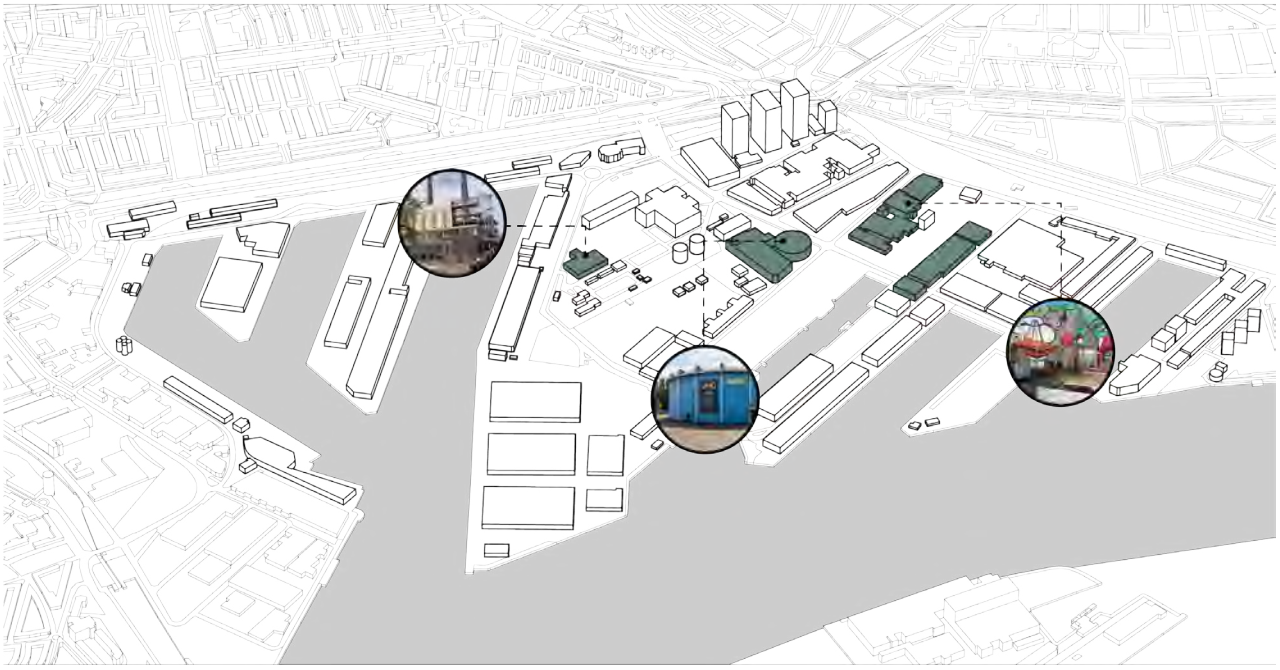


3.7 Building typology study

Monument Building

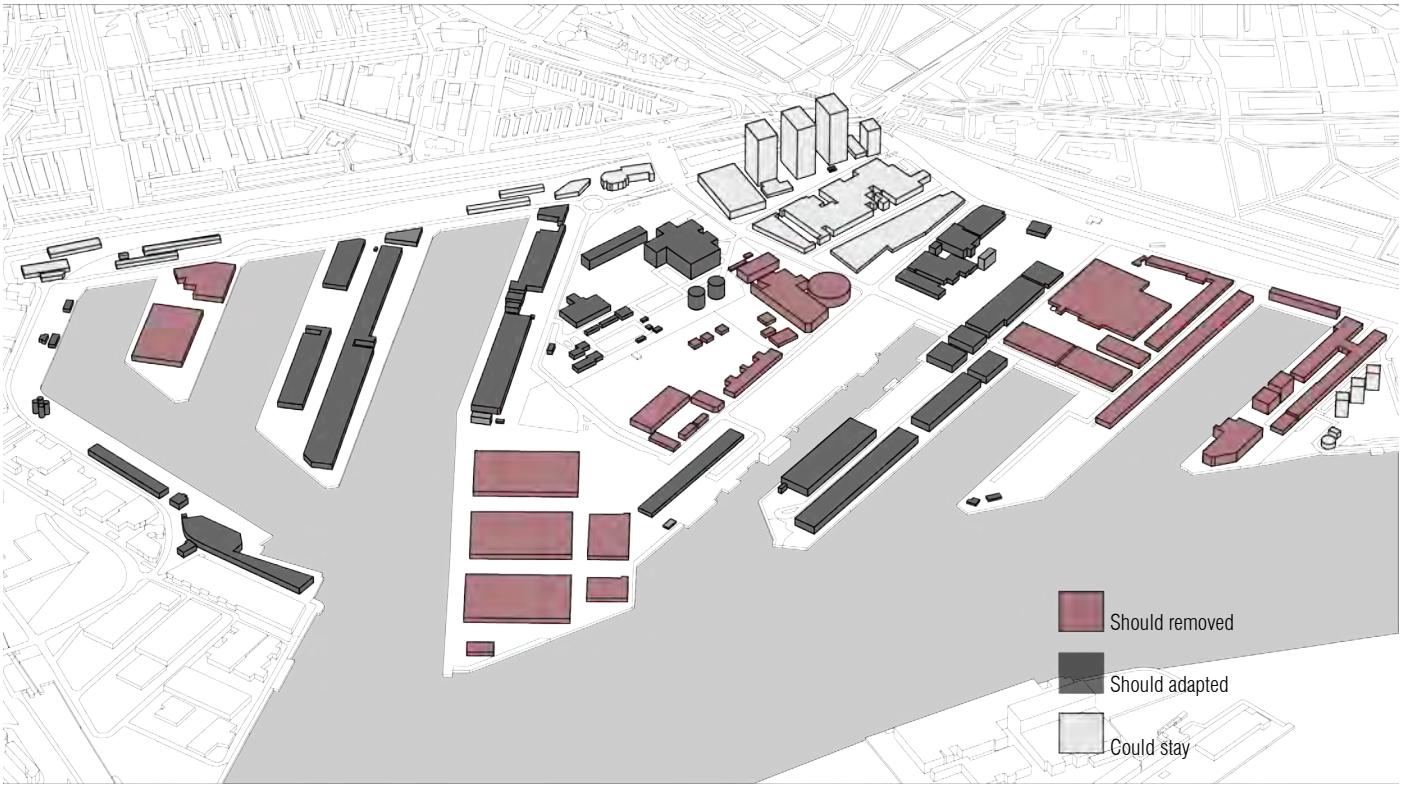


Innovative manufacture



3.7 Building typology study

Proposed treatment



The adaption or improvement of the original buildings on the site need to take a lot factors into consideration. In this part two major factors are taken into analyses, one of them is the time of the ground lease contract, which means when will buildings and the land attached to them can be put into the new function. The second one is the environmental impact of the function of the current buildings. They are divided into three catalogue. The green catalogue (Catalogue C) is the function that do not do much harm to the surrounding environment therefore could be set round the residential dwellings. The red catalogue (Catalogue A) is the function that has bad environmental impact on the environment, they might be noisy, dusty or poisonous to the surroundings. And the yellow catalogue (Catalogue B) is the almost the same as red catalogue, but they need more transportation connection with the major roads or transportation nodes.

Also the monumental buildings which have the historical value and the old buildings have new value is also being mapped. Some artists has adapted the old buildings into studios and some innovative manufactures have used the old warehouse as facilities to make new products with used materials, which matches the idea of Eco-efficient.

Combined these four maps together, a conclusion map can be draw. Some of the buildings are belong to the catalogue A but they have a long ground release contract, so instead of removing them, adaption is a better choice for consideration. Some commercial buildings are belong to catalogue C so they could stay. And some of the vacant buildings are belong to catalogue A or B, but since they have certain historical value that helps to build up the new genius loci, so the adaptation is a better option.

3.8 Conclusion of analysis(SWOT)

After all these analysis, a final conclusion can be draw. Based on the information we have, we can conclude the strength, weakness, and opportunity.

Strength: The site is well connected to the other part of the city, both in the pubic transportation and high way transportation. And the surrounding residential dwellings will also provide sufficient flow of people to the site. The infrastructure of the surrounding environment is also very well set and maintain, which is a good condition for large scale of residential housing construction.

Weakness: Even though the site is well connected to the city, the coverage of the transportation system is not even, especially the public transportation. That leads to the situation that some part of the M4H area takes much longer time to travel to the south and central area of the Rotterdam city.

Opportunity: The future design for the M4H area of the Rotterdam city government gives a good opportunity for the development of this area. With the upgrade of the industrial system and the removing of the harbor function, the M4H area can play an totally different role in the Rotterdam city. And thanks to the special place where it is both close to the center area of the Schiedam and Rotterdam city, the potential of the flow of the people and investment is promising.

Threat: As a urbanized delta area, the M4H area also face the challenge global warming and the rise of the sea level. How to maintain the safety of the area is major threat to the future development. Also, the high polluting industrial and historical polluted soil is another issue for the future citizens who are going to live their lives there.

Beside the SWOT, the long contract of the current stake holder is also factor needs to take into account. The gradual release of the land contract means the area needs a plan works for a longer period of time.

4. Case and principles study

4.1 Case study: Île de Nantes, Nantes, France

In the late 1980's a big part of the companies on Île de Nantes closed. This major event, caused by the collapse of the shipbuilding industry, was the start for the île de Nantes project. A big redevelopment assignment arose. In 1995 the project began, by composing a team which was eventually led by Alexander Chemetoff and Jean-Louis Berthomieu ad was called 'l'Atelier de l'île de Nantes'. This duo stated: "The goal is to find a way to cultivate the memory of past activities that have marked the history of relations between the river and the city, and at the same time ensure that the entire urban area develops, in its geographic centre, the look and feel of a city open to the river." (Samoa, 2014)

PLAN GUIDE

A plan guide consisted of two very important maps was set up by the designers. One of the maps is the existing situation and the other one is what was planned. (Dehaene, Levy, Declerck, & Baes-Cantillon, 2012) By updating the maps every few months or years it is possible to oversee the impacts that interventions have on the next stage, and adapt the vision for the area. The images on this page show this constant adaptation of maps. In eight years' time the existing situation did not change that much, but there was a change in the planned situation. The plan is flexible and open for change.

TOOLS

The most important tool was used in this project is the involved of citizens. The workshop and citizen dialogue were frequently held and topics such as social lives, transit, environment, housing, shops and employment were often discussed. After the communication a common sense would be formed among the majority of the residents and it would be applied in the design. (Samoa, 2014)

5 themes where important during the project:
* The memory of places
* The promotion of activities related to river
* The balance between different means of transport
* Urban development cohesion
* The creation of unity (Dehaene et al., 2012)

These topics were already reflected in the first phase of the project and were most likely essential for its success. What they did is, implementing "a series of quality public spaces and enable rapid change and re-appropriation of the banks of the island by the people of Nantes." (Dehaene et al., 2012) This re-appropriation was also made possible by a yearly event: Les Allumées. During this events artists where invited to make art in the area, for example in old warehouses. This is a quick way of showing the residents of Nantes what is possible in the area, make it attractive. Normally this would take several years in a transformation project like this. (Caro, 2011)

FOR MERWE-VIERHAVEN

What could be important for the Merwe-Vierhaven is the memory of places. Nowadays people don't enter the area and are not bonded to it. When giving the area something recognizable, people's attention is attracted, and this image will last during the development of the harbor. The creation of unity and cohesion is also very important for the project location. When the Merwe-Vierhaven becomes part of the residential area of Rotterdam, it will form a new neighborhood, even though it will take several years/decades to develop. To make sure that the whole harbor will become one neighborhood, the unity/cohesion should be ensured.

Part of the planned map in 2003 (Lelièvre, 2003)

Part of the planned map in 2008 (Dehaene, Levy, Declerck, & Baes-Cantillon, 2012)

4.1 Case study: Circular Buiksloterham, Amsterdam, Netherlands

There is a lot happening in Buiksloterham, a former industrial area in North Amsterdam. The mono-functional industrial area is gradually evolving into a vibrant new area of the city. A variety of existing initiatives in Buiksloterham are aimed towards the circular city. It is an experimental area where innovative solutions for the temporary use of contaminated soil are being tried out, self-builders are investigating the boundaries of sustainable building and generating their own energy, collectives are developing together, and developers see the necessity of creating distinctive living environments that respond to the need for sustainable value development.

The circular systems within the new developments.

There are different ideas about what the circular city is. In the vision and ambition document for Circular Buiksloterham, seven indicators (materials, energy, biodiversity, society, health, added value, flexibility and adaptivity) have been formulated for the circular city. With circularity in the first instance the efficient management of raw materials. This contrasts with linear thinking that characterizes many processes. Besides material and energy flows, it also concerns issues such as biodiversity (also important for a large number of ecosystem services), and a pleasant and healthy society.

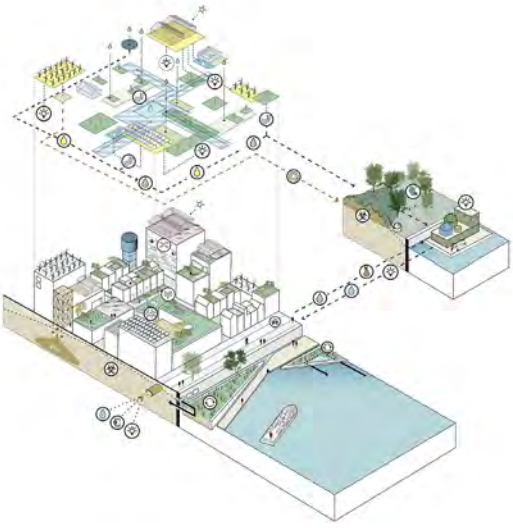
Toolbox

In order to arrive at a circular city, not only the ends of the metabolism have to be tied together. It is important to create an environment in which circularity can grow. Three research themes together form the instruments to achieve this circular growth.

* Embrace the 'New Genius Loci', created by industrialization;
* Program the city so that circularity can arise;
* Work on local exchanges of circular building blocks.

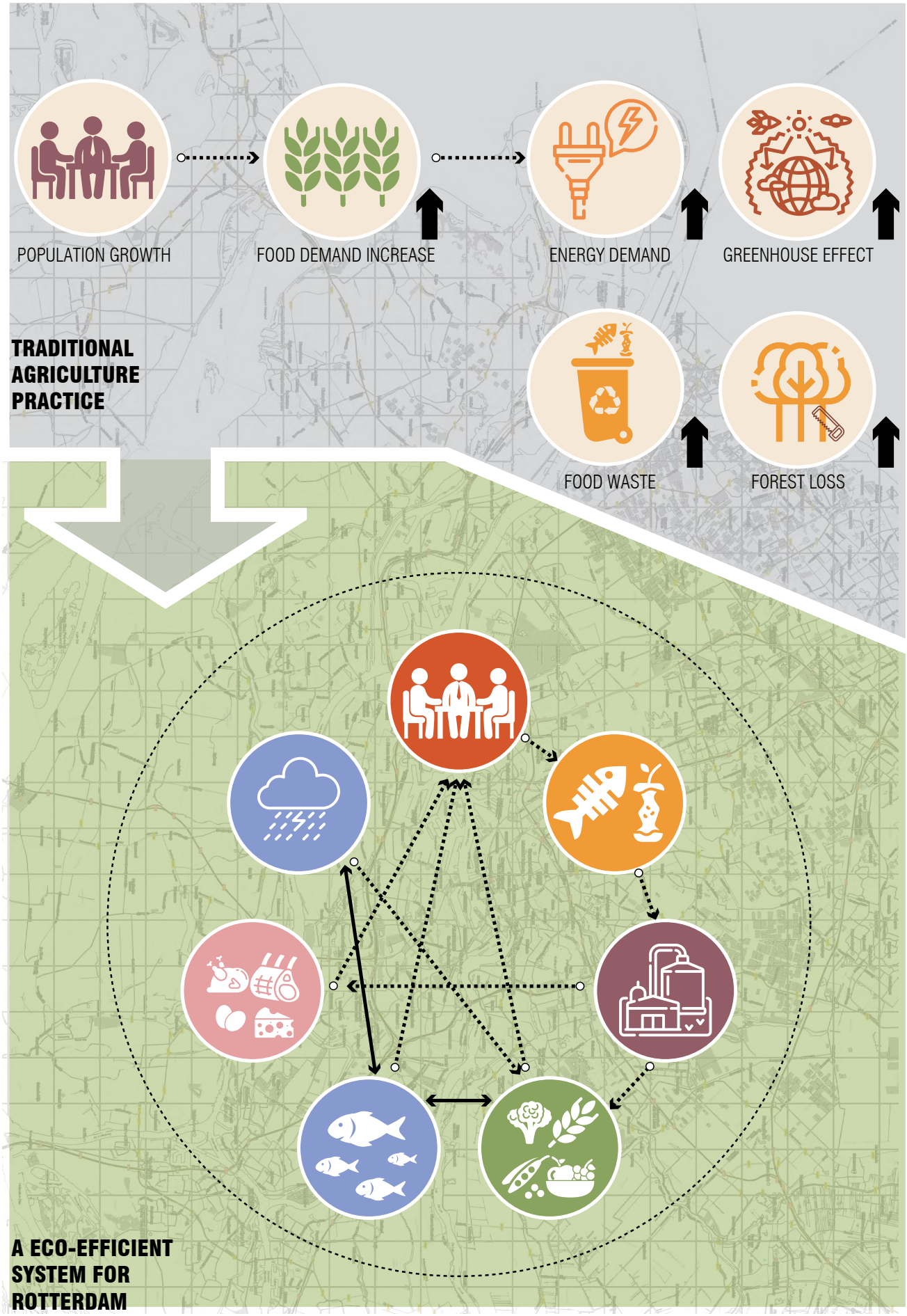
FOR MERWE-VIERHAVEN

Decentralization: What can be learned from this project is that treating the waste water and organic waste locally is the key for circular system. Using the raw materials created in daily lives as the fuel for power generating and other productive activity calls for the better garbage classification system, which means the reshape of the daily lifestyle. This project shows a great example for the transformation of the M4H area.



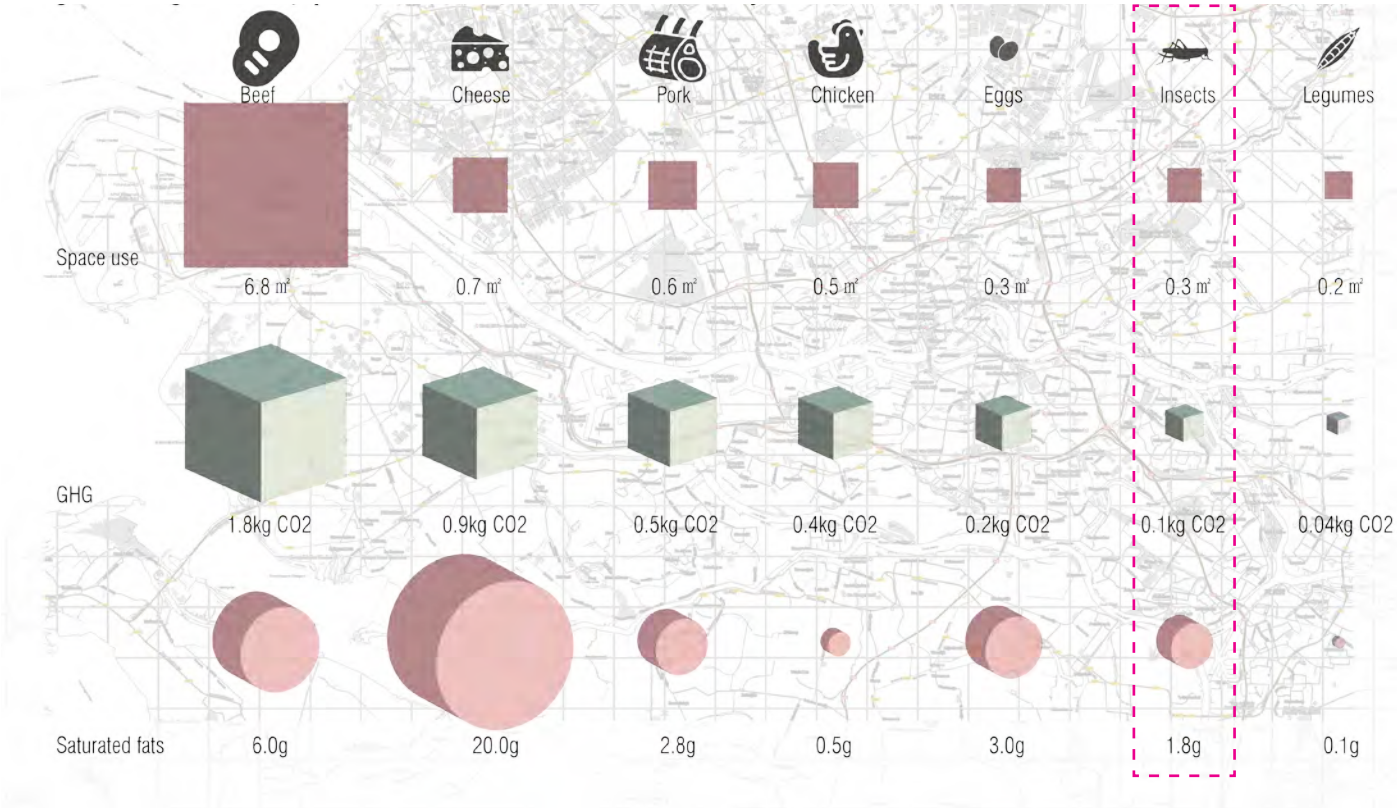
4.2 The strategy proposal

Circulation framework

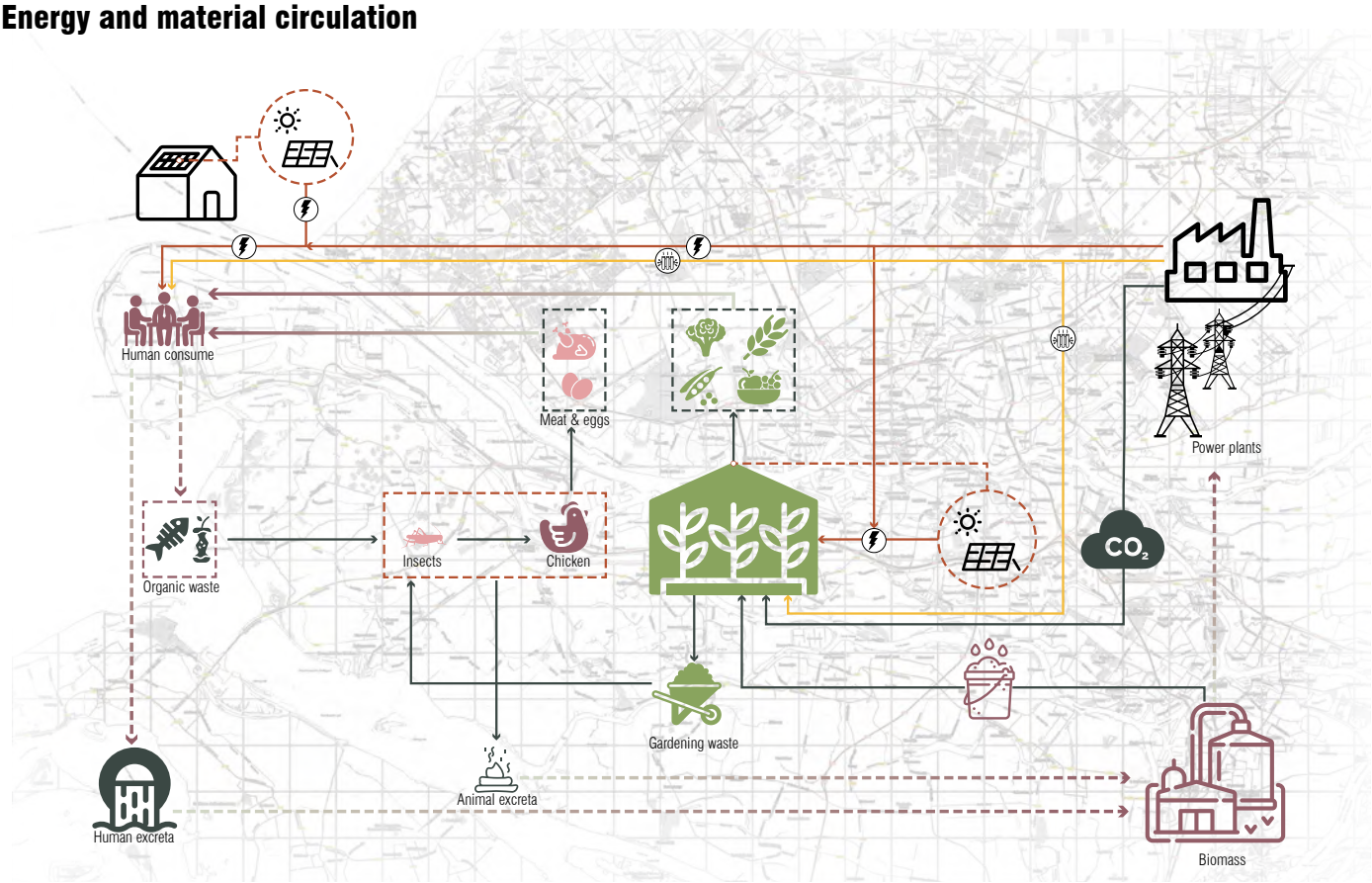


4.2 The strategy proposal

Food selection



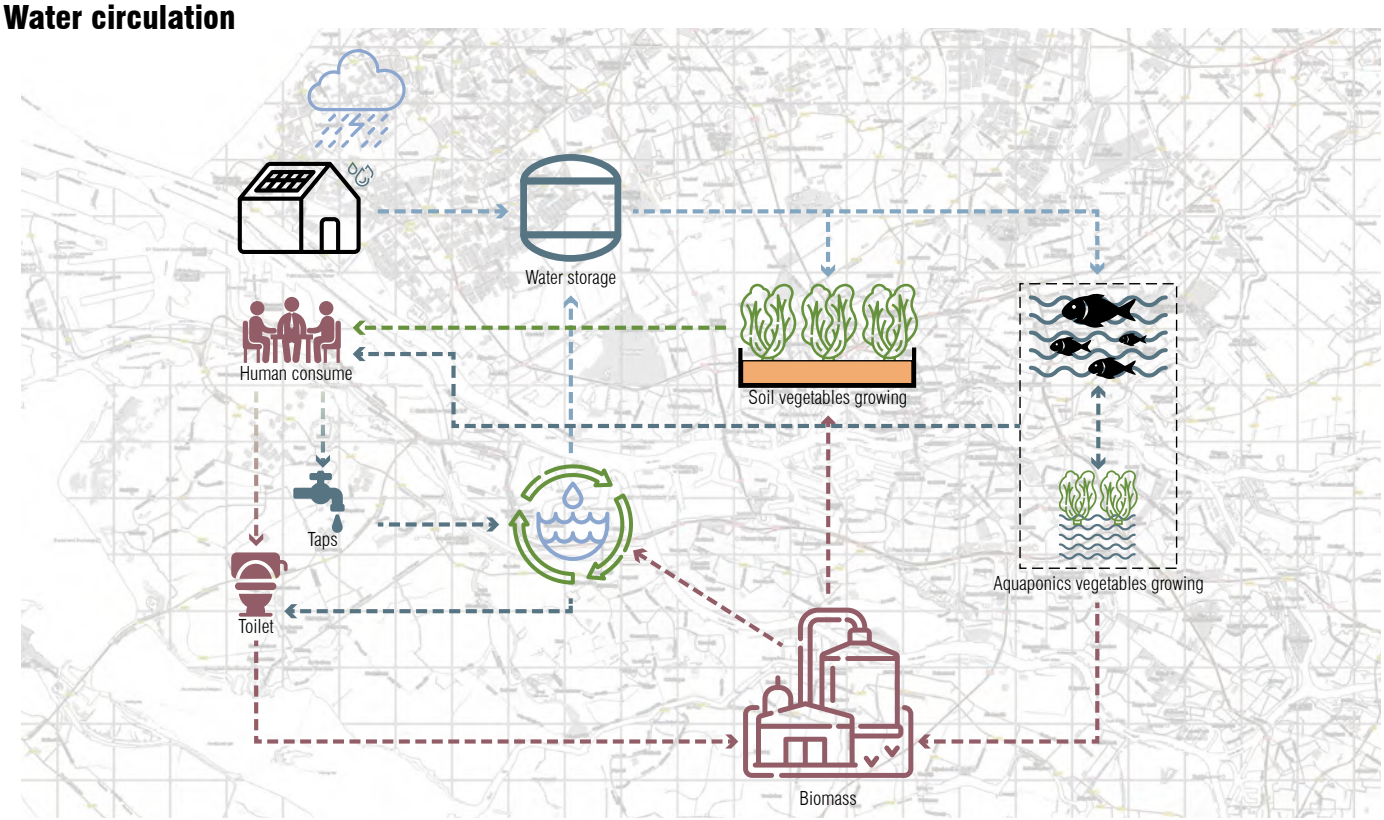
Energy and material circulation



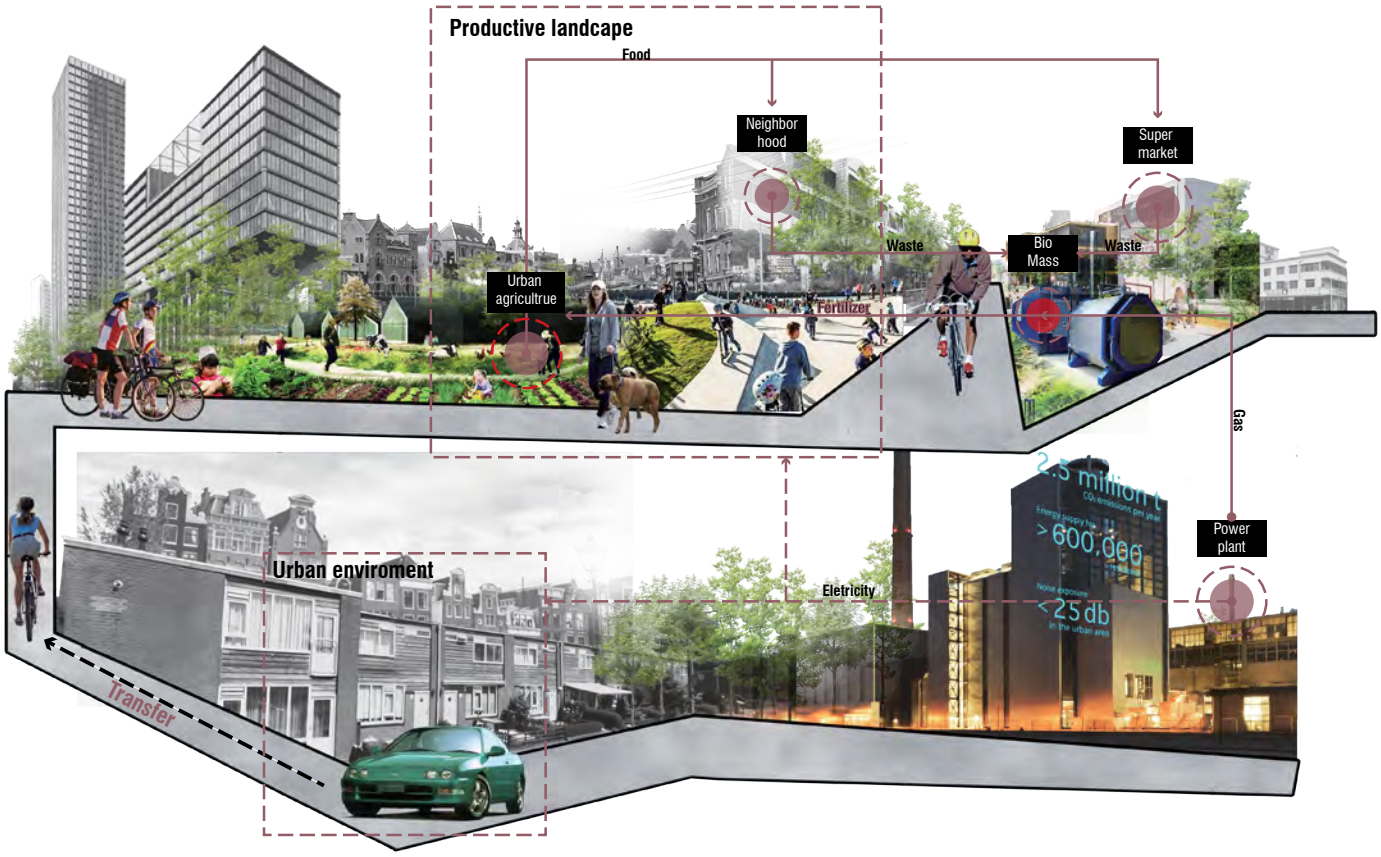
Building up framework: an open framework which allow all the flows could be involved would be built to let these flows participate with each other.

4.2 The strategy proposal

Water circulation



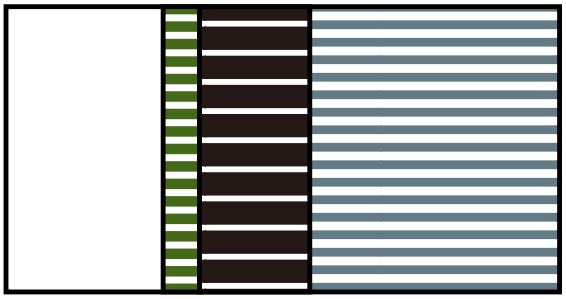
Structuring different flows into the urban space



Structuring the flows -- to understand the different flows--such as waste, energy, nutrition (phosphorous) and also people involved in the flows like the outflow of phosphorous in the daily use product. Address the product and factors of the flows and the spatial effect of the flowing circular system.

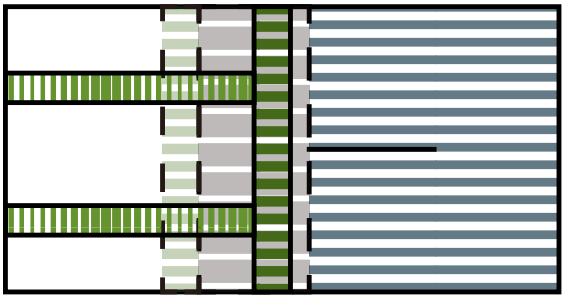
4.2 The strategy proposal

Phase 1



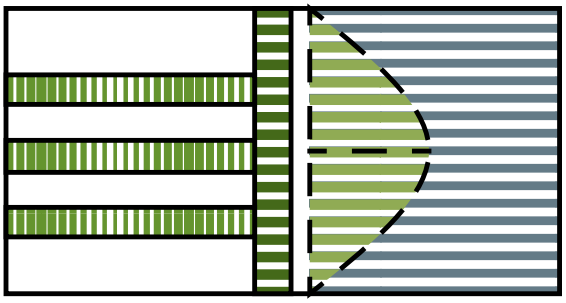
The original spatial structure separated the urban environment and the river-landscape with the linear green infrastructure - the dike.

Phase 2



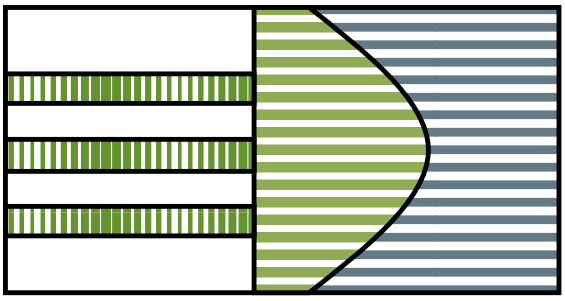
Relocating the dike, releasing the harbor space and inserting the urban agriculture industry, bring in the job opportunities and clean technologies helping the re-urbanization of harbor area.

Phase 3



Using landscape infrastructure to improve the ecological vitality of the edge of river banks.

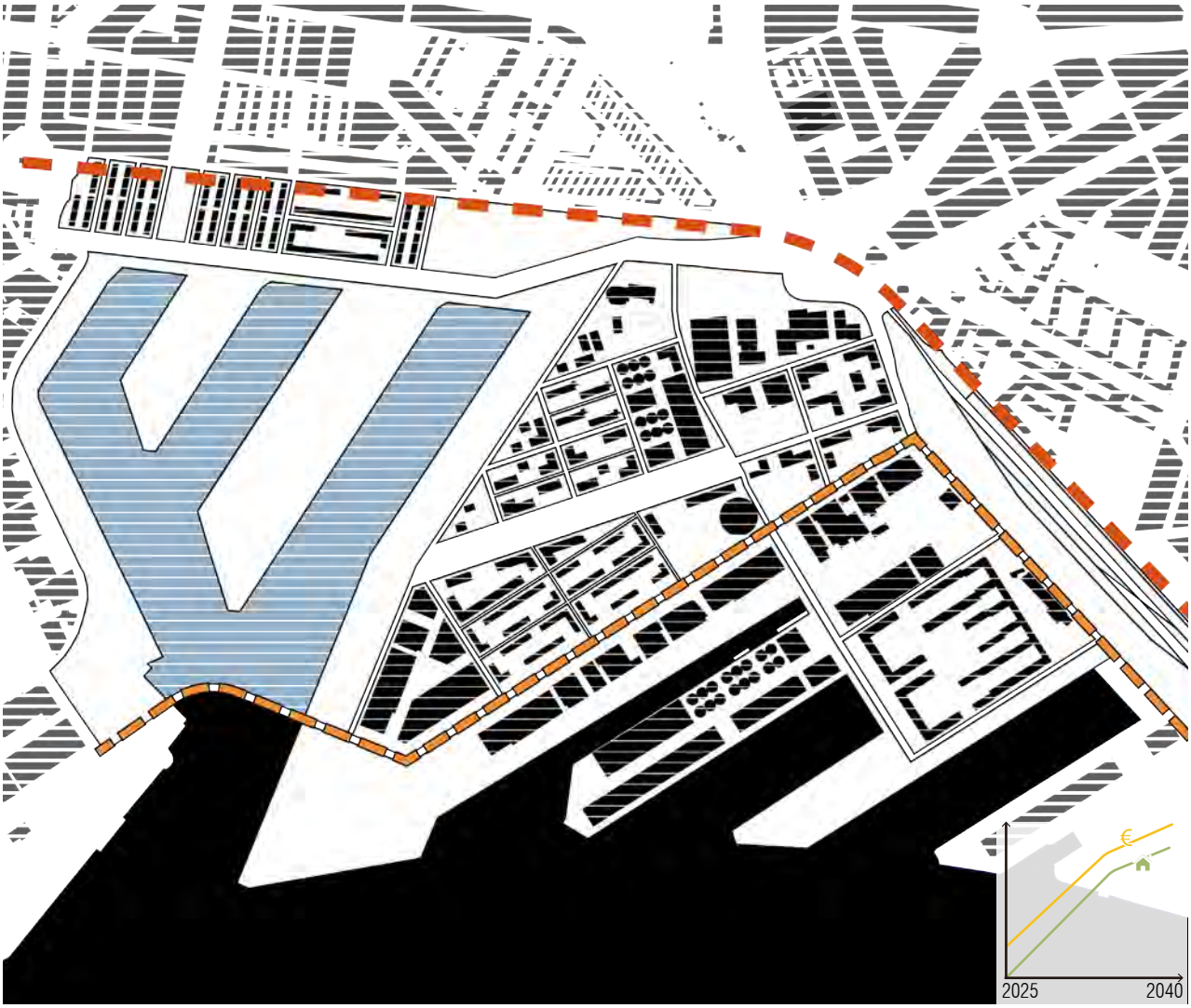
Phase 4



The ecological edge will expand into a integrated surface for the urban environment and river-landscape, and a safe infrastructure for urban function.

4.3 Possibilities

Possibility 1



In this scenario, the economic growth and the new houses need growth is match the expectation and great deal of population will be located in this area. Great a mount of new buildings and new industrial will also choose this area as their site. Therefore the safety of this area will be more important. In this case, a new dike will be built to protect the former harbor area, which will turn into a multi-functional urban space with commercial, residential and productive area. Because of the closed off of the harbor, there will be a inner lake for recreational function and aquaculture

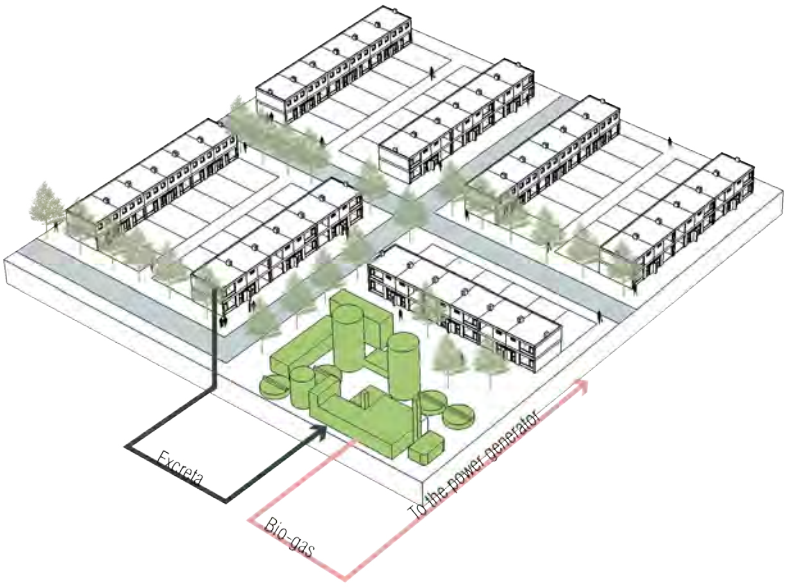
In this scenario, water quality could easily controlled so the aquaculture could happen in this area. But the closed-off of the dike also separate the river-landscape from the urban environment, which is not very beneficial to river ecology. Also, the relocation of the dike needs a great deal of construction, that means great deal of investment.

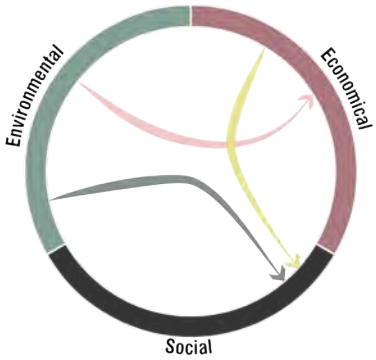
4.3 Scenario buildings

Possibility 1

In this scenario, the growth of population and economic is not as fast as people expected, therefore the need for new houses is no that strong and more land could be used for productive function. Also, more old warehouse and buildings will be kept and adapted into new function. With the withdraw of the harbor function, the former harbor area will turn into wider ecological edge compared to scenario 1, and the ecological value of the area will be increase more significantly.

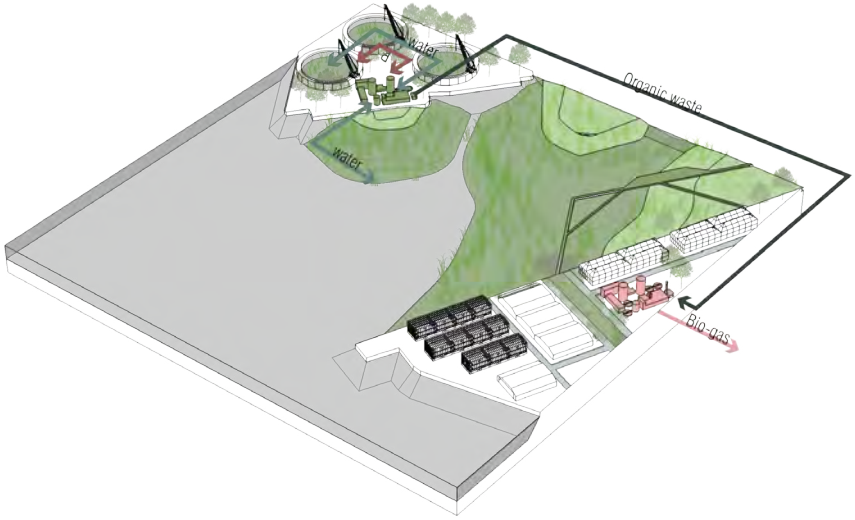
4.3 The abstract tool box

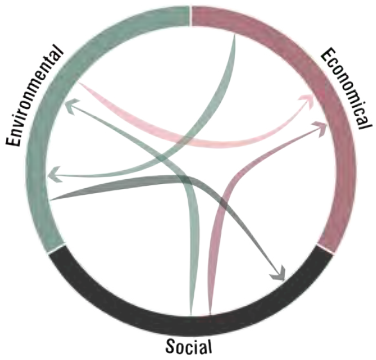




This is the prototype of the combination of residential building and biomass. The human excreta will be piped to the biomass to create bio-gas, and the biomass will also provide fertilizer for gardening and urban farming.

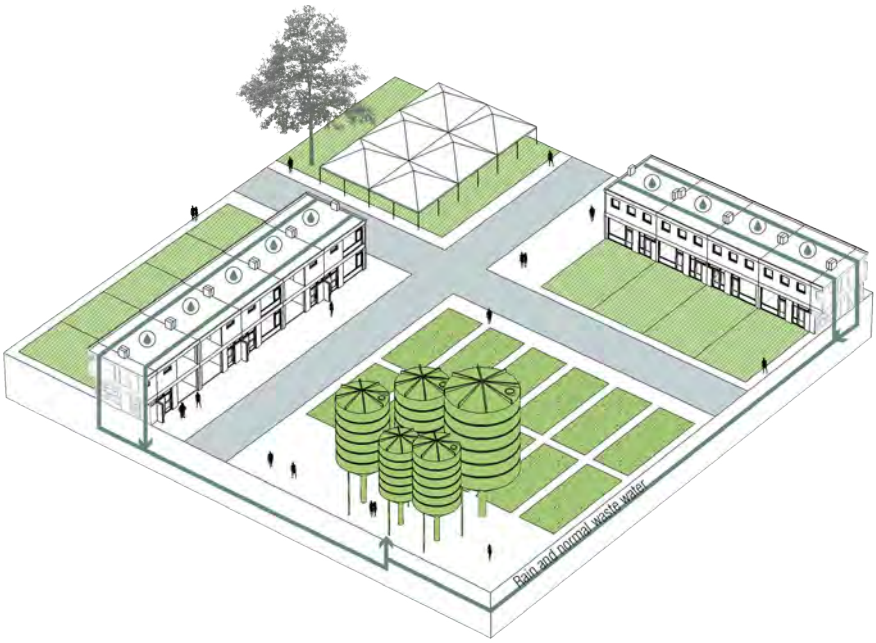
4.3 The abstract tool box

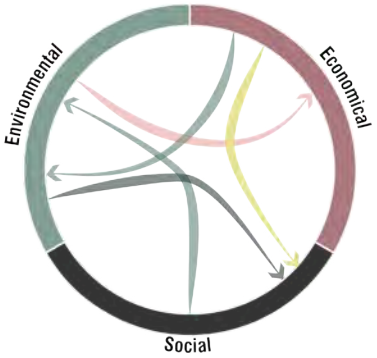




This is the prototype of the combination of ecological edge and the residential area in the former harbor area. The ecological edge provide a natural river landscape for the citizens and some recreational activities, and the plants in the ecological edge will also help purifying the water and restore nutrient from the polluted river water, and create a habitat for wilds such as birds.

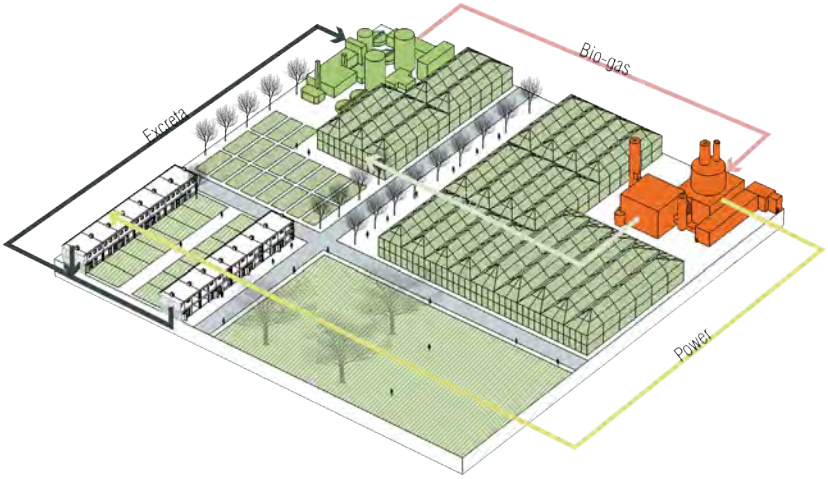
4.3 The abstract tool box

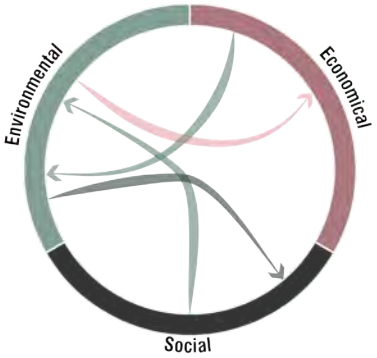




This is the prototype of combination of recreational park, residential buildings and open-air urban farm. In this system, the rainwater will be collected on the roof of houses an restore in the tank, and later will be used for irrigation. The recreational park can also serve as the open market for food trade.

4.3 The abstract tool box





This is the prototype of combination of greenhouse agriculture, open-air farm, residential area and other facilities. The greenhouse will be major productive facility and the open-air farm will be a educational show case. And the greenhouse will closely be situated next to the power plants so that the heat provided by the power generating could be easily used.

5.Applycation

5.1 Master plan and system design

5.2 Greenhouse system design

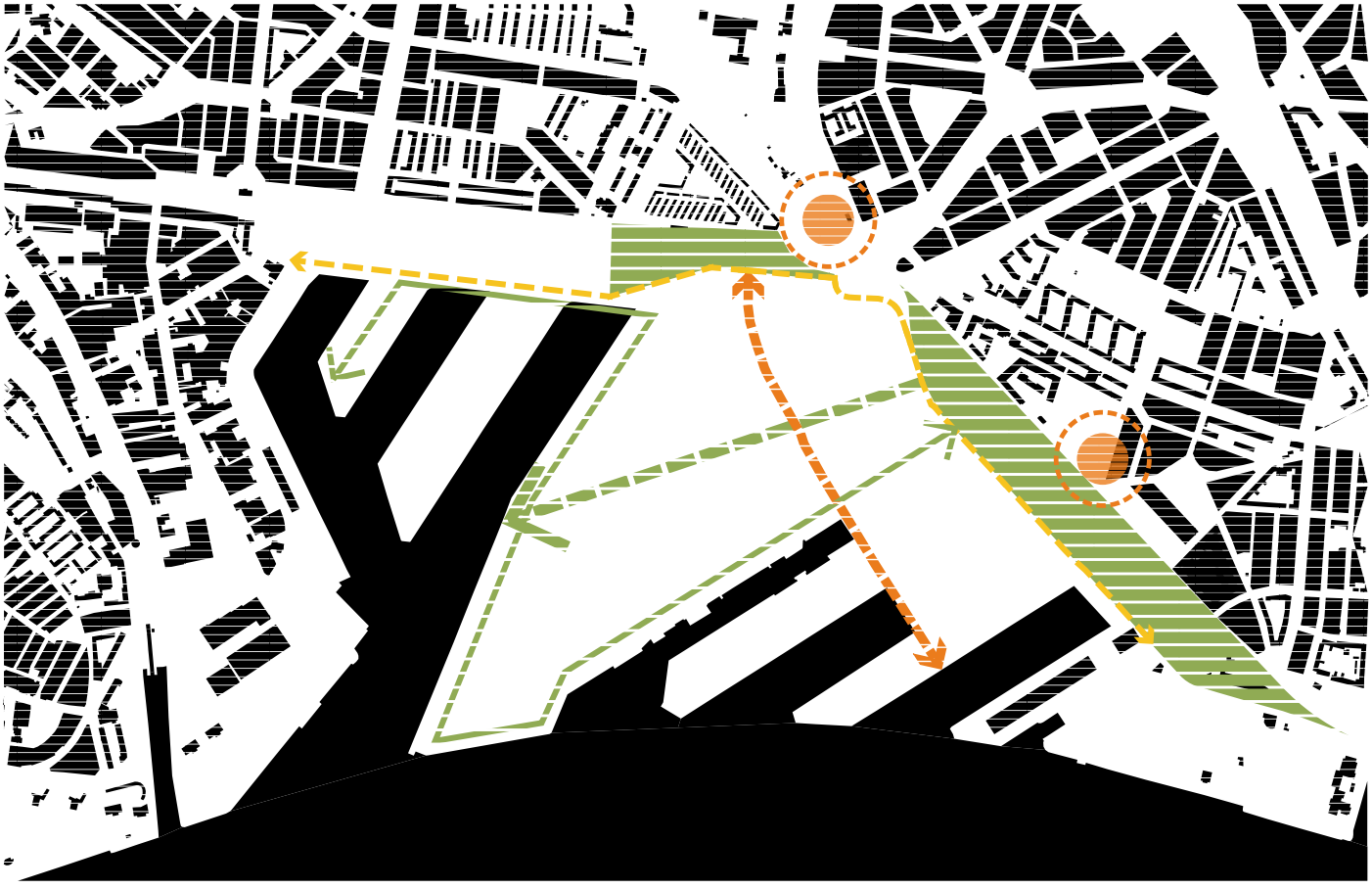
5.3 Ecological edge- applying strategy facing flood risk

5.4 Detail design

5.5 Constructing with process

5.1 Master plan and system design (Applied strategy)

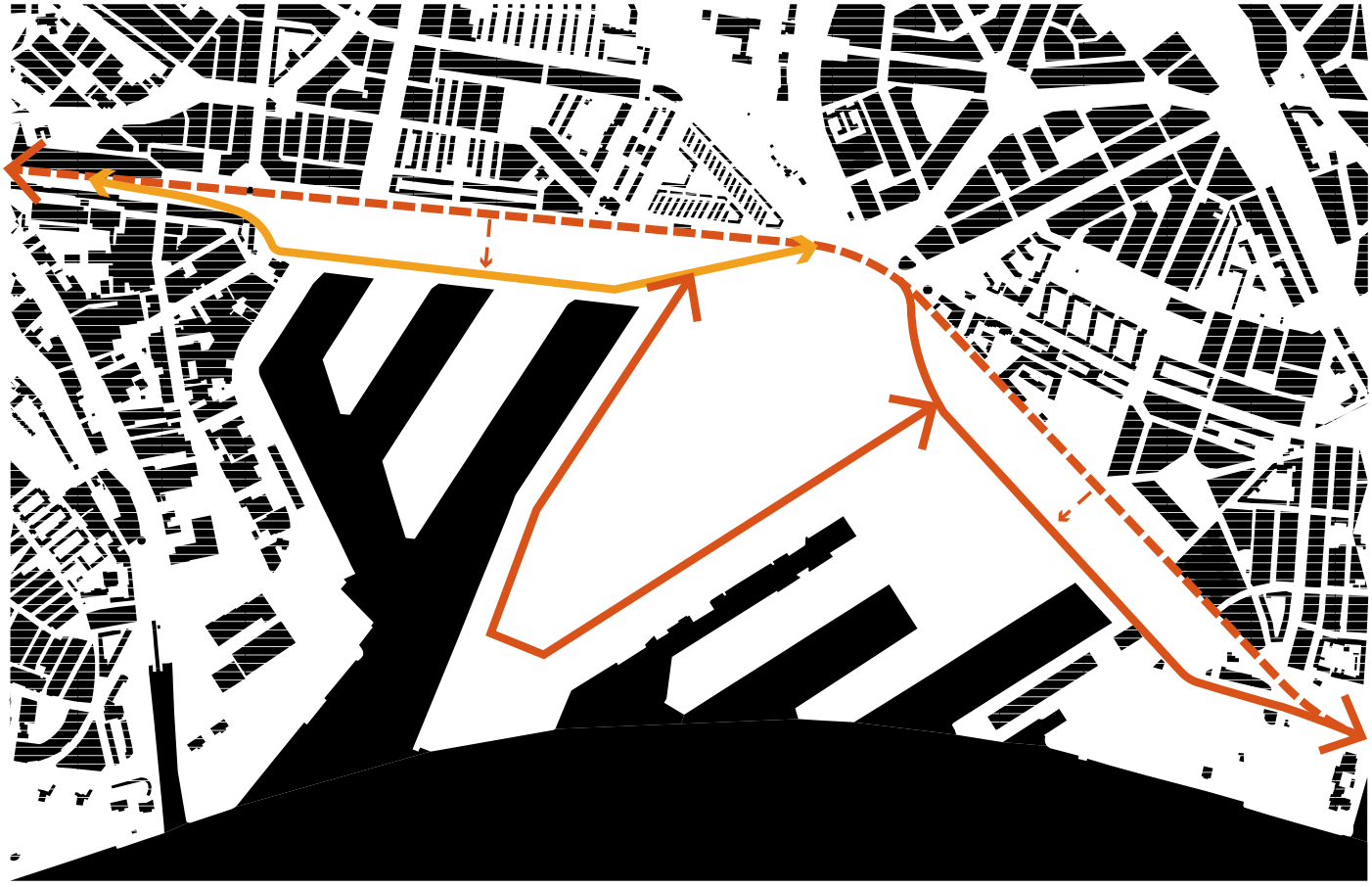
Spatial Planning



The Marconiplein station has two exists, and these two entrance or exists are the main sources of the flows of the peoples. The exist on the east side are facing a recreational park, and it is a good attraction for pedestrians. Therefore, in order to attract more people to the sites, the exist on the north side will also need a green open space. Additionally, a green axis will be placed to connect the recreational park and the waterfront, and a better walking environment for pedestrians and cyclists along the river will be created.

5.1 Master plan and system design (Applied strategy)

Flood preventing strategy



In order to protect the new urban area, a new dike system will be created. The old dike will be relocated closer to the water front, and the new circle of dikes will be built. And the dike at north part of the harbor area will be served as a temporary protection before the ecological edge could play their roles in flood protection.

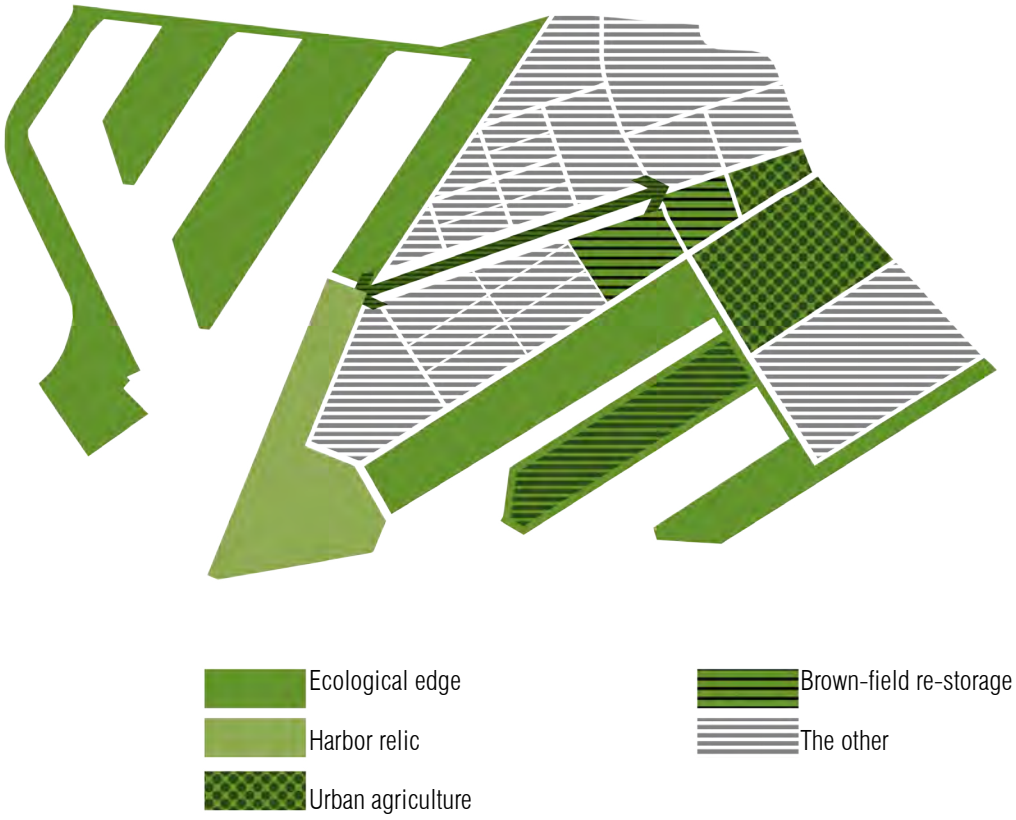
5.1 Master plan and system design

Density

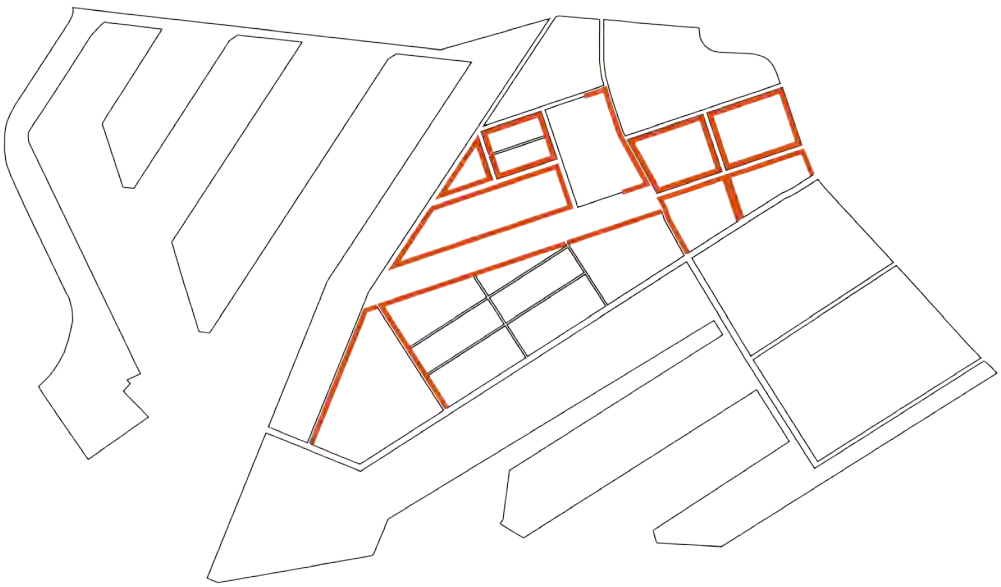
Program

5.1 Master plan and system design

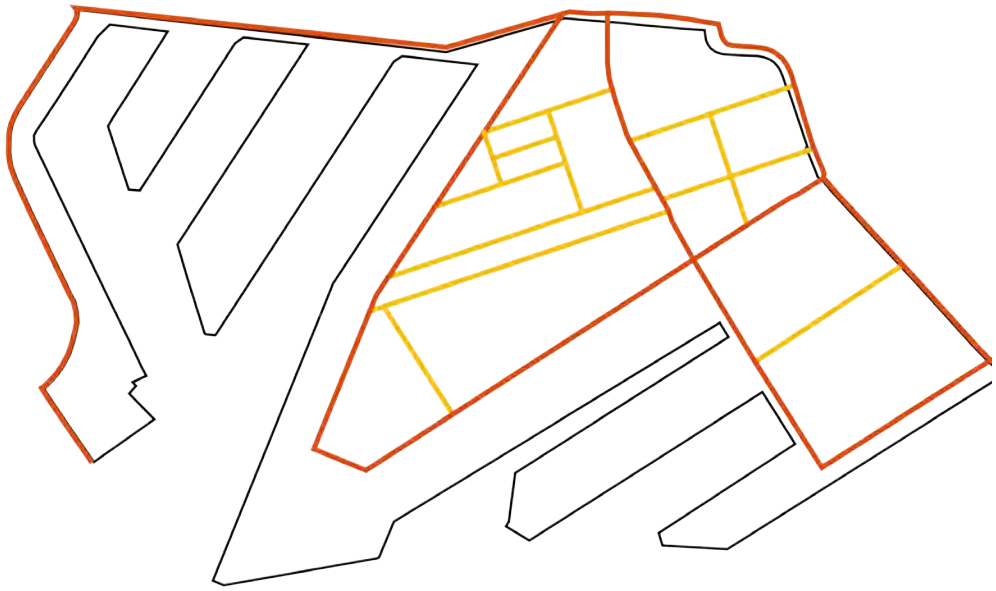
Green network



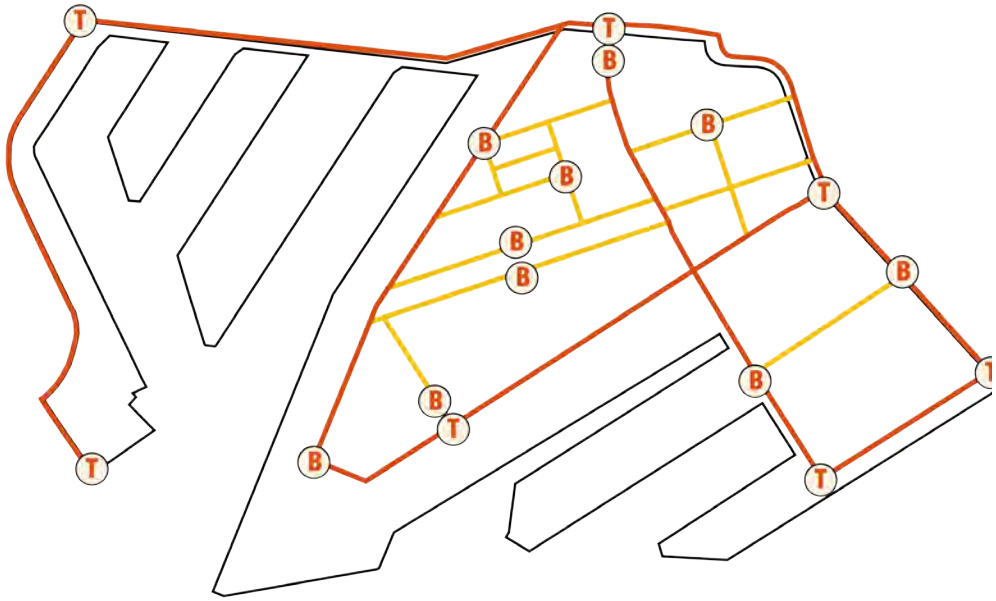
Active retail frontage



Road grid



Public transportation



Productive area

The greenhouse will provide jobs and financial income for the whole area to maintain the working of the system. Some open-air farm land is already exist in the area will be preserved and provide low-priced organic food for the surrounding low-income community

5.1 Master plan and system design

Energy strategy

Solar panels on the roof top, is the main source of the whole area. It is a decentralized system, and every building with a solar panels is a independent unit, which will also share their energy production with each other. An average household needs 29m2 solar panels(Gemeente Rotterdam) for daily electricity usage, and there are 130000m2 solar panels on this site, therefore around 4400 households could be supported by them.

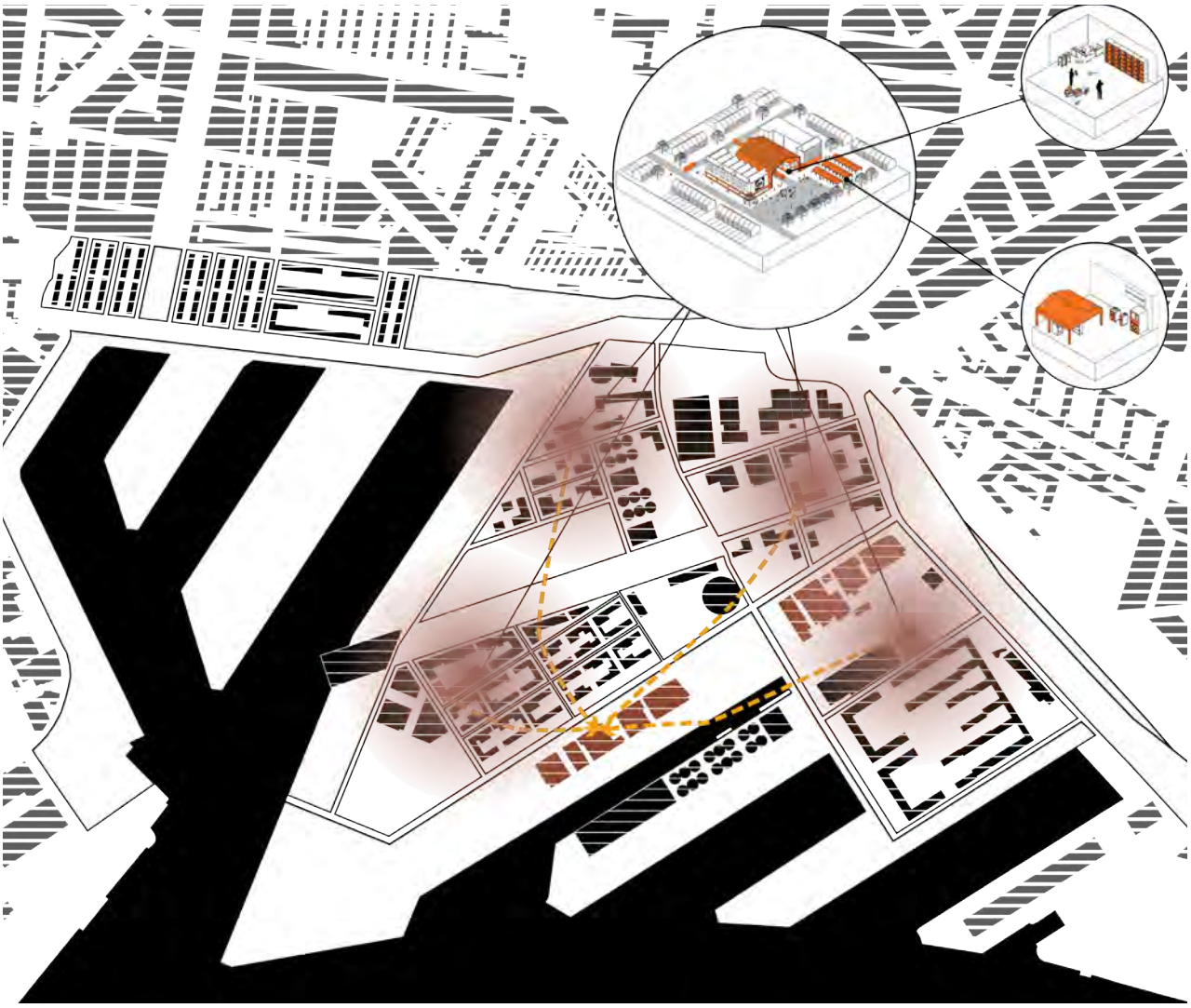
Energy strategy

Biomass and the power generator, could provide 0.01PJ per year and the heating for greenhouse and neighborhood, it is also a supply and back up energy source for the whole area.

5.1 Master plan and system design

Rainwater collection

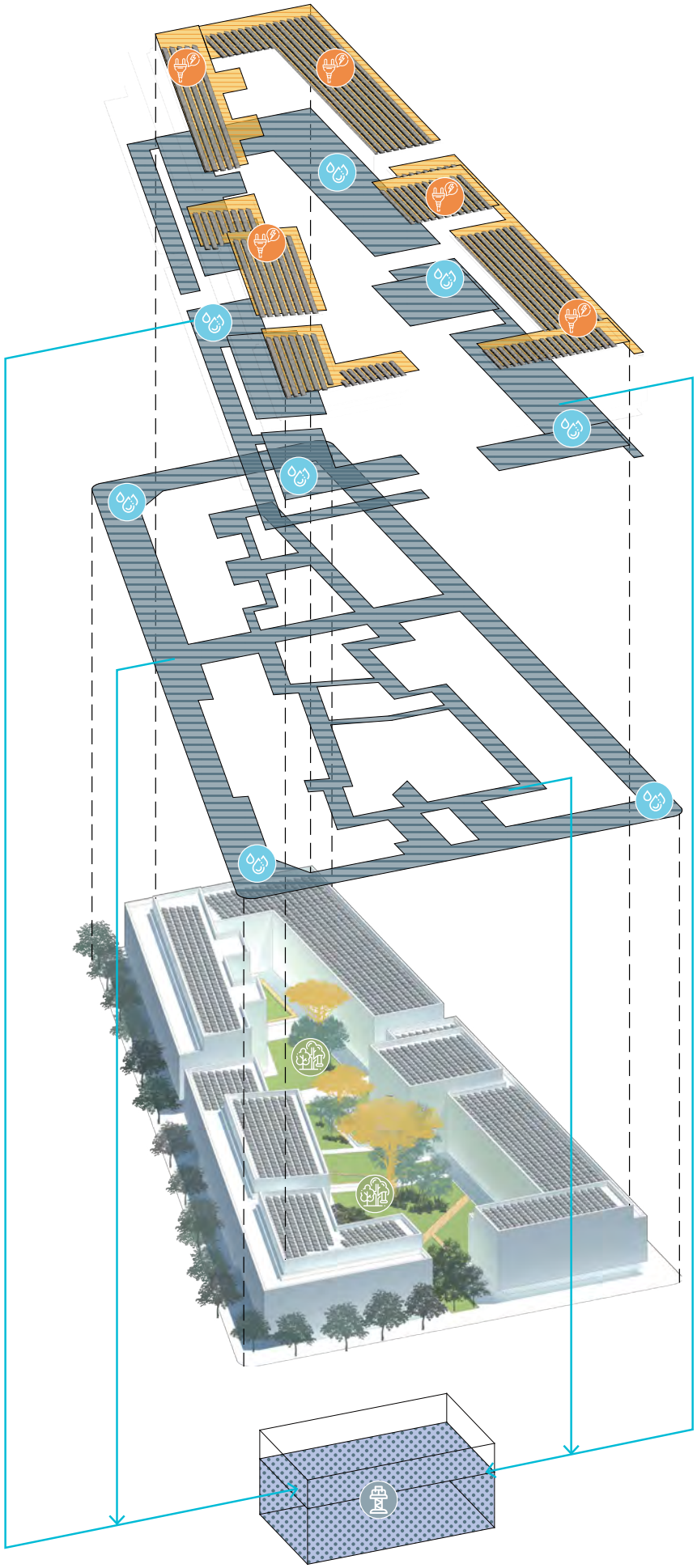
The rain water will be collected in the courtyard of the commercial and residential buildings, with simple filtration and storage, could be used in the irrigation of the urban farming



Solid used product recycle

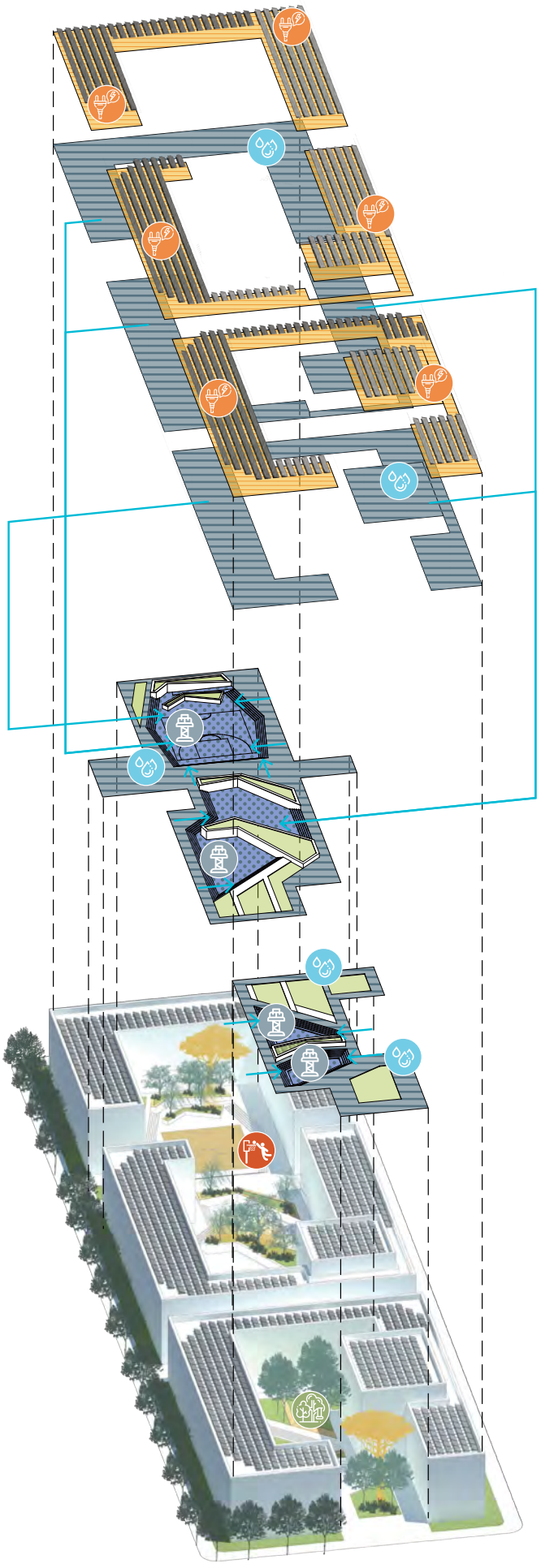
Fully using the innovative manufacture exist in the area, and encouraging the residents to take part in the recycle of the used products, the collecting points will be spread around the residential and commercial area.

5.1 Master plan and system design



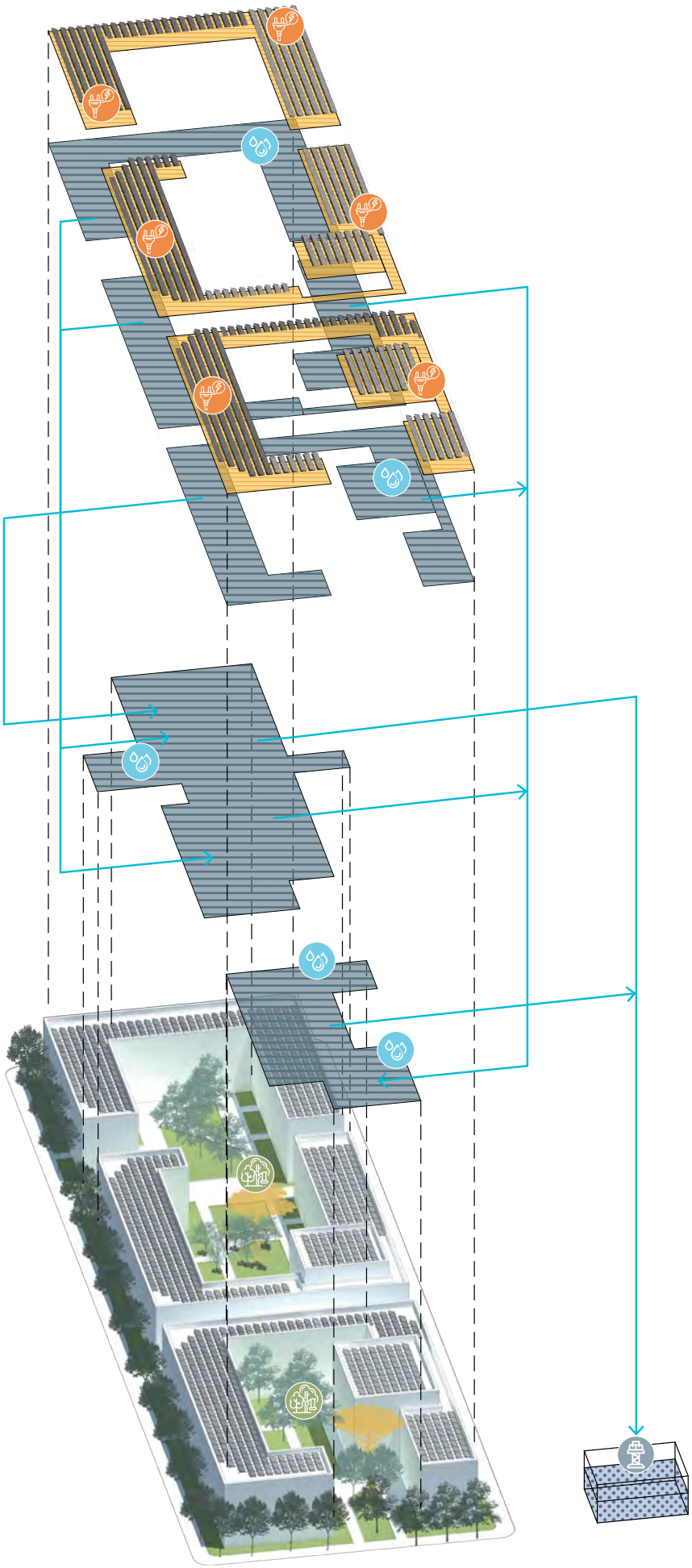
The house of residential and commercial area are important units for generating energy and recycle the rain water. The solar panels on the rooftop is the energy units and the rain water will collect through the pipes. The storage of the rain water will have two options. The first one showing here is storing in the underground tanks. And on the ground is the recreational equipments and open area for citizens.

5.1 Master plan and system design

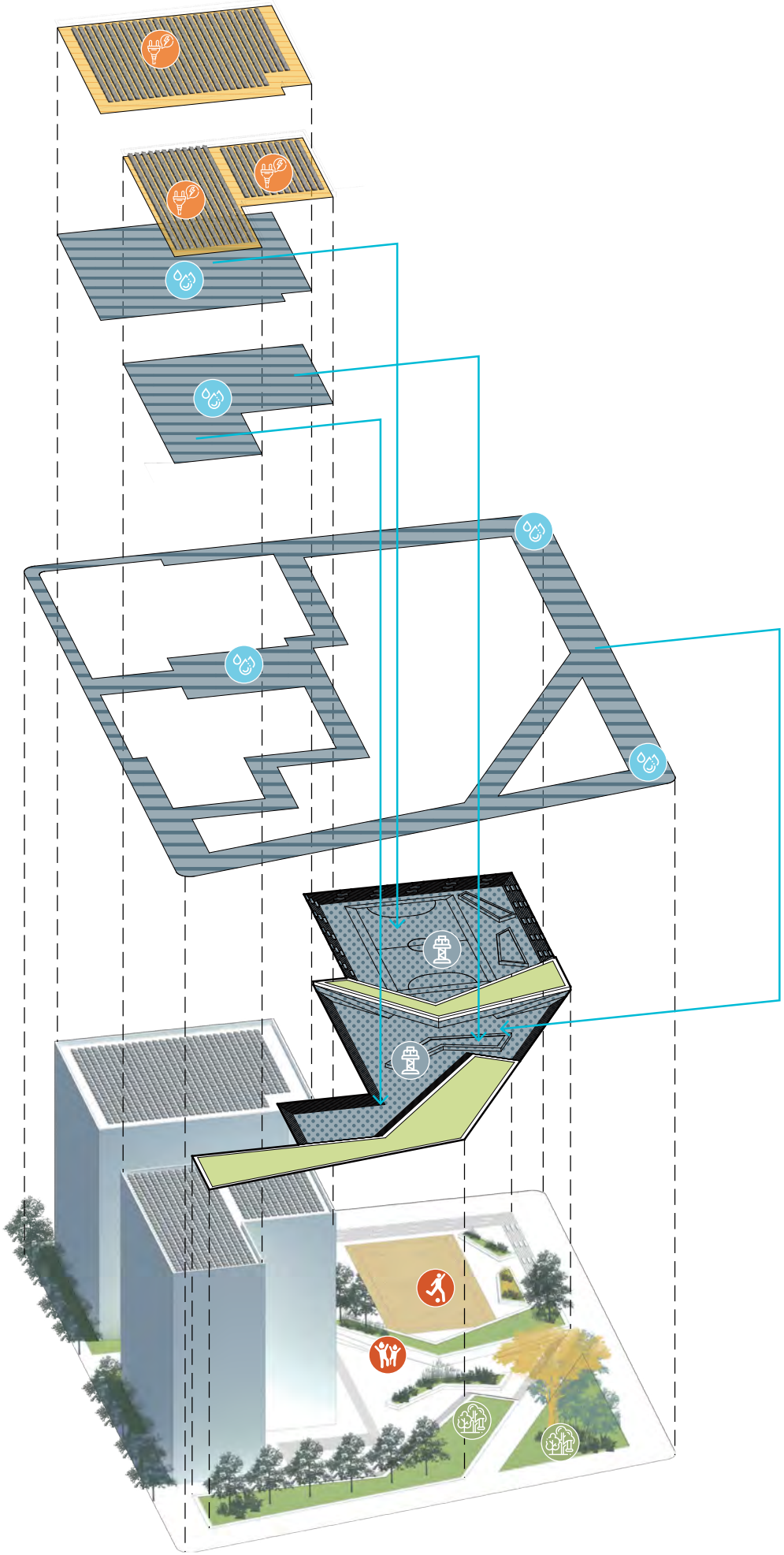


The second ways of restore the rain is storing them in the on ground facilities. The rain storing pool will first serve as the sports field or playground for children and residents, when there is massive of rains, the basketball or football court will turn into a water pool for storing the water.

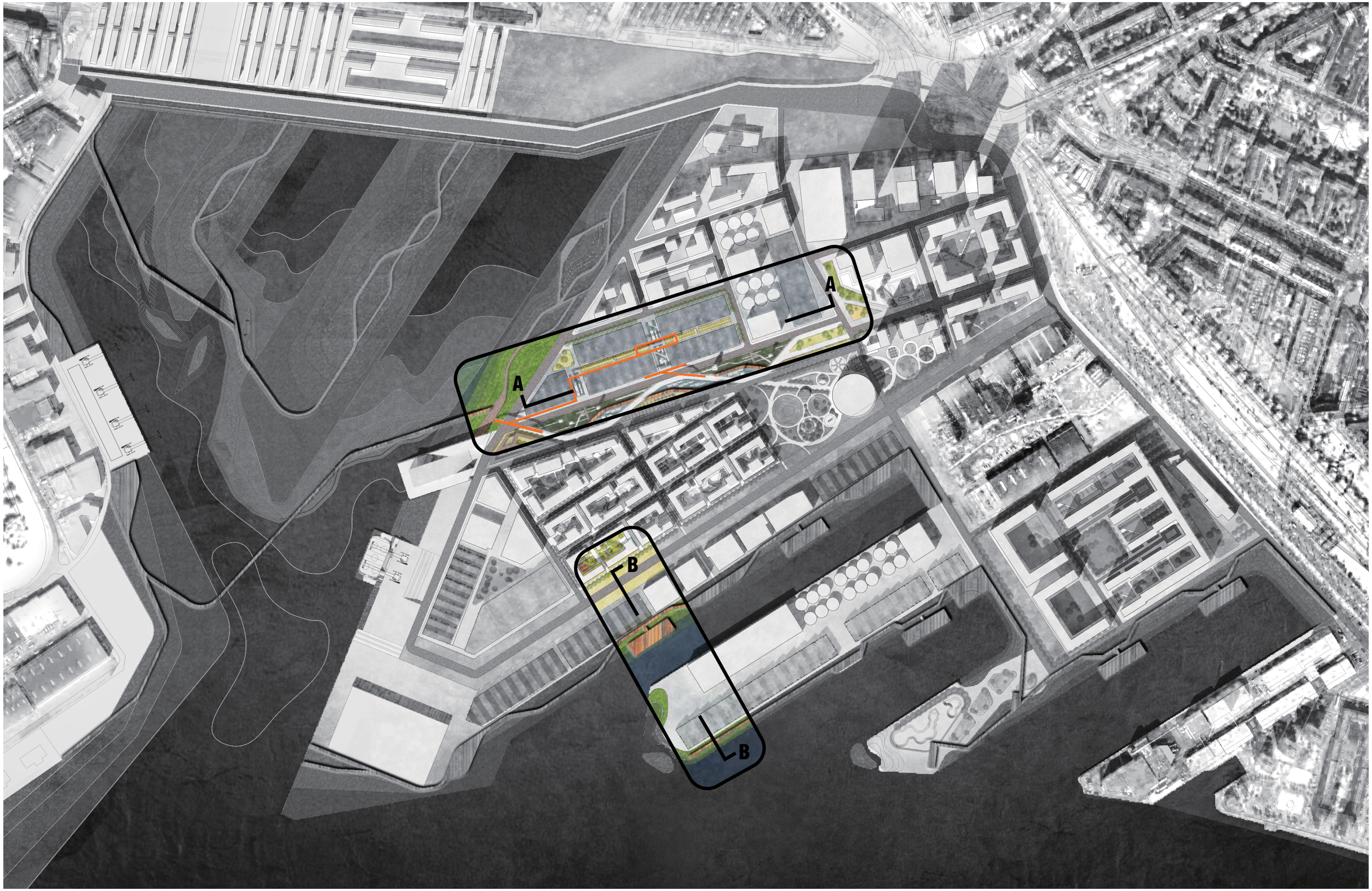
5.1 Master plan and system design



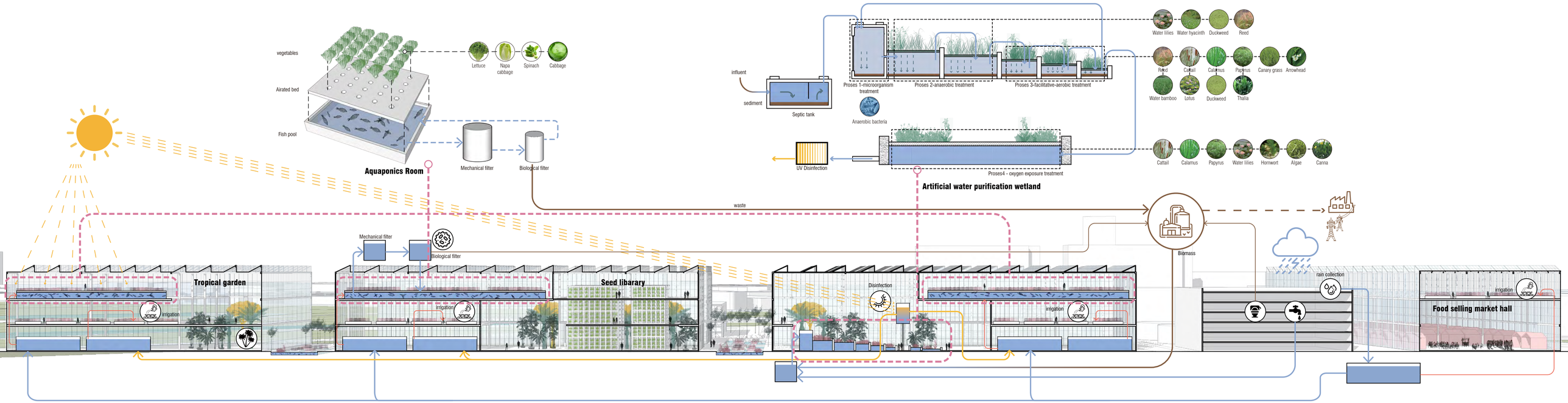
5.1 Master plan and system design



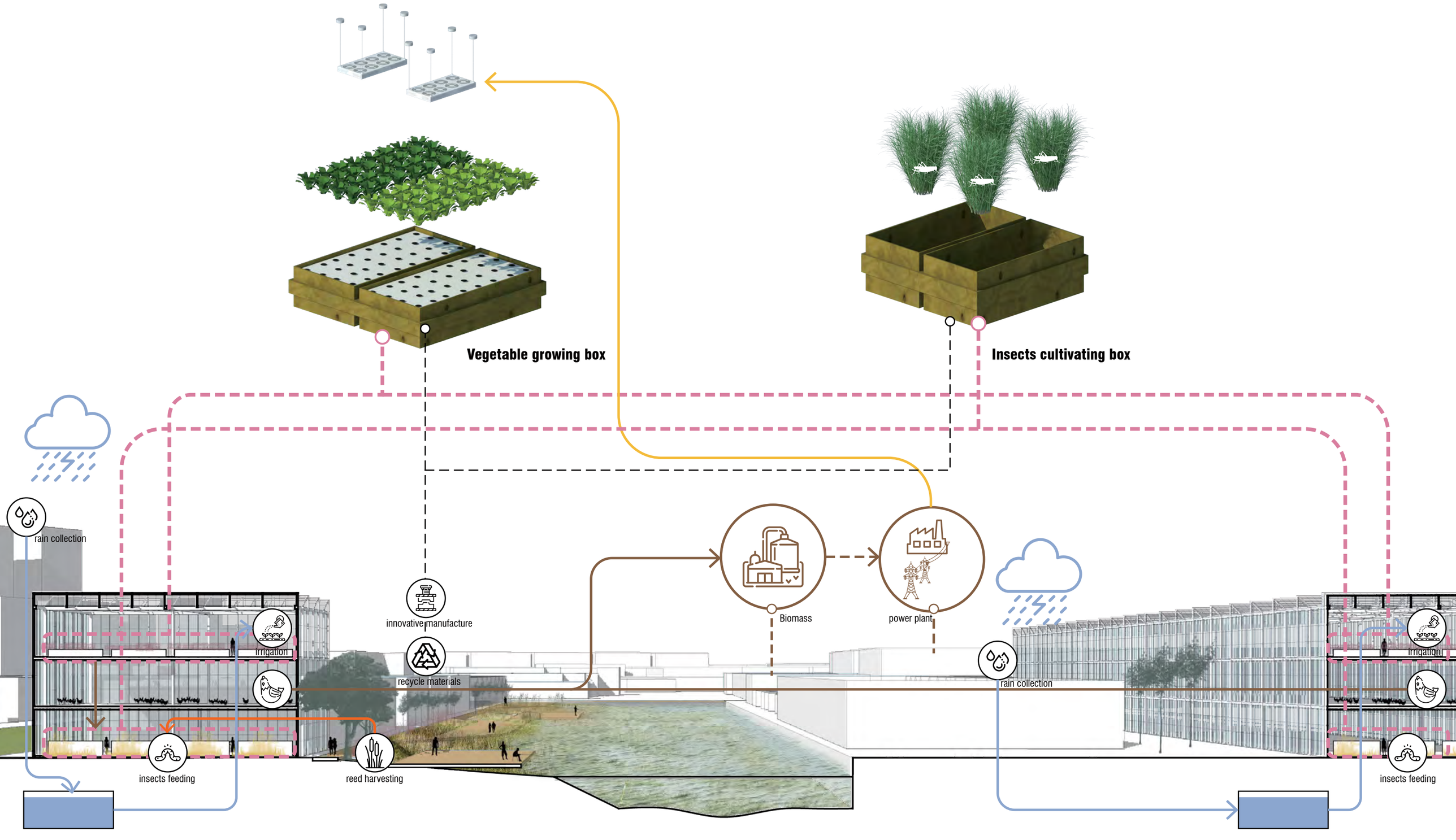
5.2 Greenhouse system design



5.2 Greenhouse system design(Section A-A)

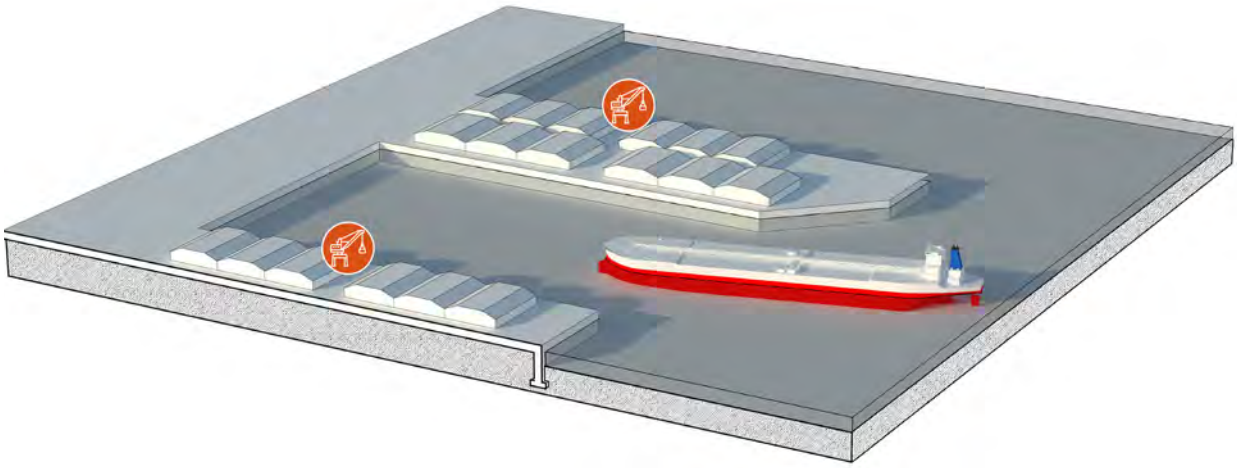


5.2 Greenhouse system design (Section B-B)



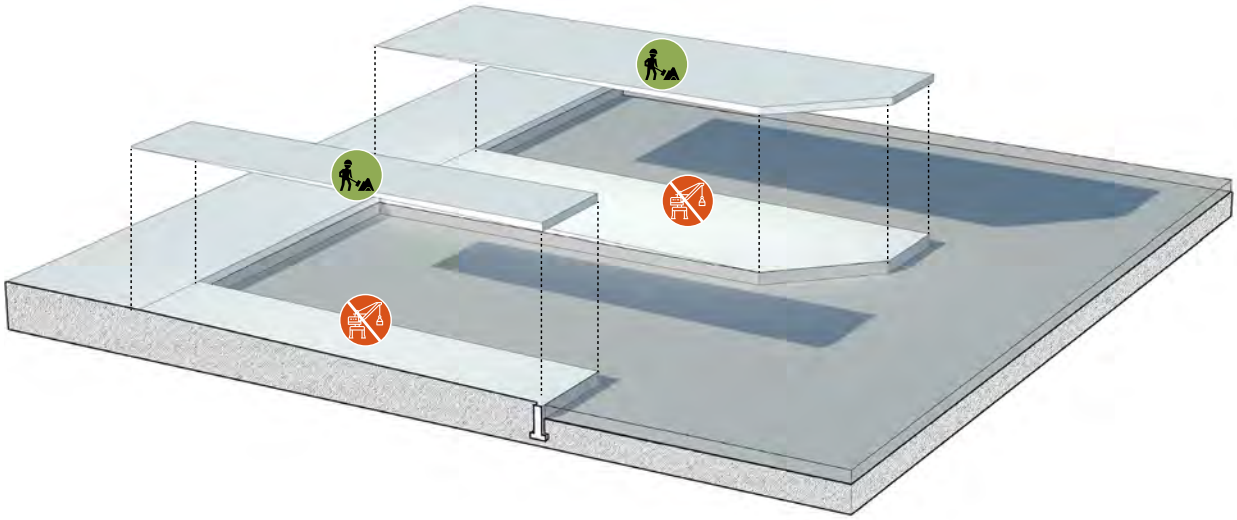
5.3 Ecological edge- applied strategy facing flood risk

Original phase



As you can see here, the quays of the harbor originally are sealed with the thick concrete, can not be permeated by water. The ecological vitality is reverently low and even some pollution would be seen.

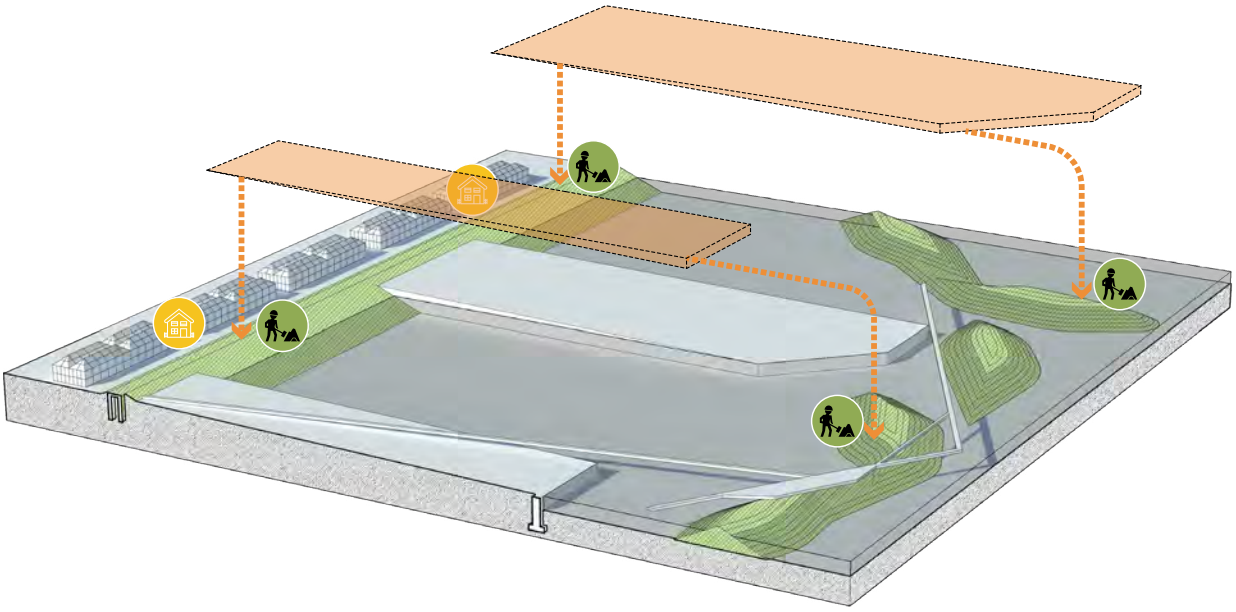
STEP 1



With the withdraw of the harbor function, the reuse of the quay as an ecological area is possible. First is to restore the interaction between water and soil. The asphalt of the quay will be remove and heightened soil of the quays will also be taken away, to create a gradient change of height of the harbor and makes the old quay a water sensitive area. However, in order to maintain the stabilization of the soil, the concrete that underneath the regular water level (NAP+3.0) will be keep.

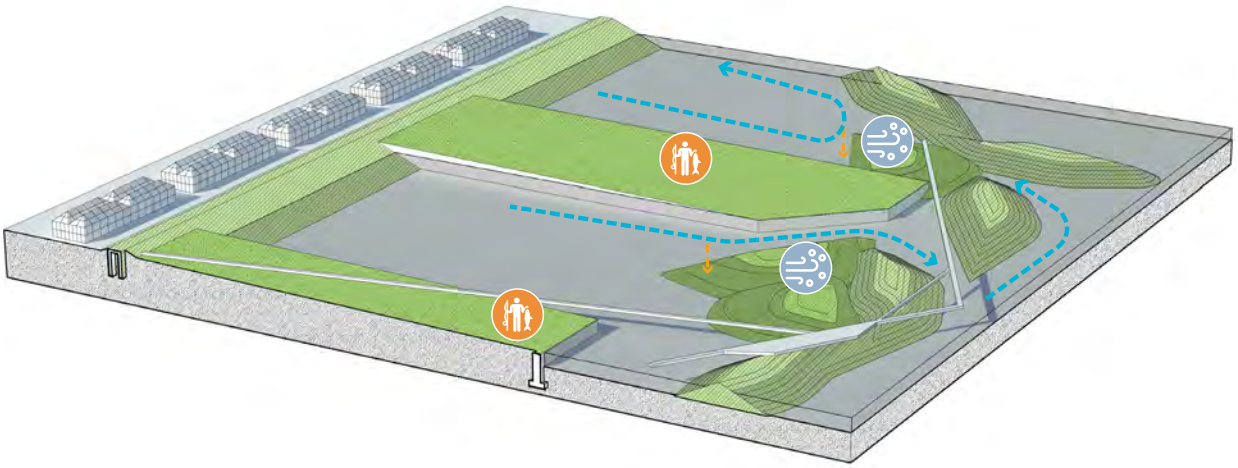
5.3 Ecological edge- applied strategy facing flood risk

STEP 2



The removed soils and asphalt will be materials to build the new dike to protect new urban area and the chains of artificial islands. The artificial island will help to slow down the speed of the current, so that the soils and other materials will have a better chance to sediment around them. If this process continue, with time go by, the natural movement of water will bring us a belt of ecological tidal wetlands. That is the ecological edge of the new urban area.

STEP 3



Eventually the sedimentation of the river will get more and more around this area and the plants and animals will makes their new homes there, the ecological value of the river will be restore. And the old quays will also be the new recreational area for the citizens to get the chance to get close to the nature.

5.3 Ecological edge- applying strategy facing flood risk

Materials test

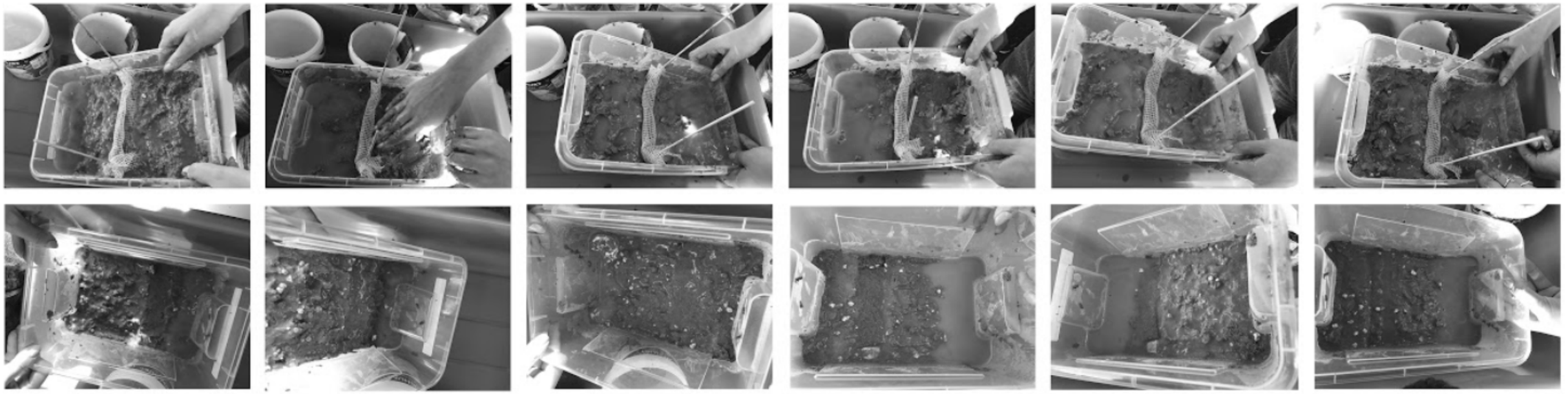
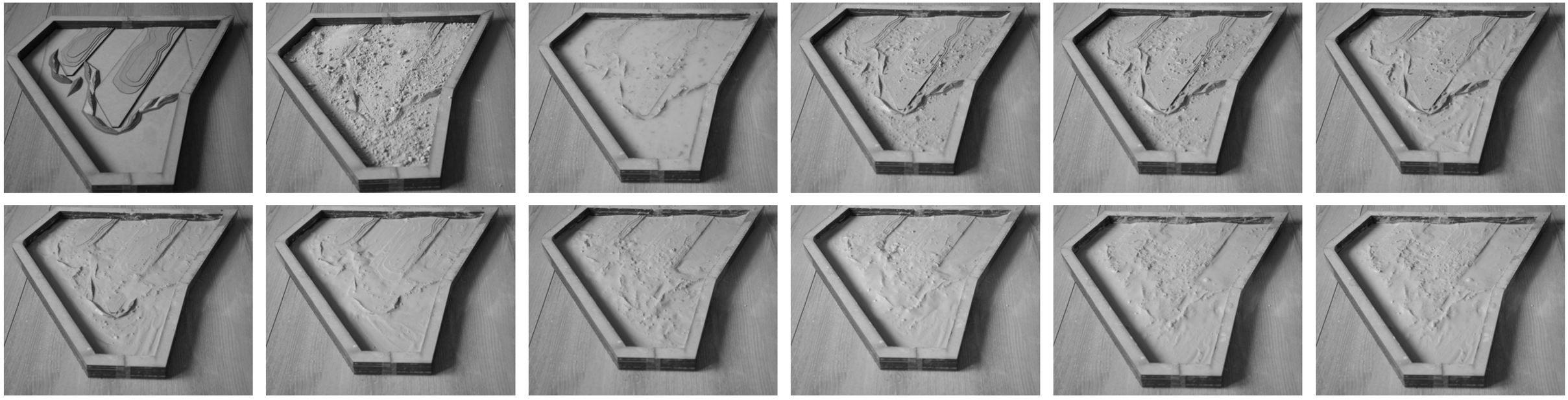


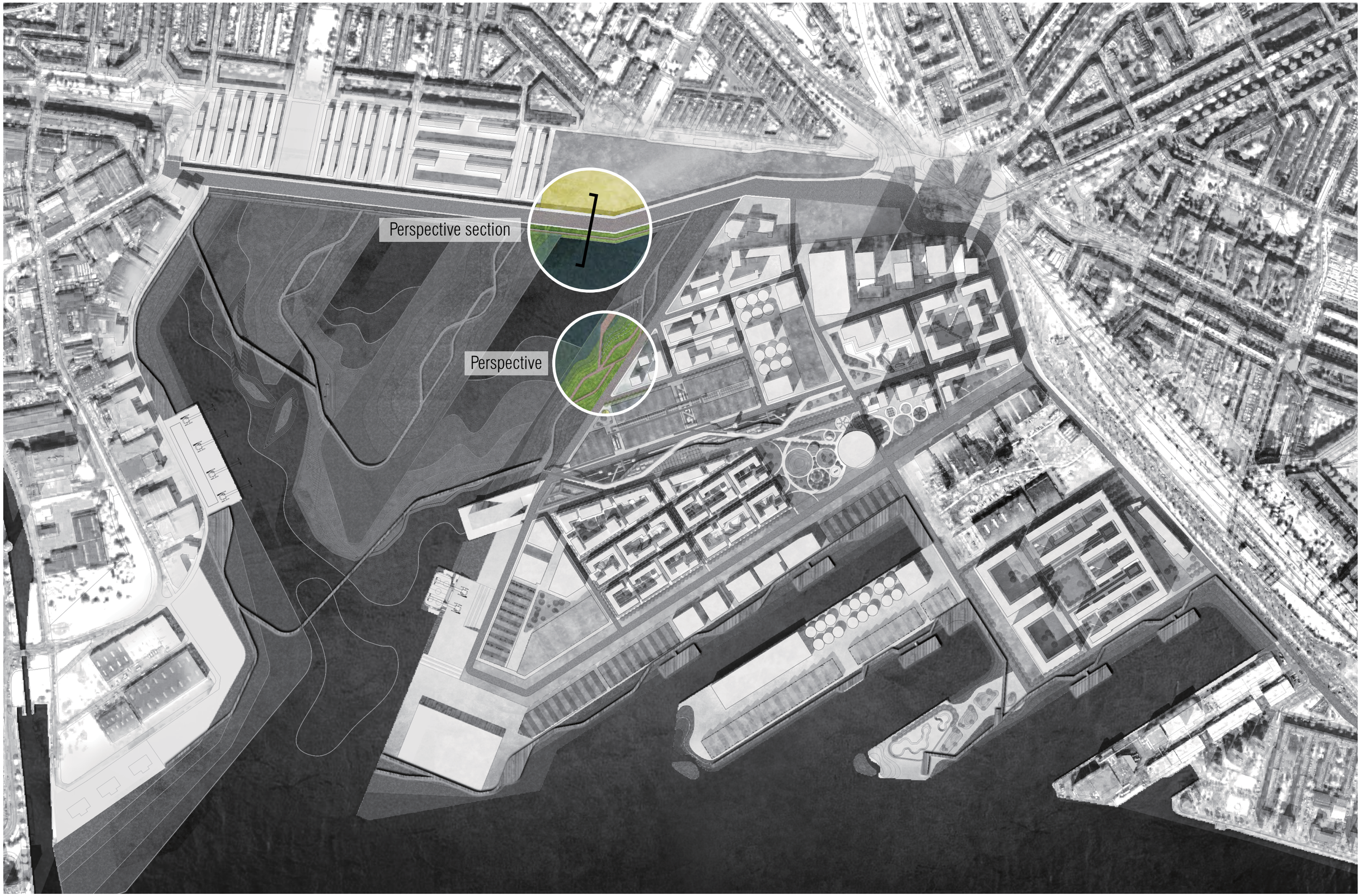
Photo credit: The dynamic models workshops

Sands box experiments

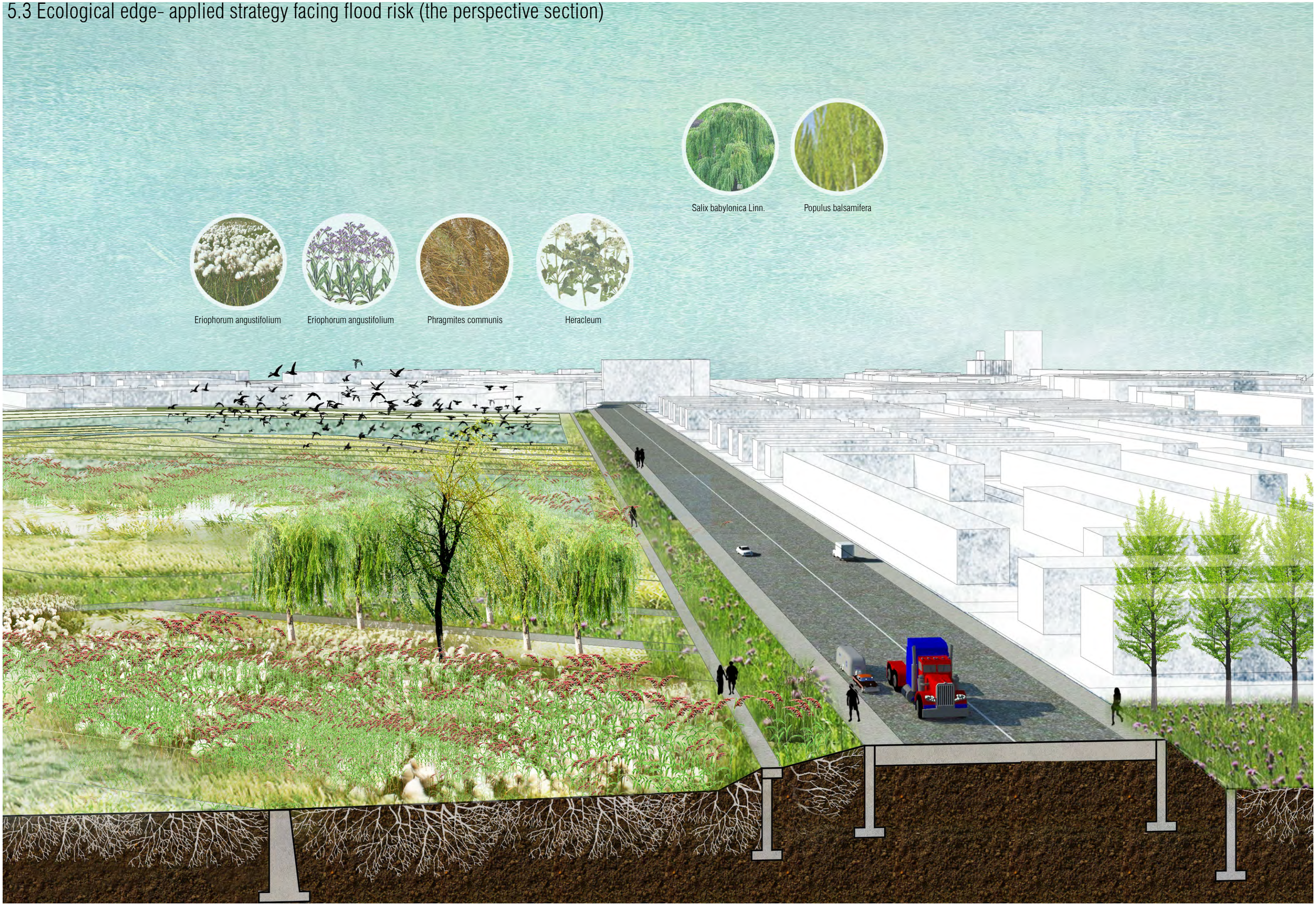


In order to understand how the movement of the tidal could effect the forming of the sedimentation, I had made some experiment to simulate the movement of the tides. Of course this kind of physical models is not scientifically accurate since a lot of other effects may affect the sedimentation were neglected. But at lease this experiment would generally show the effect of moment of the current and sands. Also, this kind of experiment will also give me the basic clues of how will the newly sedimentation look like and allow me to predict the spatial atmosphere.

5.3 Ecological edge- applying strategy facing flood risk

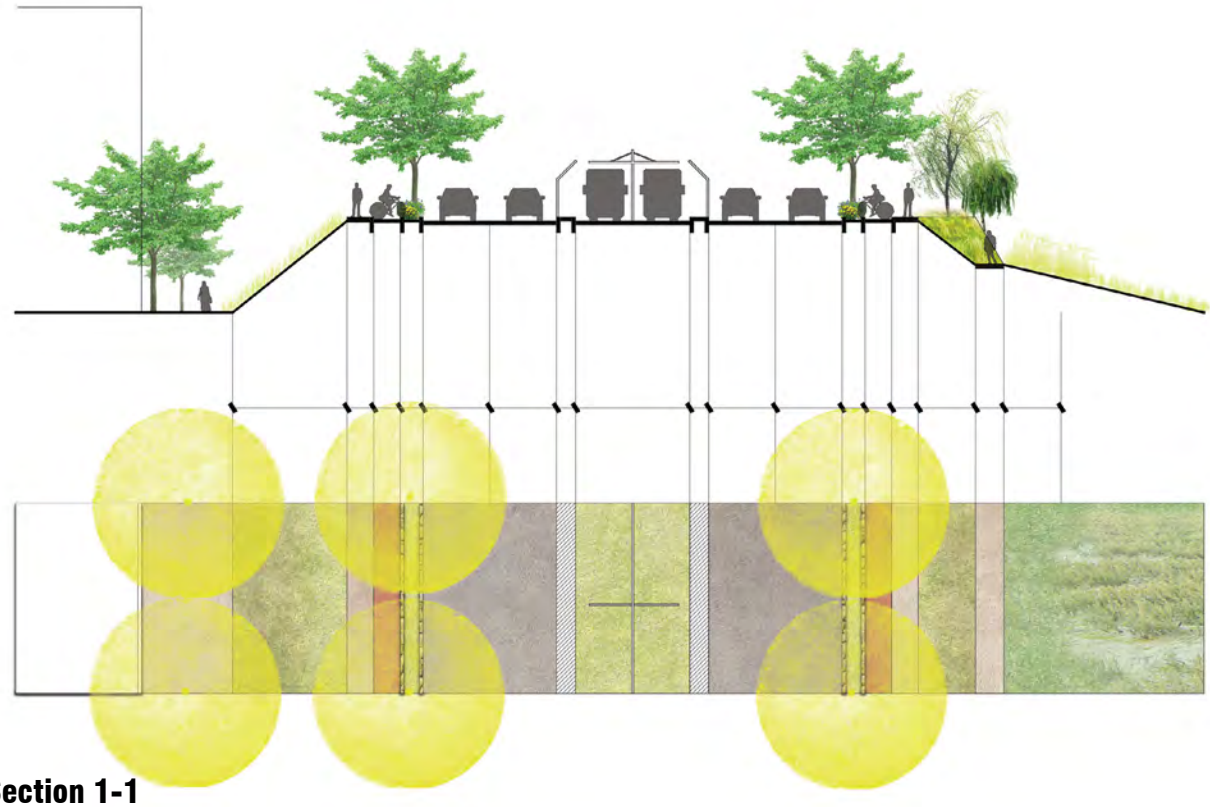


5.3 Ecological edge- applied strategy facing flood risk (the perspective section)

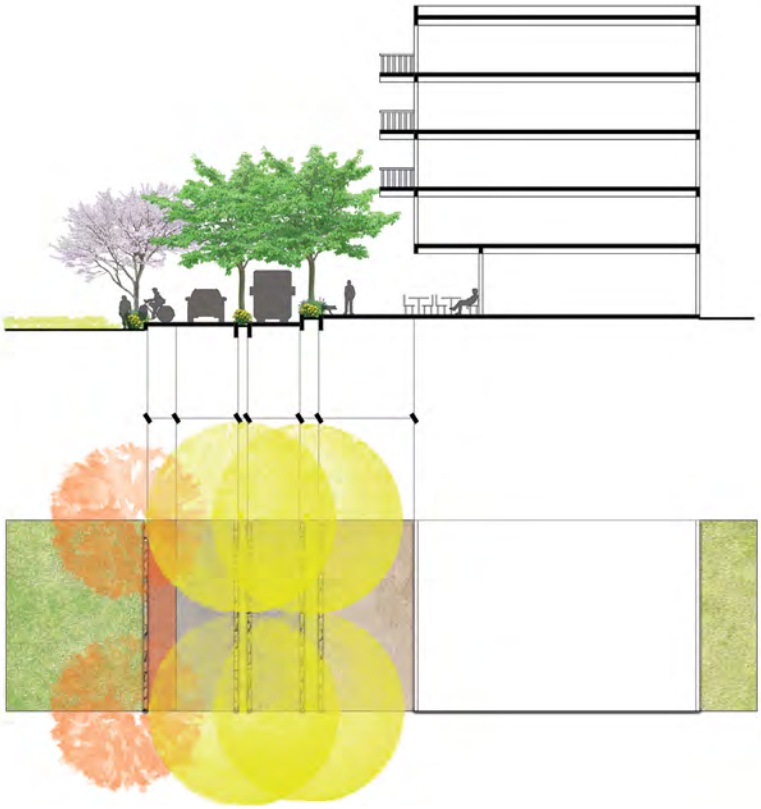


5.3 Ecological edge- applied strategy facing flood risk (perspective of tidal park)

5.3 Detail design (Street profiles)



Section 1-1



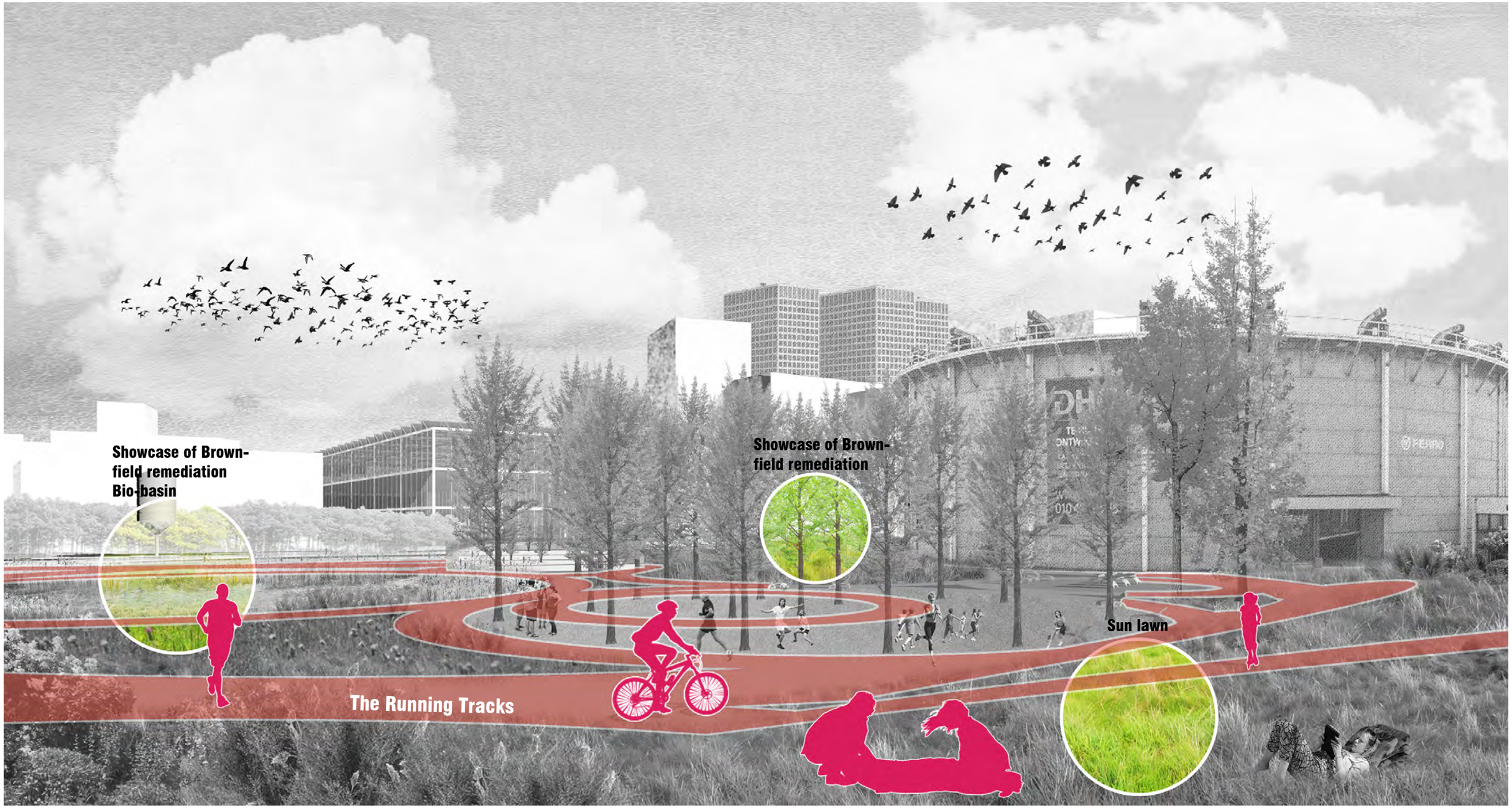
Section 2-2

5.4 Detail design(Perspective)

5.4 Detail design(Perspective 1 - Before)

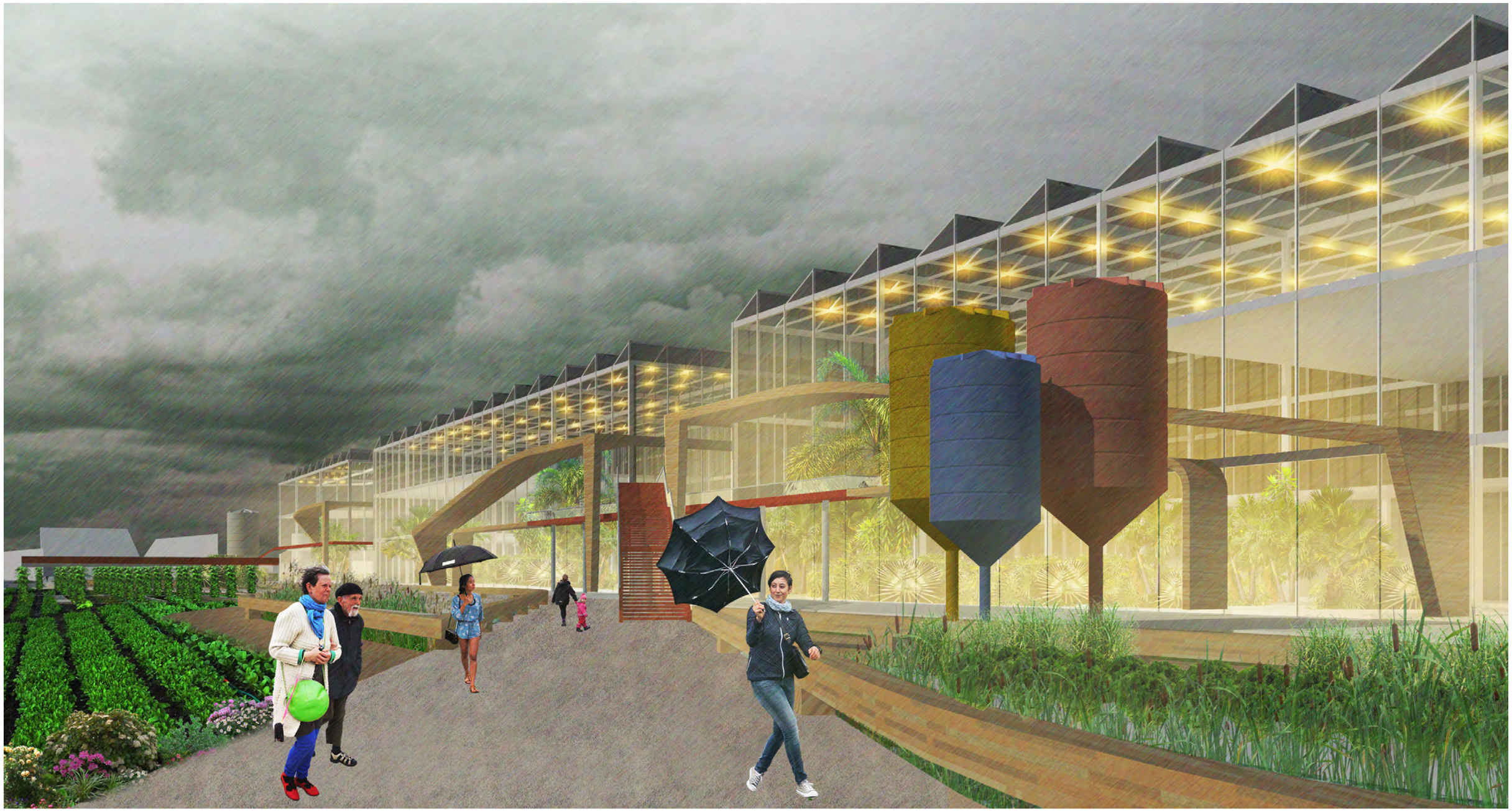
5.4 Detail design(Perspective 1)

5.4 Detail design(Perspective 1)



5.4 Detail design(Perspective 2 - Before)

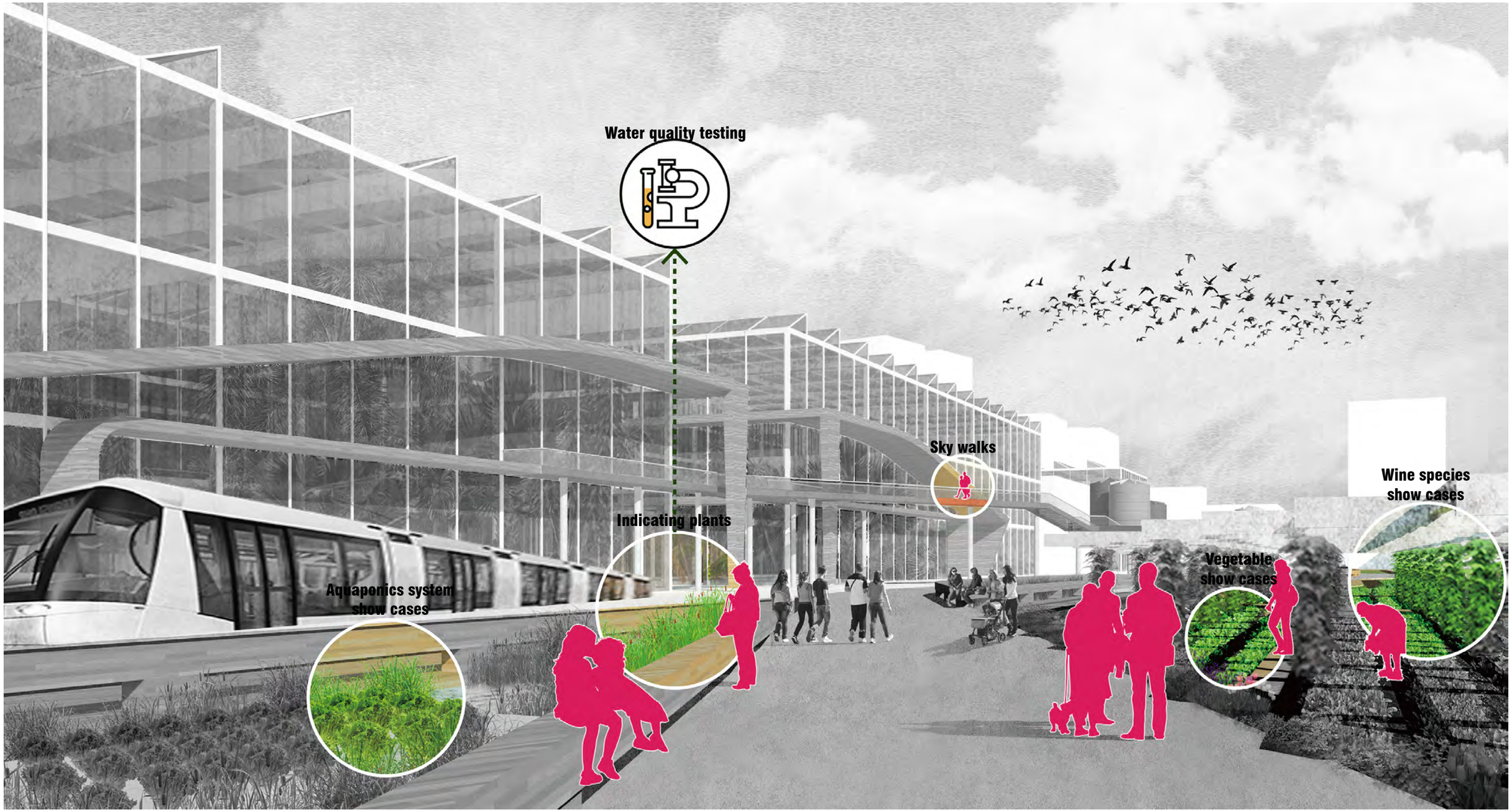
5.4 Detail design(Perspective 2)



5.4 Detail design(Perspective 2)

5.4 Detail design(Perspective 3)

5.4 Detail design(Perspective 3)



5.4 Detail design(Perspective 4)

5.4 Detail design(Perspective 5)

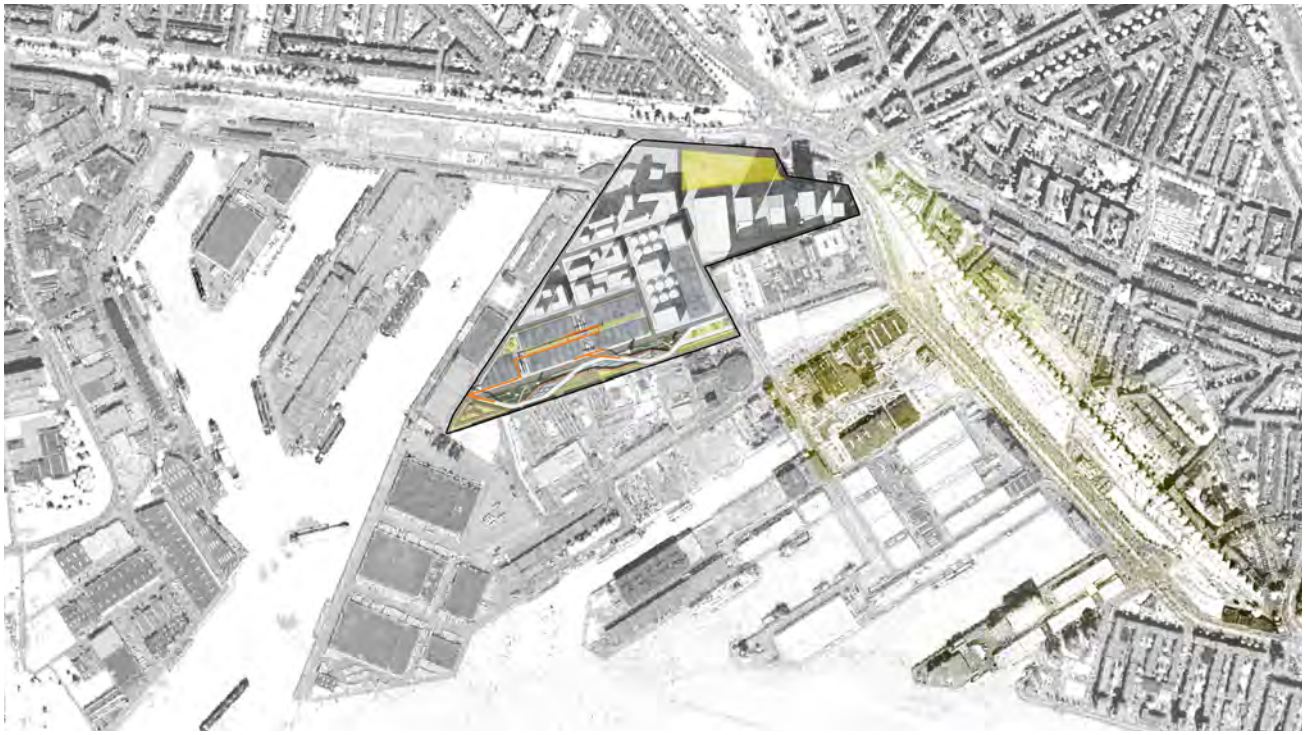
5.4 Detail design(Perspective 6)

5.4 Detail design(Perspective 7)

5.4 Detail design(Perspective 8)

5.5 Construction in steps

STEP 1 (2020-2025)



STEP 2 (2025-2030)

STEP 3 (2030-2035)

STEP 4 (After 2035)

6. Reflection

Reflection report

1. The landscape infrastructure as a sustainable development strategy

In the modern industrial system, the entire attempt to recycle use of used materials is 'down-cycle' (McDonough, W., & Brungart, M, 2009), which means that the quality of the materials is decreasing during the process of recycle using. That means the recycle materials no longer meet the requirement to be made into the products that they used to be, but need to turn into some lower value products. And with this kind of process continuing, the materials cannot be made into any product again and turn into useless garbage again. This kind of down-cycle is not the efficiency way to build up a circularity of Flowscape. In the terms of food production, this kind of waste of resources could reflect on the abuse of the phosphate fertilizer. On the one hand the productive system highly rely on the shrinking and unrenewable resource, on the other hand we throw away and burn tons of the organic food remains and kitchen garbage in the incinerator, or just pour them into the river. The design of urban farming landscape system is aim at solve this kind situation. By the biomass generator, the nutrient contained in the organic waste could be restored in the food growing in the greenhouse and farm land, the remaining energy in the wastes could be fully used, and the waste water could be purified and used for irrigation. The process of the purification of water is also a process of restore the nutrient (especially the phosphate) from the water. However, this kind of design needs a completely reconstruction of the sewage system, and the investment of the building of biomass system. It is questionable that this method could be fully applied in all different parts of Rotterdam city. Whether to apply this kind of system in different situation should need a specific study of the different environment.

The food production system we have is vulnerable and unsustainable. The metropolitan areas are facing the problem of pollution food production, a new possibility of food production system is needed to establish. Also, the change of the climate is another threat to the food productivities. A new food production system should be more efficient at productivities but should also be more eco-efficient. The new system should also be a part of the natural metabolism of material and nutrient, and use the force of nature, for the long term development and coexist with the nature.

With the help of the circular system, the productive activities happen in the M4H area could be waste free and energy efficient, and the productive facilities are also a part of landscape. In the economical term, the productive activities could provide jobs for the citizens and the recycle of the waste could minimize the ecological price. The unsustainable way that nature had to be paid for the revenues of polluting economy is cause by the separations production economy and nature. (Tjallingii, S. 2000) By combining the productive process and recycle process with the help of natural process, this kind of paradox is hopefully to be solved.

2. Relationship between "flowscape" and the project

The title of the graduation studio is Flowscape, which means a landscape infrastructure is not only a technical structure but also a carrier of nature and urban process. It proposed that landscape architecture is a way to provide solution for the environmental problems and adapt to the surrounding environment as well as providing appropriative environmental condition for long term dynamic nature and urban development.(Nijhuis, S & Jauslin, D, 2015)

Transforming the M4H area into Eco-efficient and circular community through urban farming is under the guiding principle of Flowscape. The M4H area is located in between the Rotterdam and Schiedam city, and it is also a former harbor area. The situation of this area is highly complicated, the challenge of developing this area into a healthy community including the brownfield remediation, old industrial upgrading and inserting the new industry and business in order to bring in the job opportunities. In order to transform this area into an environmental friendly and waste –free community for sustainable development, the material, energy and nutrient flows of Rotterdam city was being studied, to discover what kind of character could the M4H area be in the future development of the city. Also, the landscape structure and river landscape of the Rotterdam city is also a part of the research. In addition, the different potentials for the urban farming of Rotterdam city are also being studied, in order to provide a scientific and suitable solution to combine the urban farming industry into the new urban fabric and historical context. As a result, the transformation design of the M4H area into an eco-efficient urban landscape which will provide a coherent landscape infrastructure and system for nature and long term urban development while considering ecological, technical, architectural and social aspect under the principle of Flowscape.

Furthermore, to consider the research in the wilder social context, the situation which the surrounding citizens have weak connection with M4H area is another issue needed to be solved. The mono-functional harbor area and parking lots give the impression of the busy and dangerous industrial productive area, and the separation of the dike and high speed transportation is also keeping the citizens away to think this area as a place to stay and meet. Combining the productive activities and recreational activities into one public space and improve the spatial quality is another focus point of the research. By developing the multi-functional greenhouse system and the landscape axis with open-air urban farm, the productive space could be public and educational at the same time. The interaction with indoor environment (the greenhouse) and the outdoor environment will create diversity of atmosphere and space. The cultivation of the multi-functional public space makes the involving of the public and commercial activities possible.

3. From research and design

In order to make the study more reliable and accurate, a lot of quantitative study had been made. However, a paradox between the abstract data and concrete spatial design emerged. It took a great afford for me to translate the research data into an architectural design language. With the help of my mentors, it is realized that categorized the research by different scales help me a lot in sorting out useful

information. Research on different scale will provide a more comprehensive understanding of the project. First my studies begin with the global scale, since the domestic food production activities all have their global impact. Later, the regional and domestic data and mapping are taken into account. By layering up different map, such as the flows of materials, nutrients and energy of Rotterdam, I built up specific spatial models of Rotterdam in my mind, and that helps me shake off the stereotype of the city and reconstructed the urban environment based on different kinds of flows. That gave me the insights of the relationships between physical environment and abstract data, and helps me transform the research into design.

Also, study from the social, economic and ecological aspects also helps me understand all different need of different stake holders, and built up a project that could fulfill different groups of people. Through different cases studies, it is discovered that the majority of the successful projects of urban transforming has one common place, which is the involvement of public. This kind of involvement is a way to study different kinds of social and economic need of different stake holders. As long the as the different requests can agree with each other and be fulfilled, the stake holders will actively take part in the action of reforming their neighborhood and create strong identity recognition of the place.

Case study

The main goal of the case study is to learn from the rich occurrences and background knowledge with specific direction of research question. Different possibilities which can apply to the certain research question were discovered and for the further design, multiple design principles could be abstract from all these possibilities.

4. Lessons learned

In general, all the food productions system in the urbanized area is facing the similar problem: the lack of land resource, the waste of nutrients and energy and pollution. Although in my research I choose a very specific situation, to transform a former harbor area into an integrated system of different flows and the solution to threats of extreme weathers accompanied with the climate change, but the essence is how to formulate an eco-efficient food production system in the built environments. So the rules of building up a circular system of materials and nutrient were studied and understood to help me get the handle of it. Working with the circulation of energy, nutrient and water is my strategy facing the challenges. Also, design with the combination of engineering approach and natural process is my solution to the climate change. To cope with the systematic problem, a vast study of different information in different aspect is very important. That lessons I learned from the process of my study is to structure all kind of information in the same context is also very important, otherwise the chaos of the information will blur the direction of study. In my perspective, take the natural process into account is not only about restoring the ecological vitality of the river, but also taking the urban environment back into a natural circulation of materials and energy, and let the force of the nature could be used in the further development of city.

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