

The transformation of a harbour area to an area whose subsurface is prepared to future (unknown) changes.

Merwe Vierhaven Rotterdam

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## Contents

### **Analyses**

Subsurface

Subsurface and subsoil

Subsoil

SEES

SWOT

### **Goal**

### **Literature**

### **Versions**

### **Phasing**

### **Final Design**

Excavation

Remediation

Infrasctructure

Cables and Pipes

Monuments

Functions

Sustainability

### **Phasing**

### **Detailed Design**

Area 1

Area 2

Area 3

Principles

Sections

Impressions



assessment management analysis developed framework take  
contaminated development different  
integrating practice impacts case-specific under-considered ESS regeneration instead  
land soil renewal tools  
warning Balancing

## SUBSURFACE

# Harbouremediation

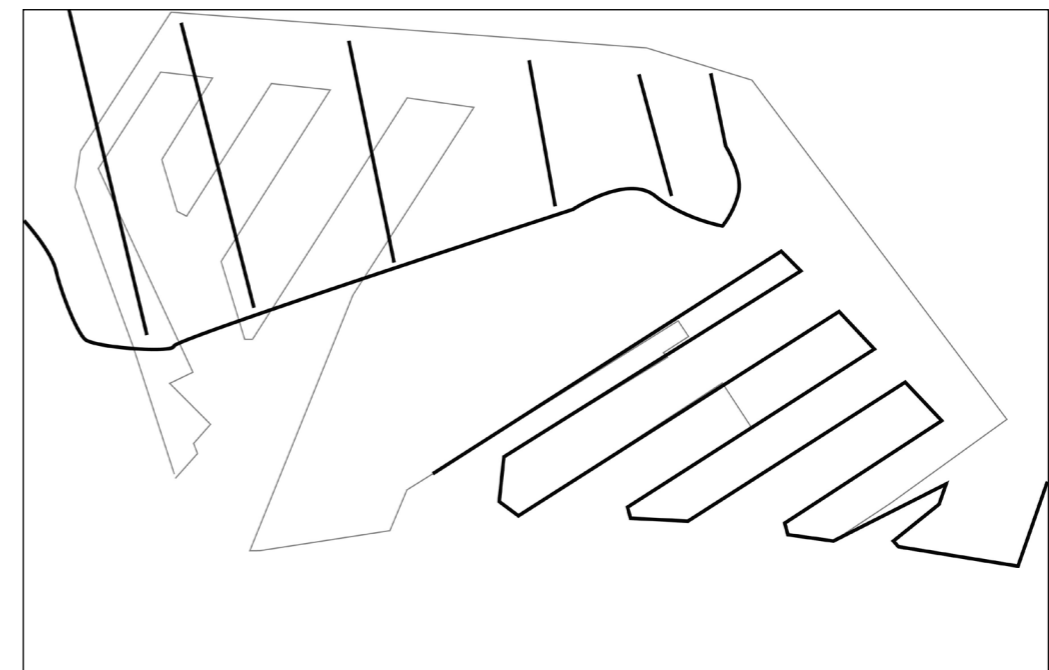
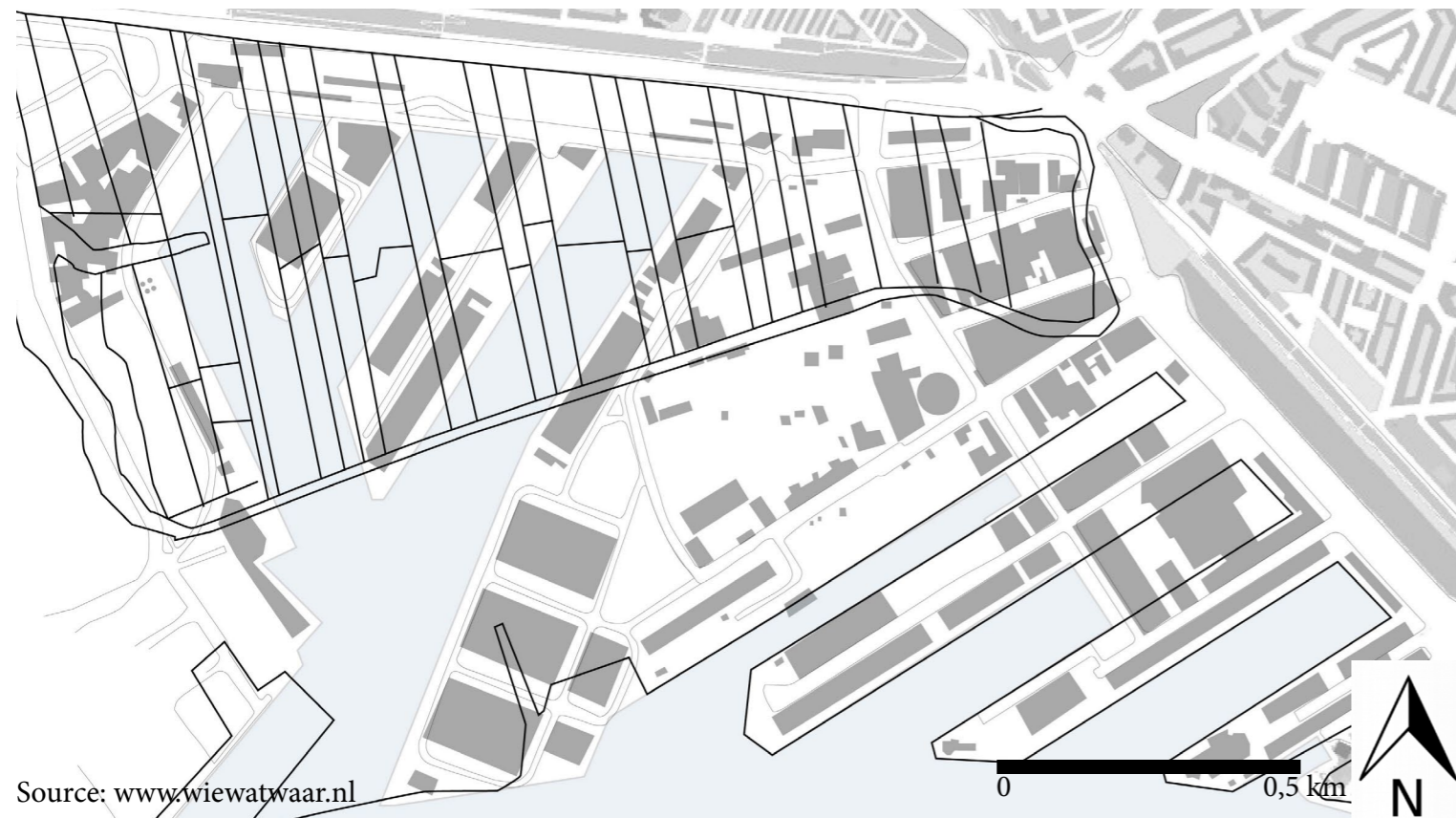
# Merwe Vierhaven

1892



In 1892 the area had a dominant polder structure and a dike to protect the land.

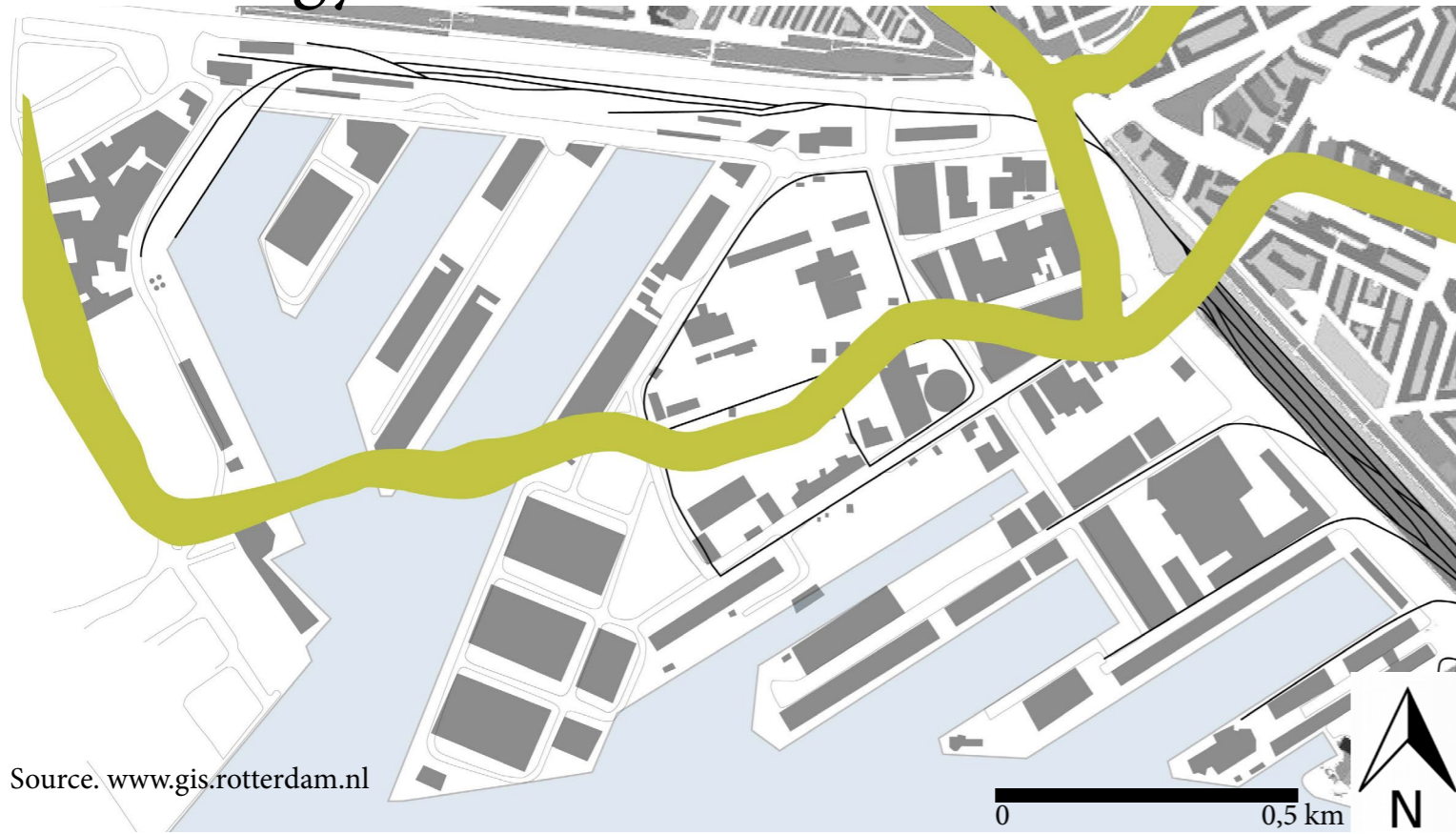
1929



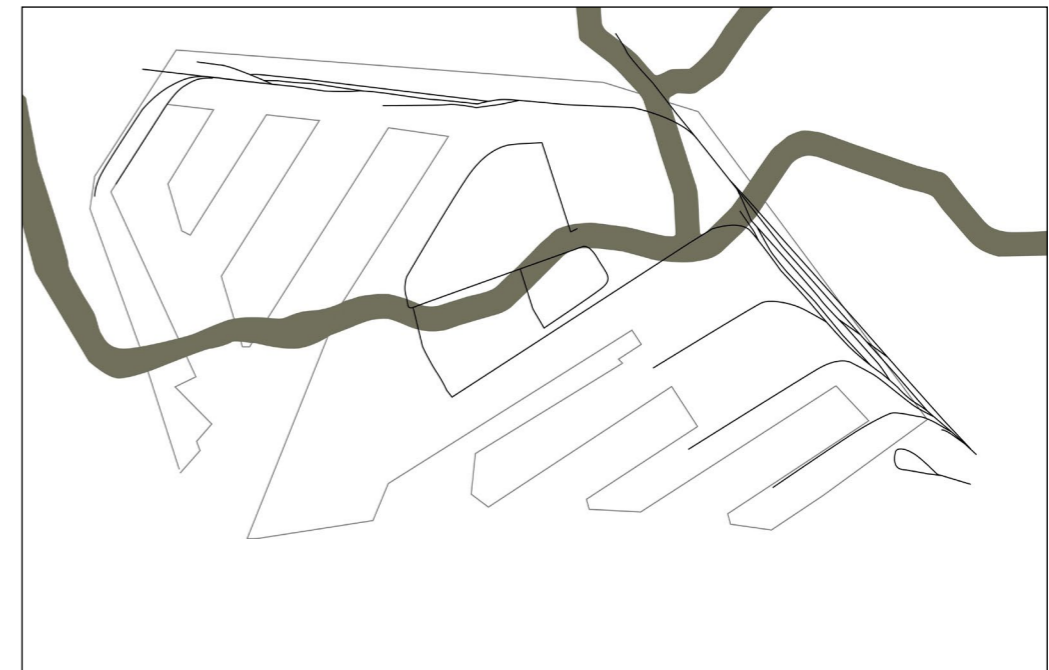
In 1929 the outer dike area is transformed in to a harbour.

# Harbouremediation

## Archeology

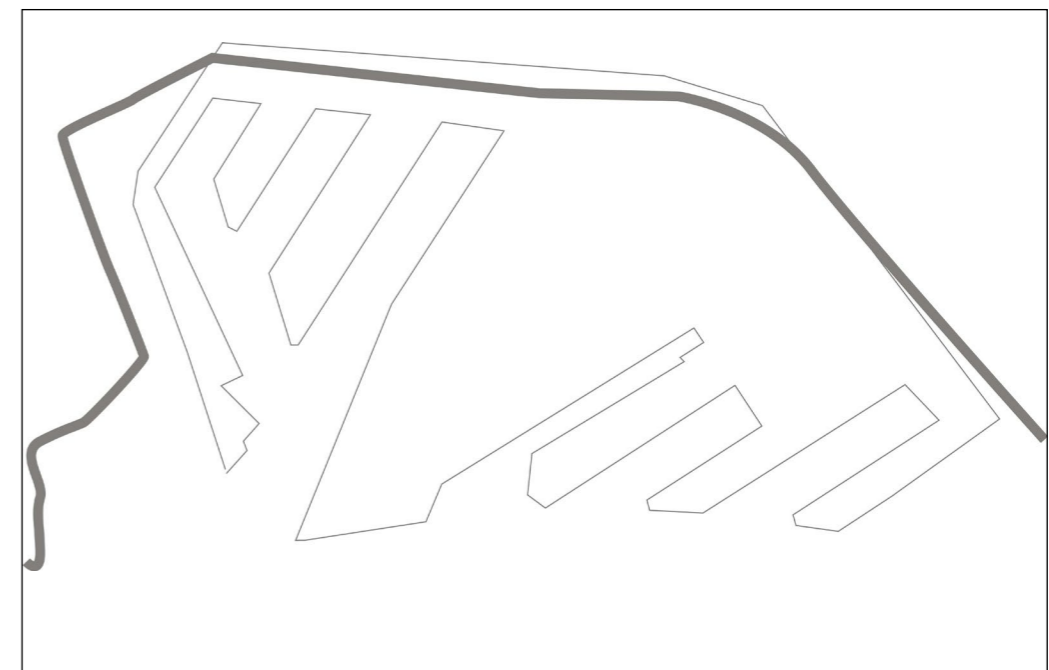


# Merwe Vierhaven



There is no remembrance of the old dike structure anymore in the Merwevierhaven.

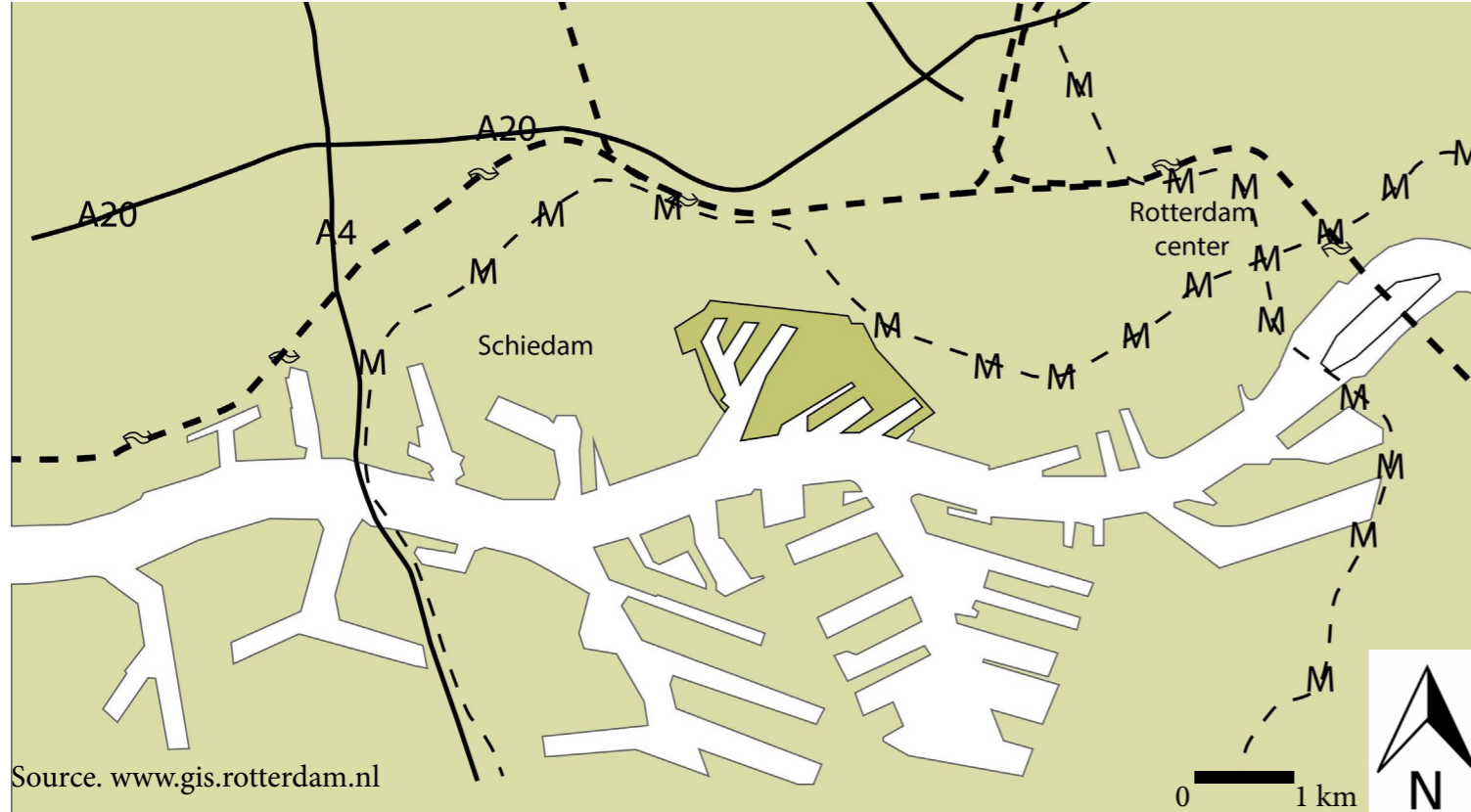
## Inner- and outerdike area



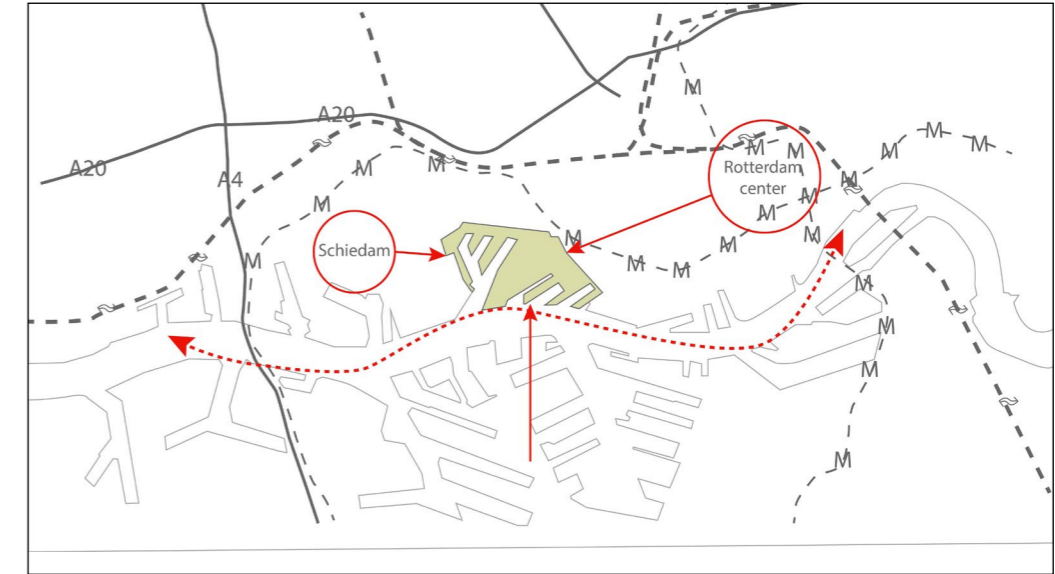
The whole Merwevierhaven area is an outer dike area.

# Harbouremediation

## Infrastructure

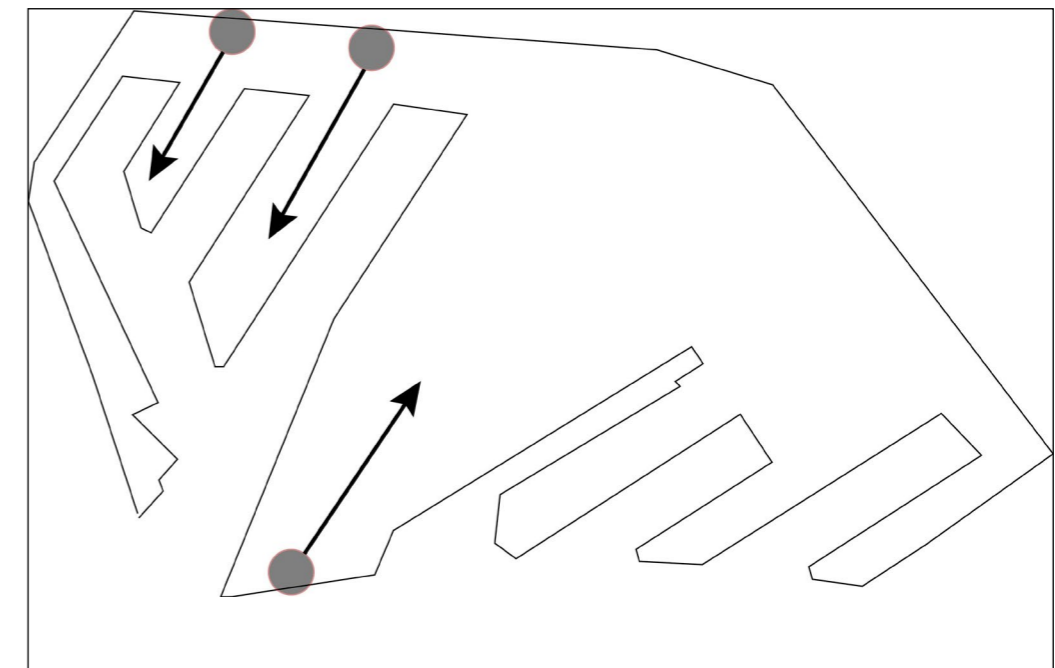
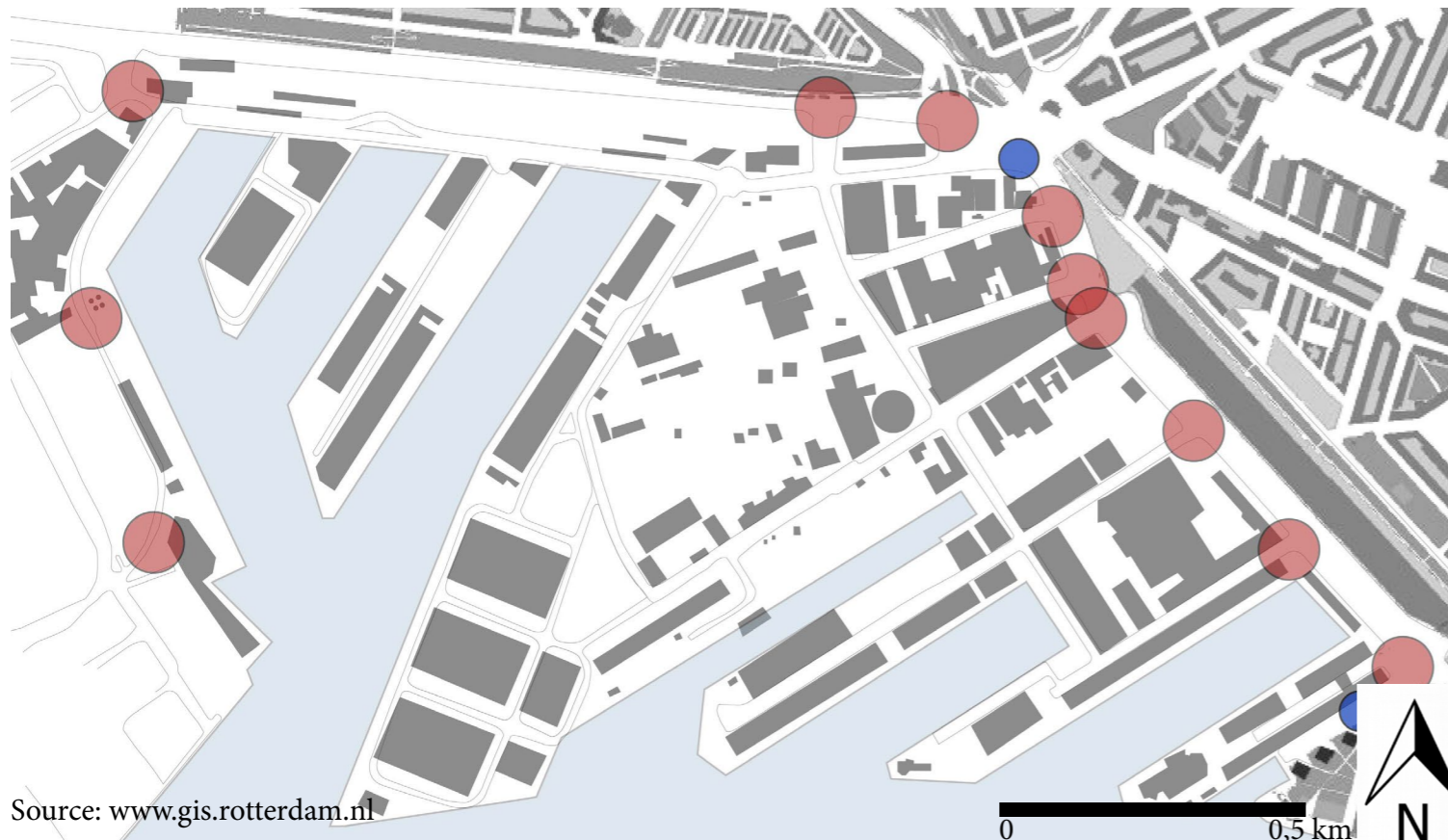


# Merwe Vierhaven



The Merwevierhaven area is good accessible with public transport and by car, but has no connection with the other side of Rotterdam over the river Maas.

## Entrances

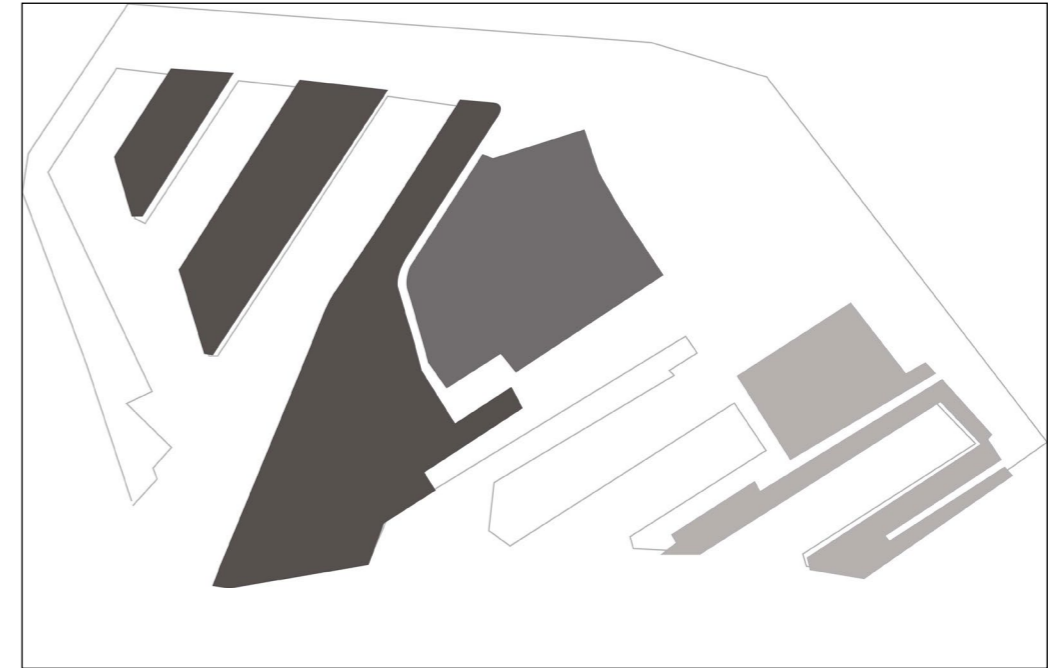
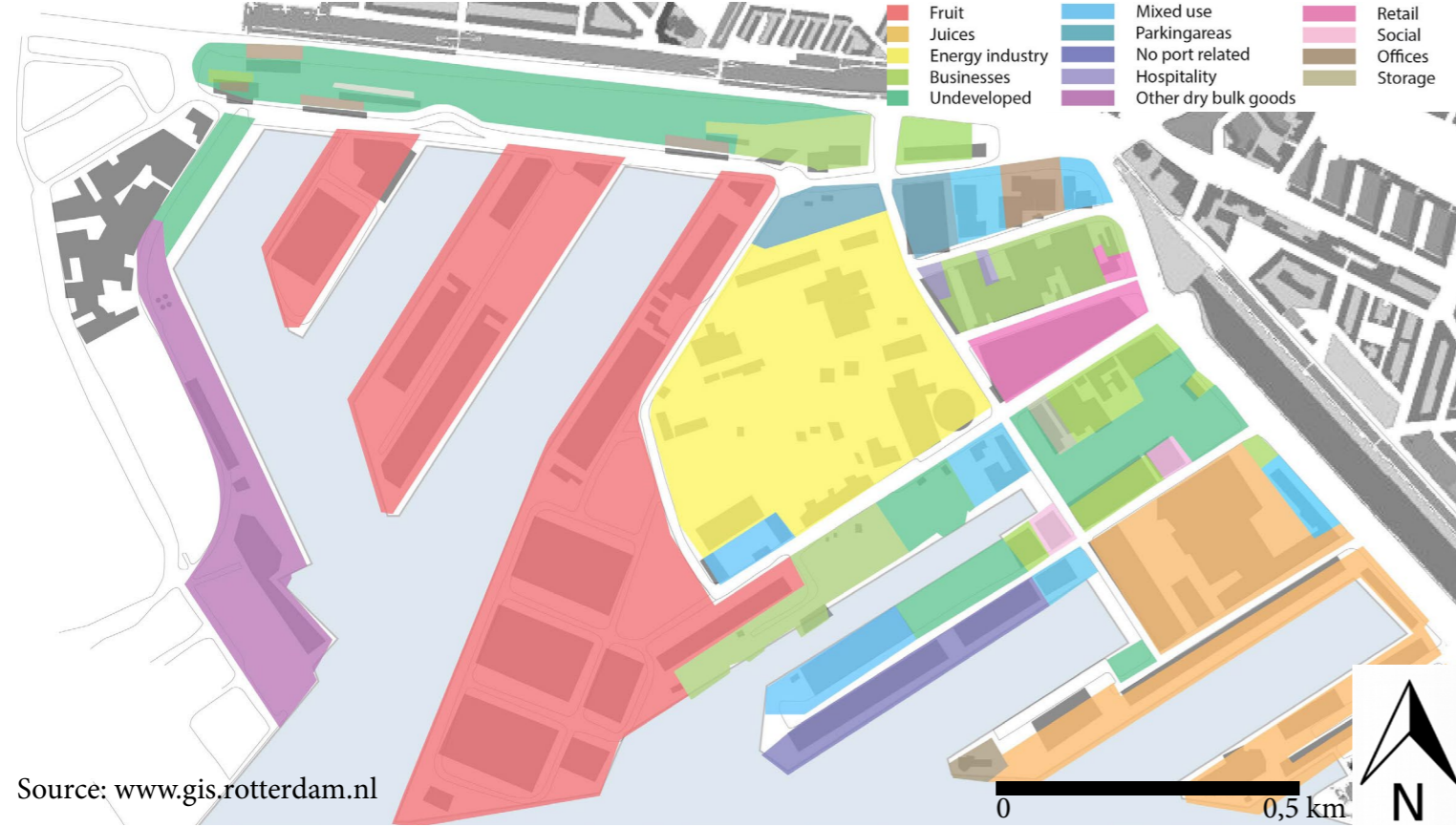


The western harbour arms, the Merwehaven, do not have a clear entrance, all the other entrances are situated at the Vierhaven on the eastern part.

# Harbouremediation

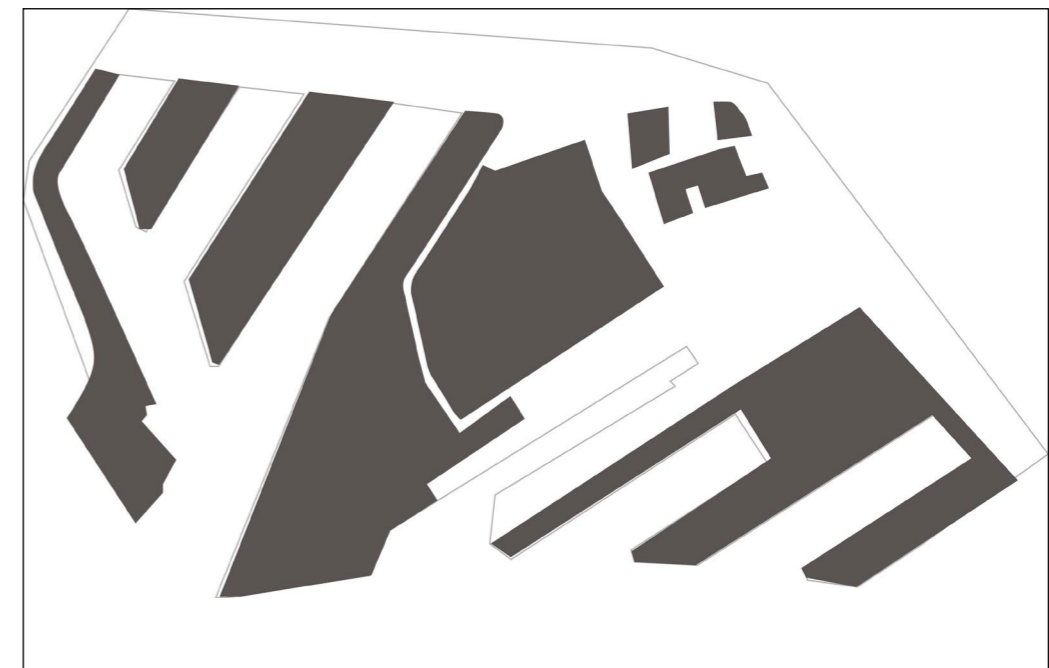
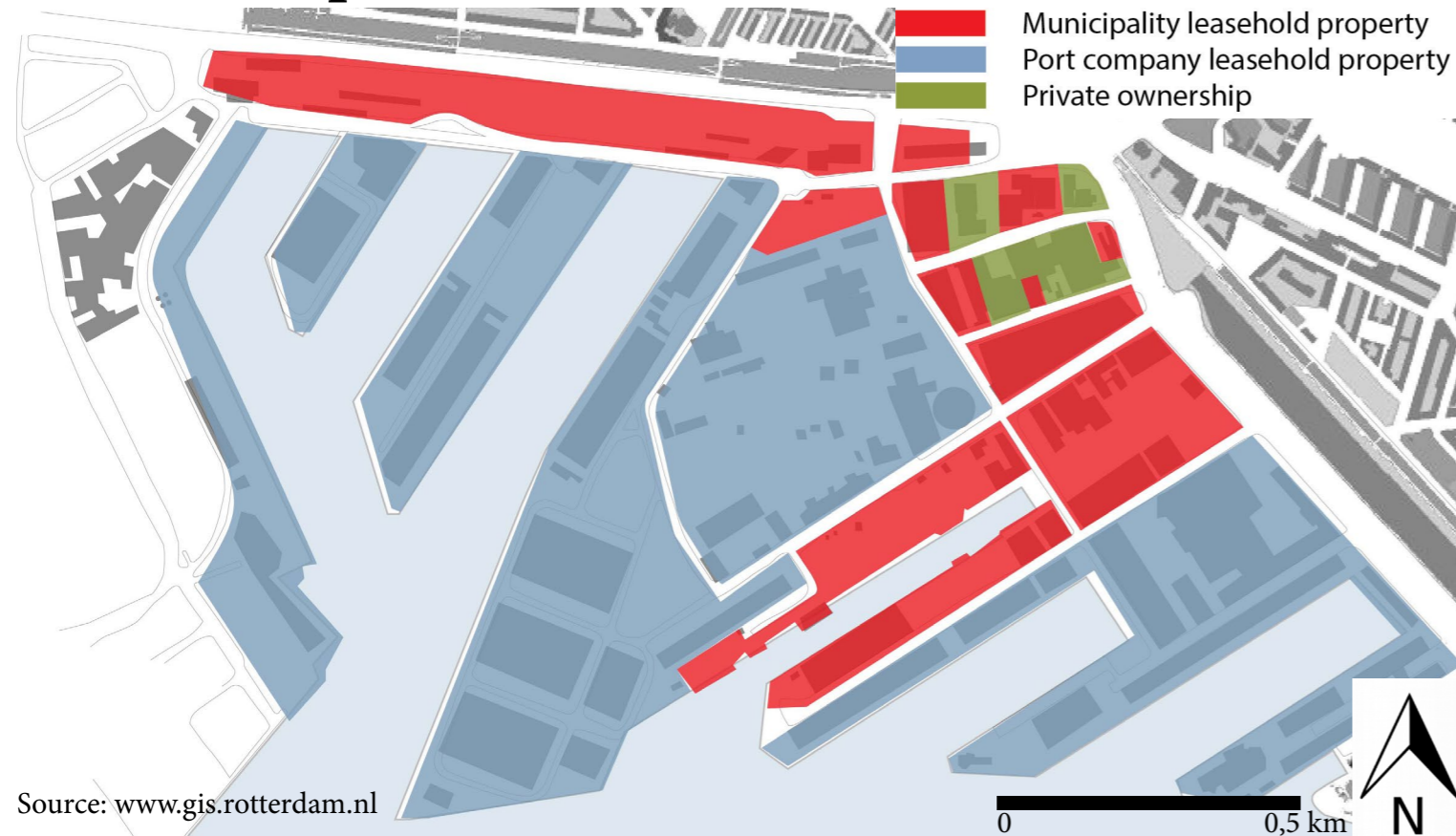
# Merwe Vierhaven

## Current functions



Nowadays the area knows a mixture of functions. The most important once are the fruit and juices (fruit en sappen) industries and the EON factory.

## Ownership

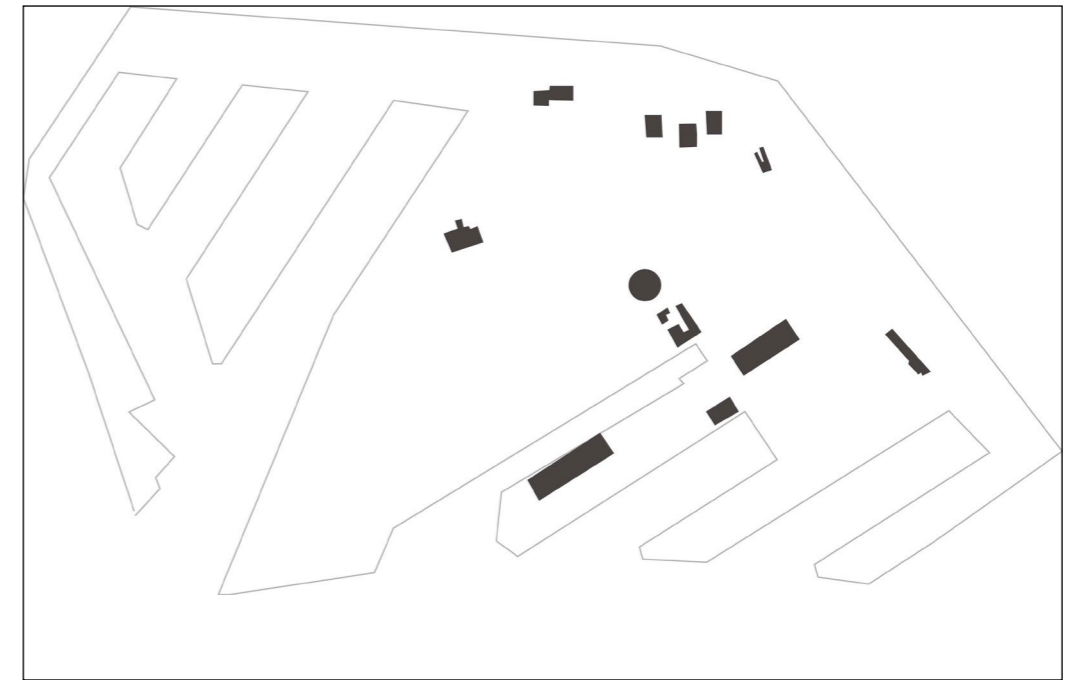
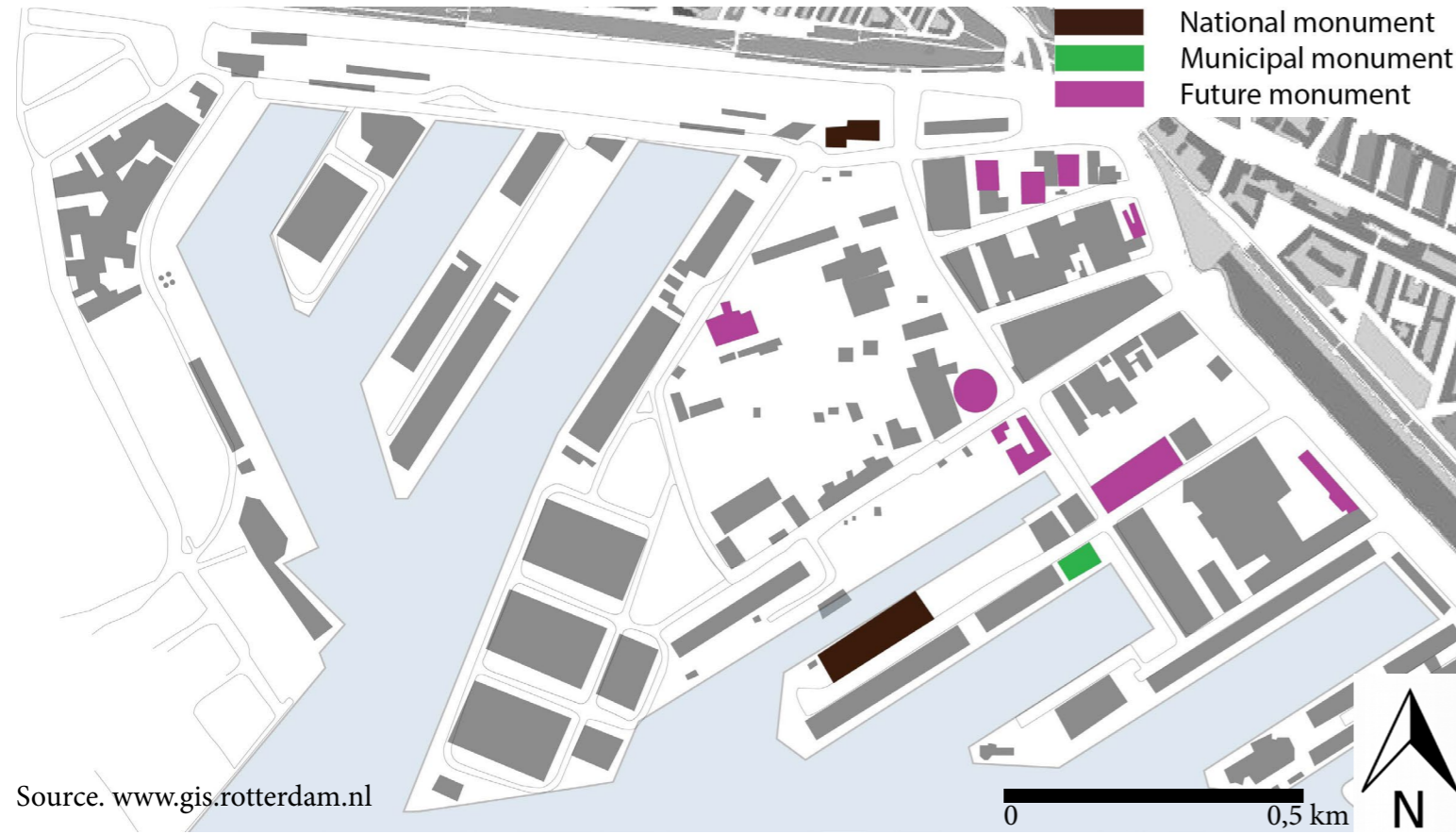


Most of the area is owned by the harbour company, and a smaller part by the municipality. Both are leasing the ground to other parties.

# Harbouremediation

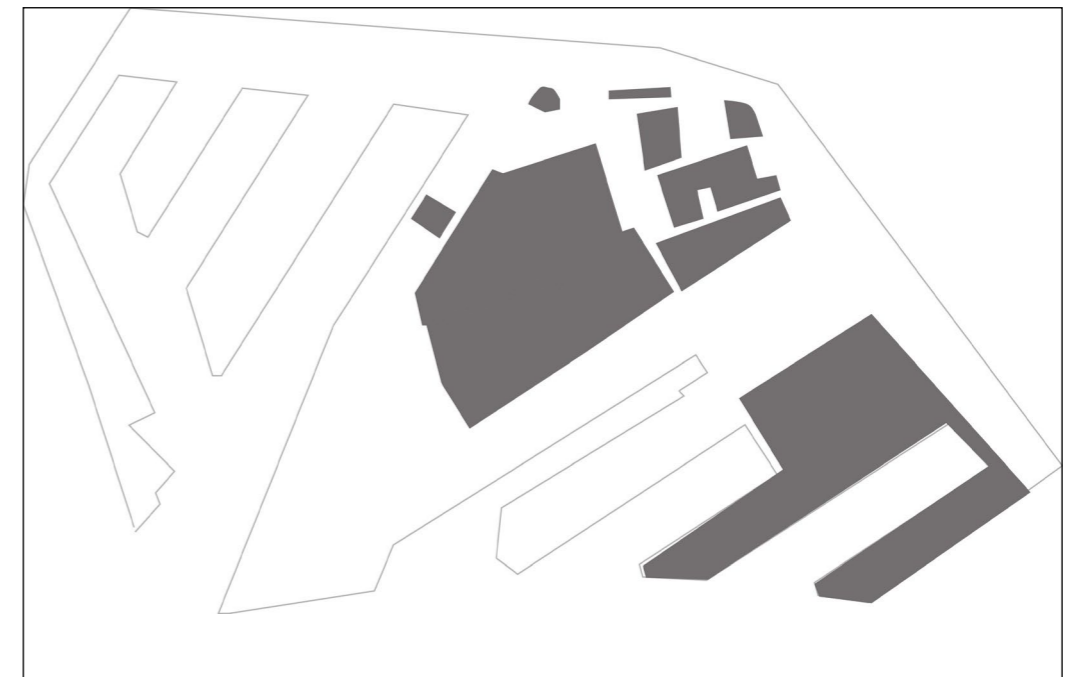
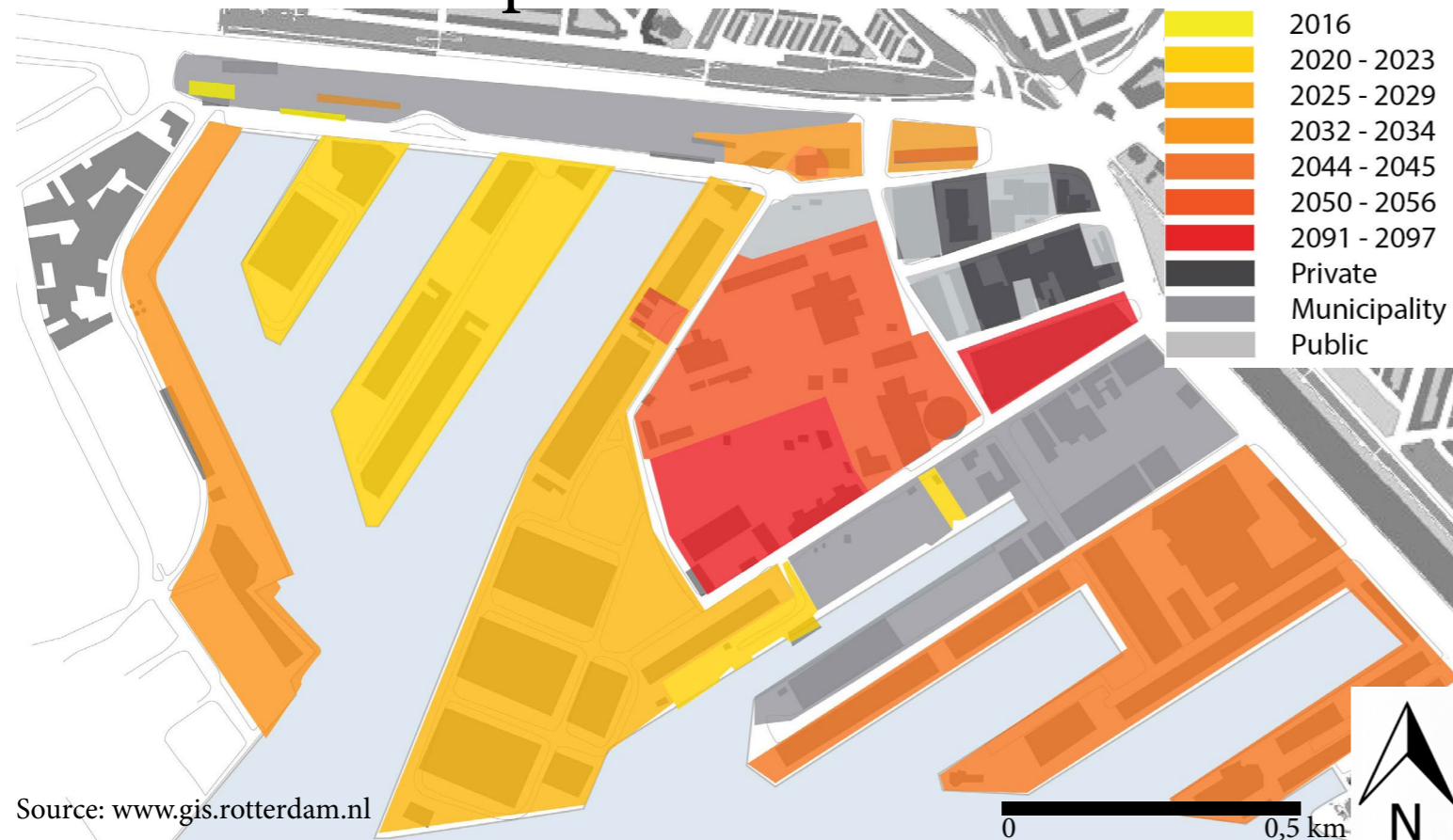
# Merwe Vierhaven

## Monuments



There are a few monuments in the Merwevierhaven area, and some buildings are on the list of becoming a monument in the near future. There are other, non-monumental, buildings that show the character of the area as well.

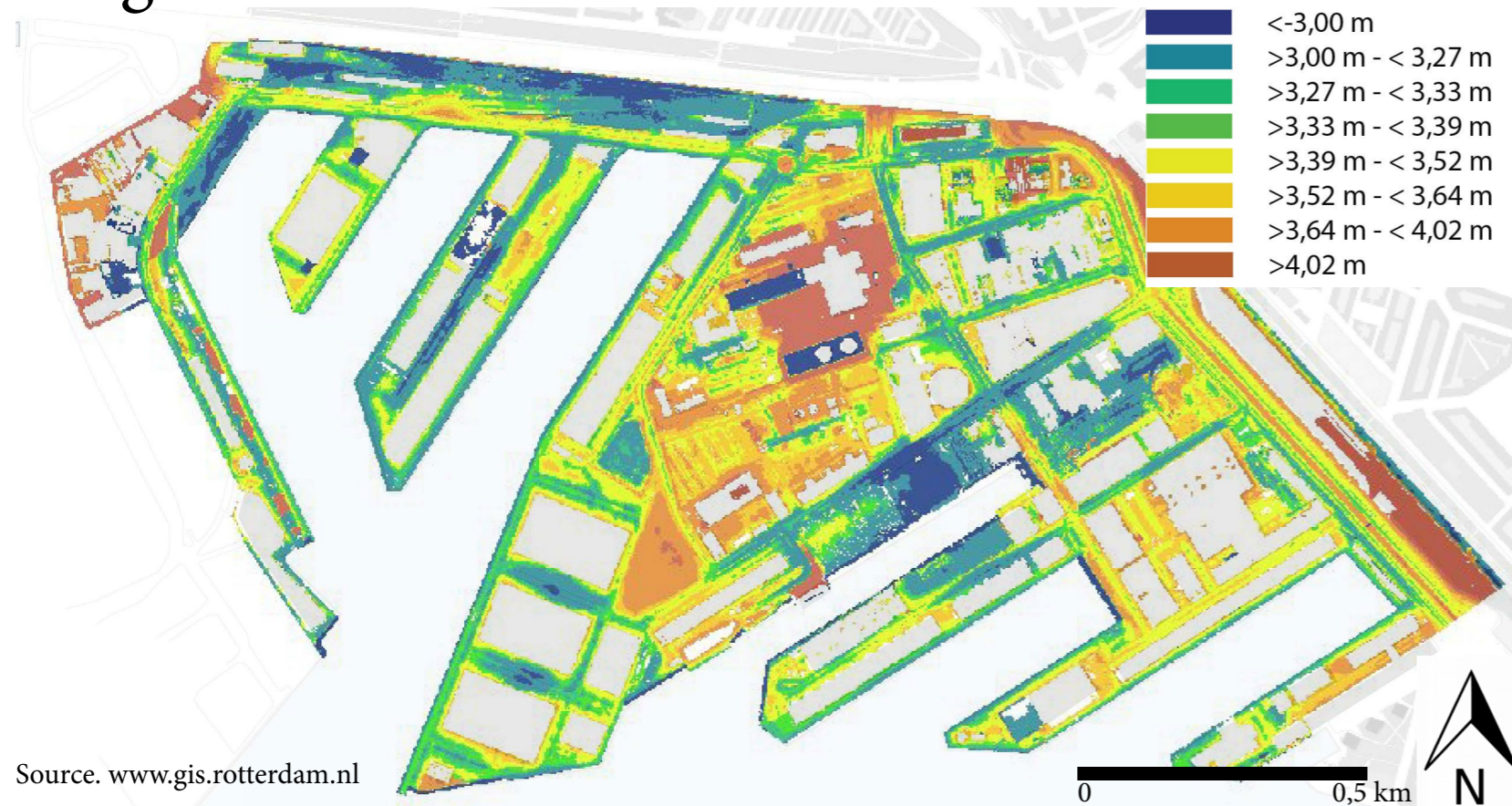
## Ground lease expiration



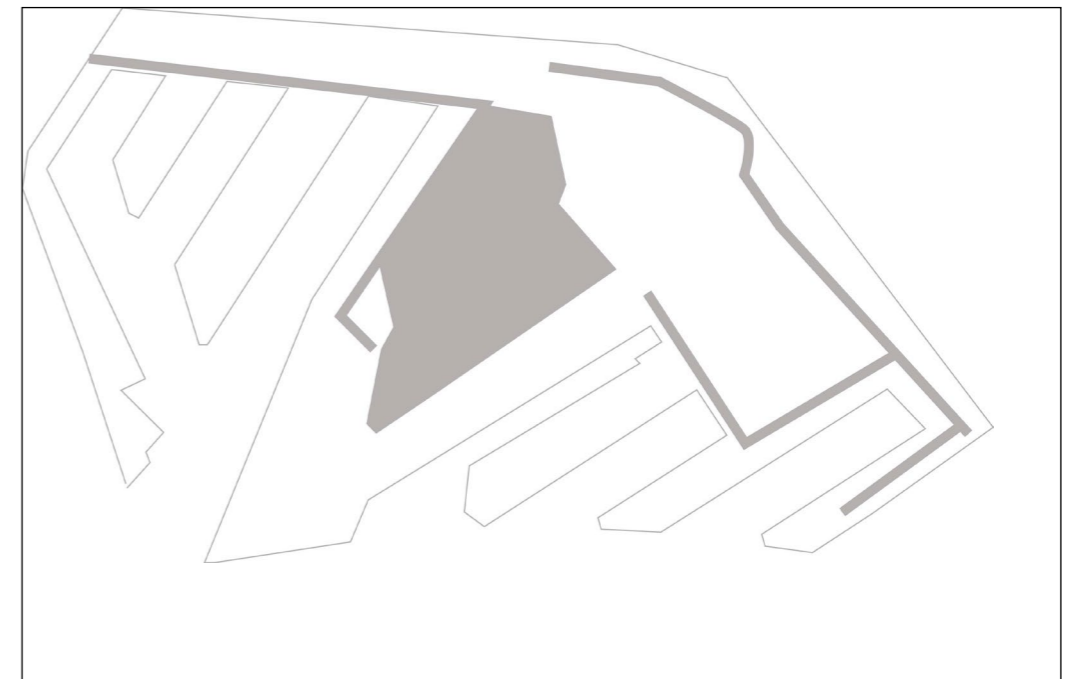
There is a big variation in the expiration dates of the ground leases. The longest leases are that of the EON factory and of the eastern harbour arms.



## Height surface level

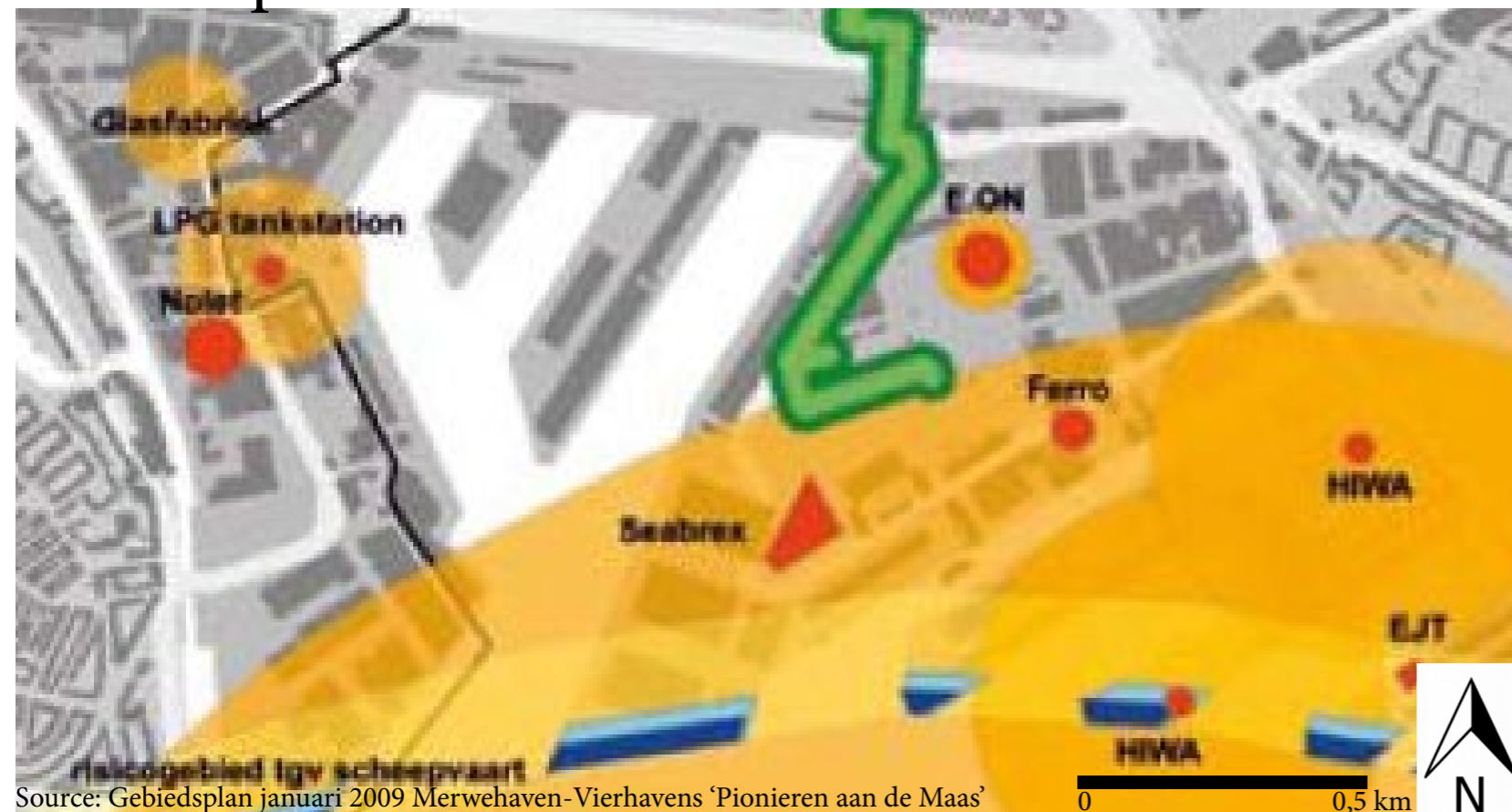


Source. [www.gis.rotterdam.nl](http://www.gis.rotterdam.nl)

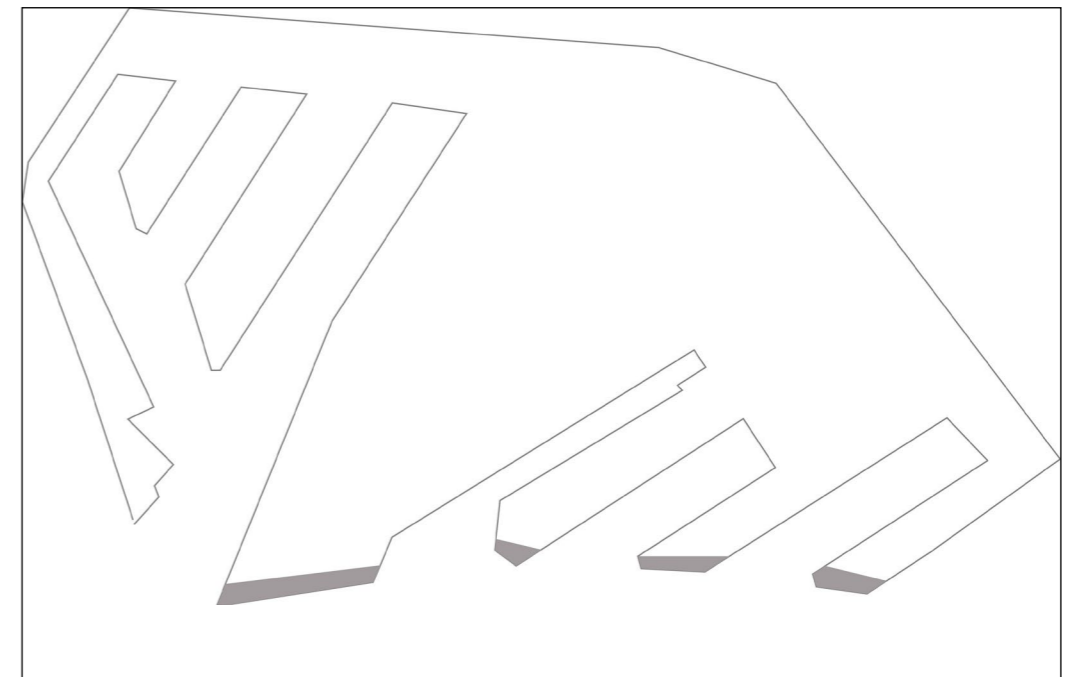


The Merwevierhaven area is an outer dike area, so the height of the surface level is very important. Most of the roads are higher than the rest of the open surface. The EON factory is on higher ground than its surroundings.

## Risk map

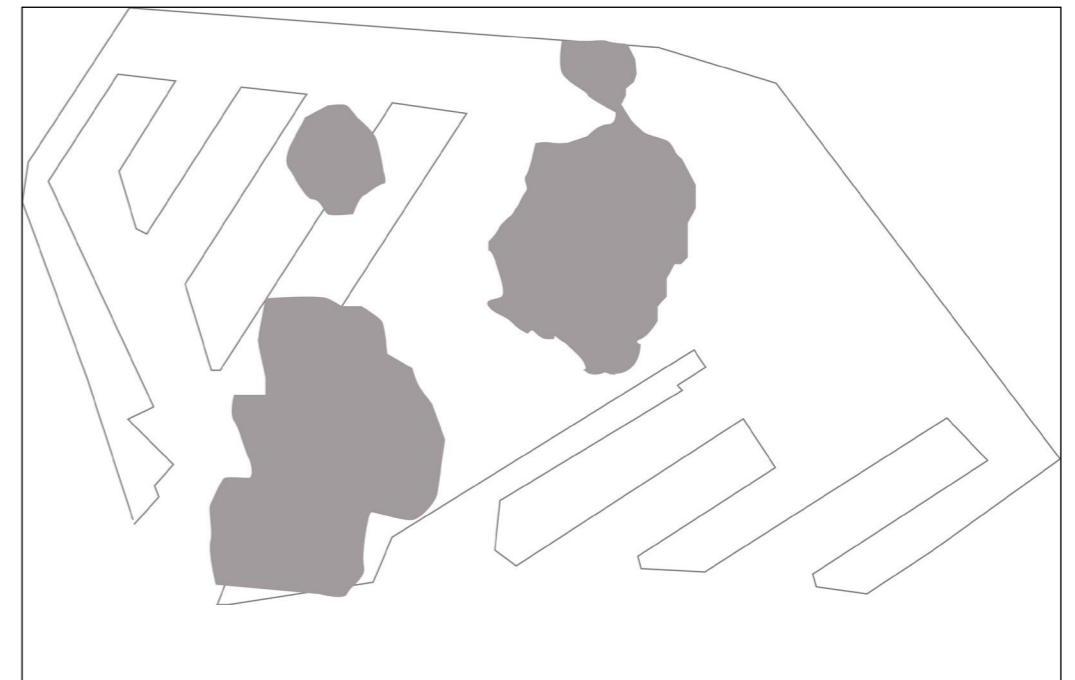
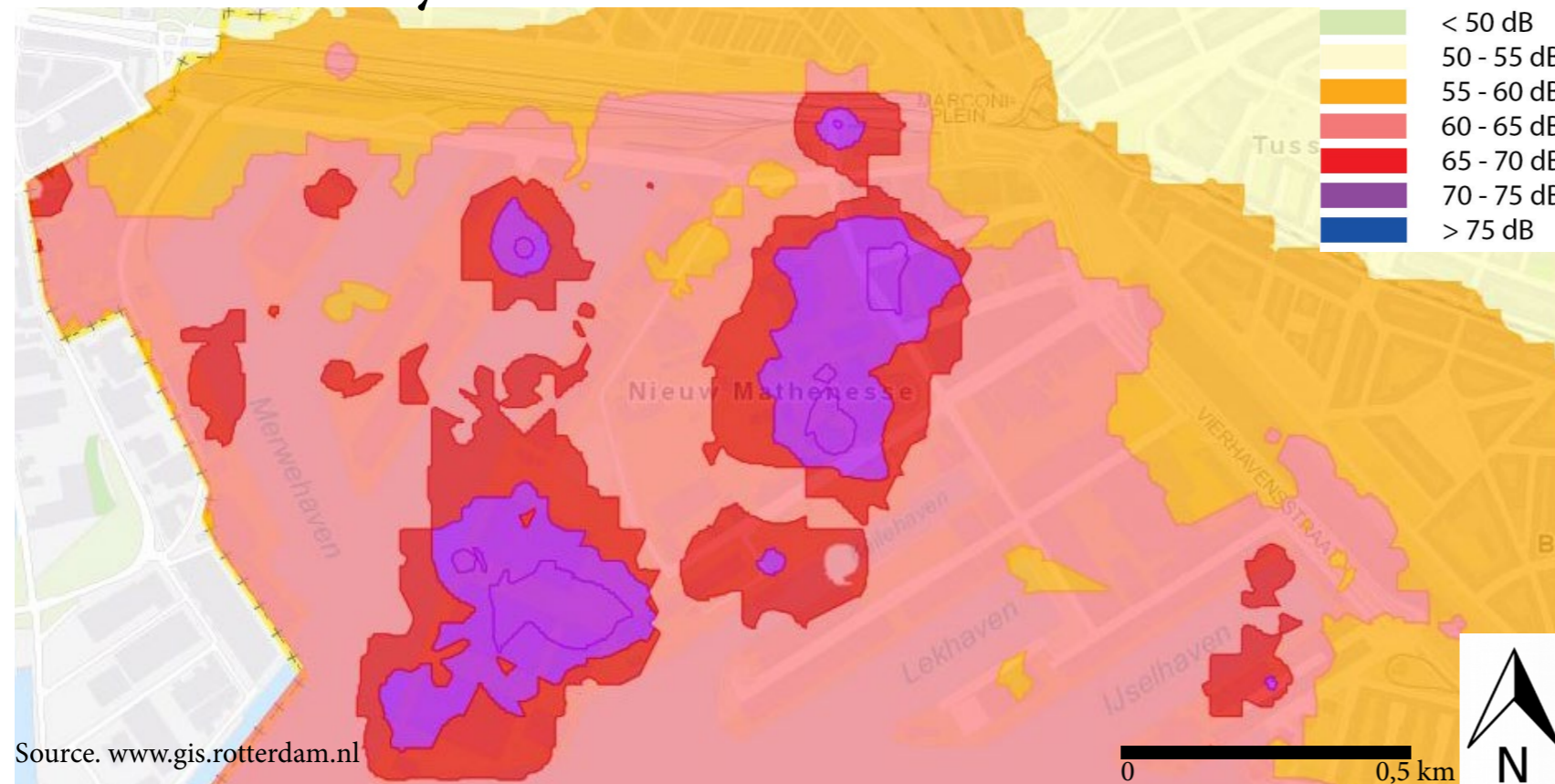


Source: Gebiedsplan januari 2009 Merwehaven-Vierhavens 'Pionieren aan de Maas'



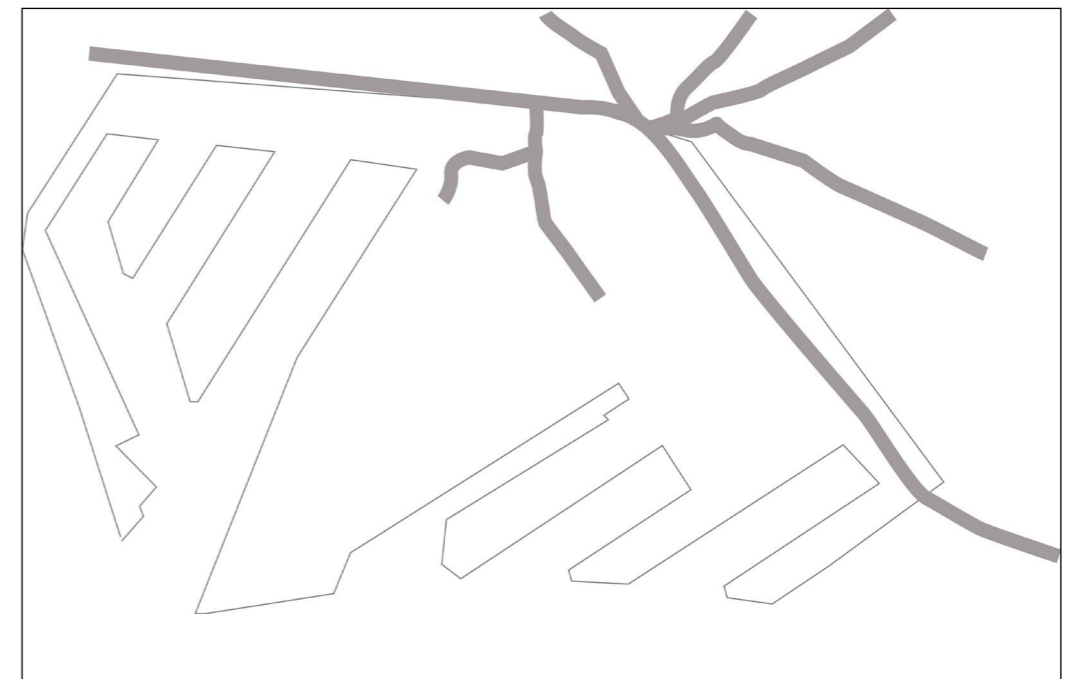
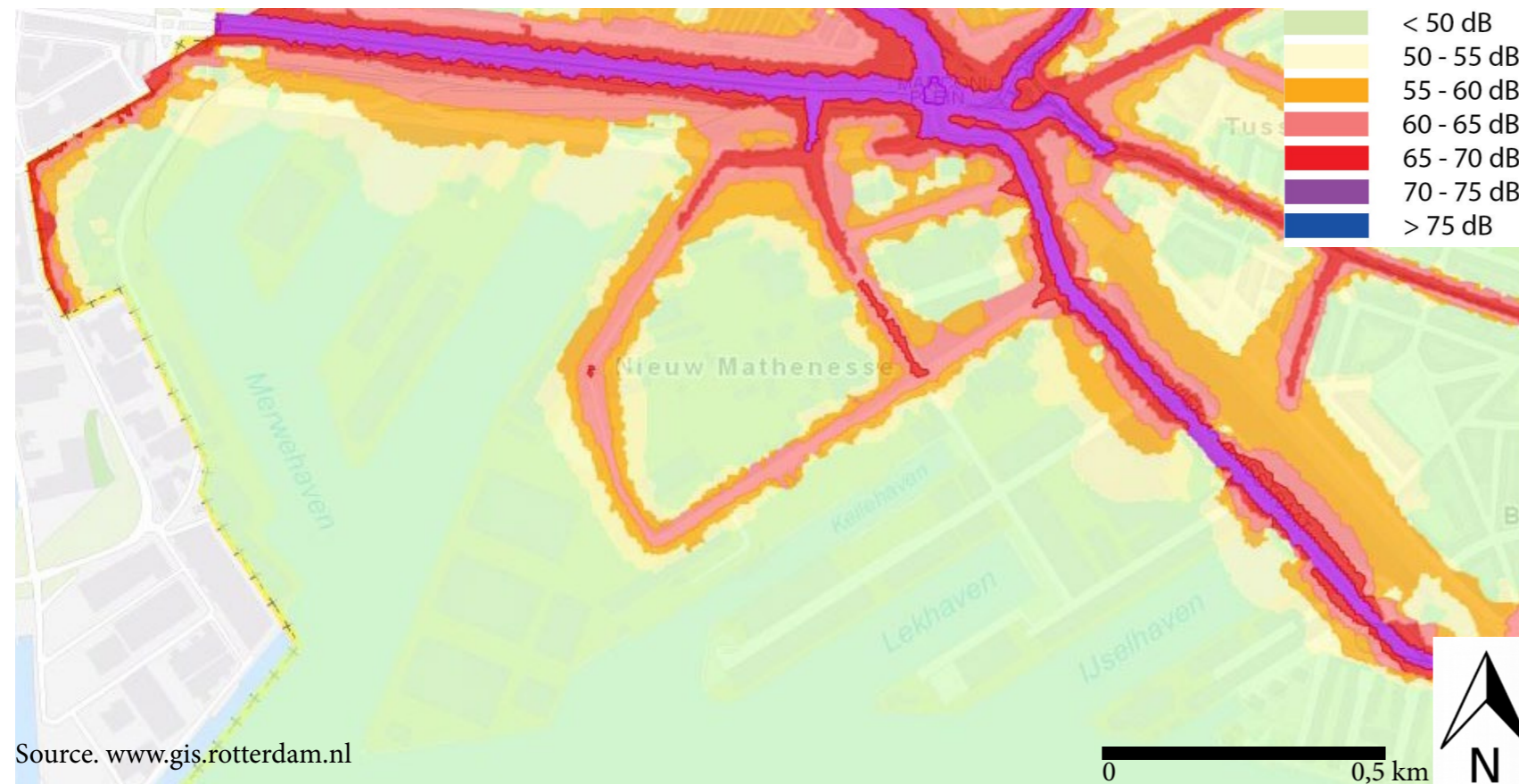
The risk map shows the current risks for the Merwevierhaven area. The most important one to take in account is the non-building zone from the river the Maas.

## Noise industry



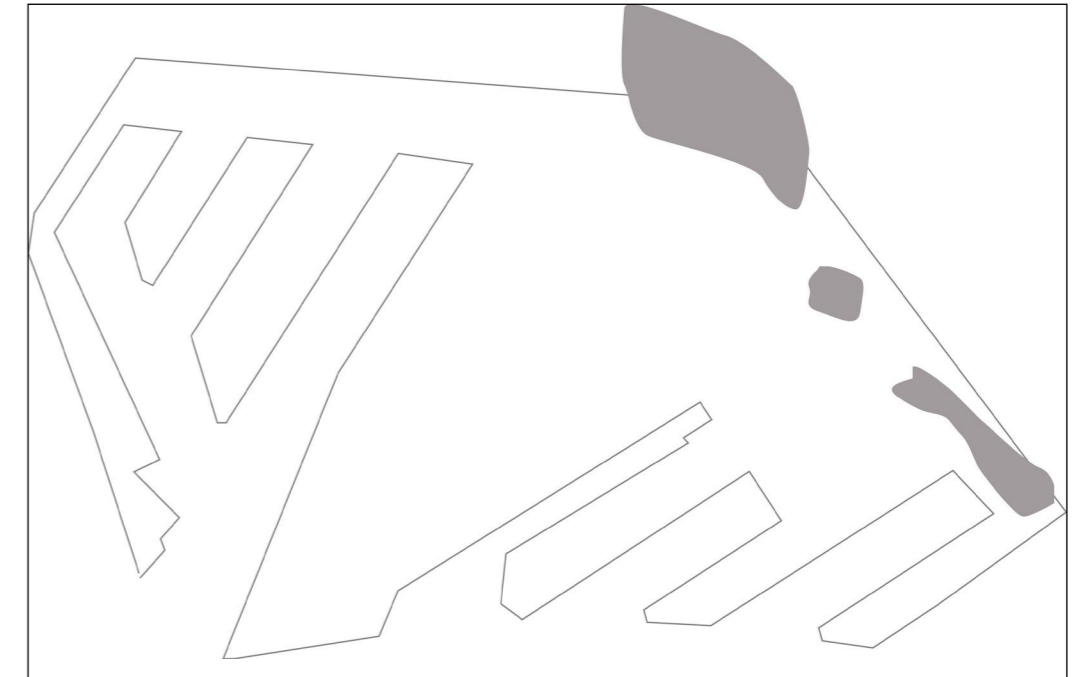
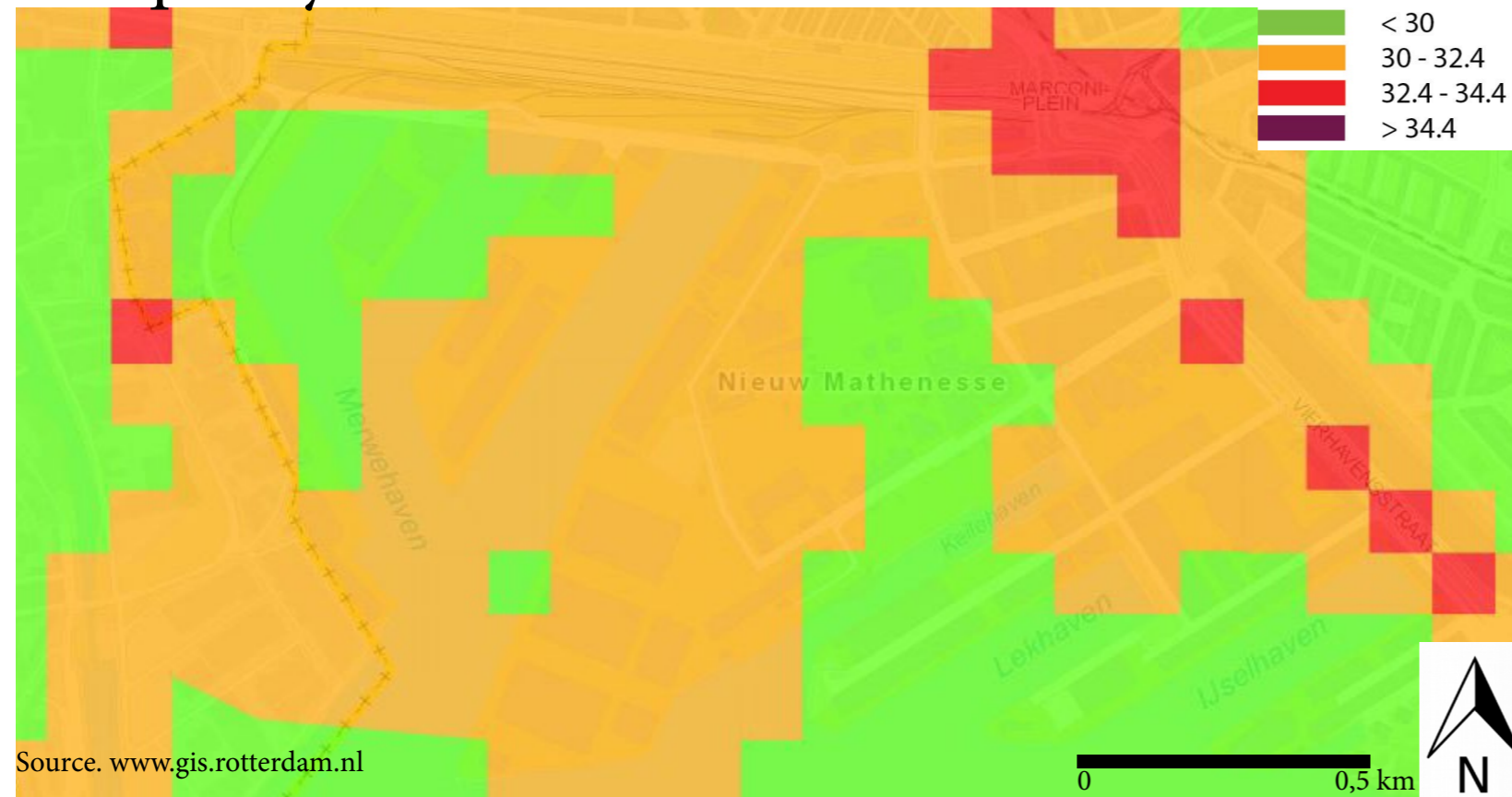
The industry in the Merwevierhaven area produces a lot of noise that causes disturbance for the surroundings. The danger of deafness occurs when a person is exposed to an ongoing noise level of 80 dB (www.arbounie.nl).

## Noise traffic



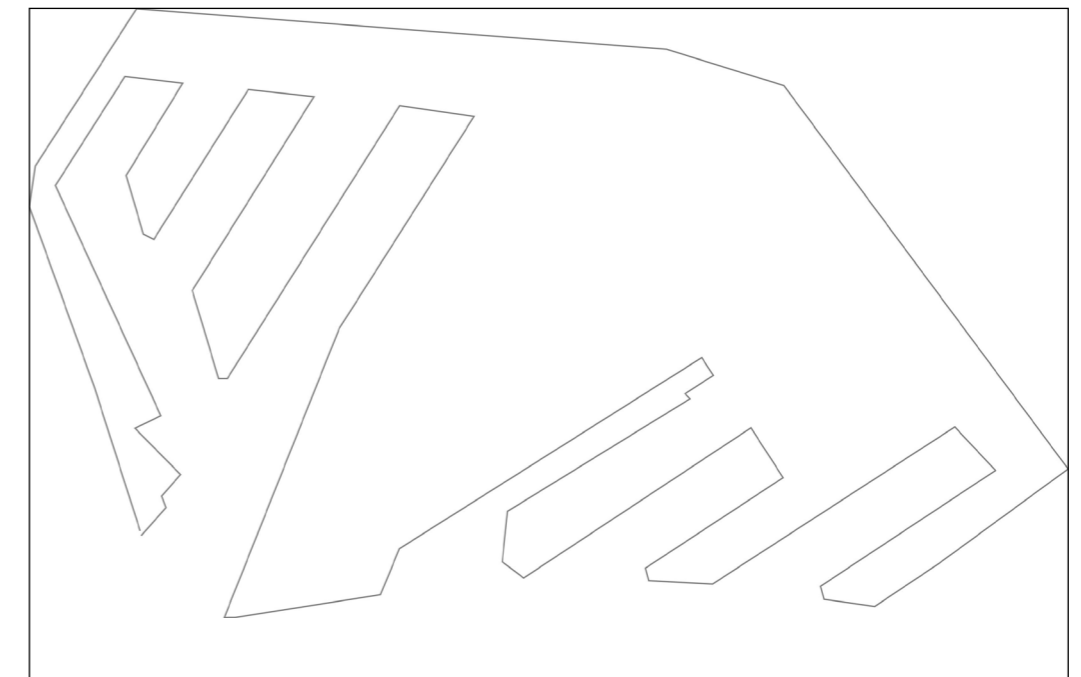
The big road on the north part of the Merwevierhaven area is very noisy, but the noise does not go far into the area. The noise of the road is not ongoing, because it depends on the traffic passing by.

## Air quality NO2



The amount of NO2 measured in the air is no threat to the Merwevierhaven area, expect for a little bit in the north-eastern part, at the big road crossing, Marconiplein.

## Air quality particulate matter

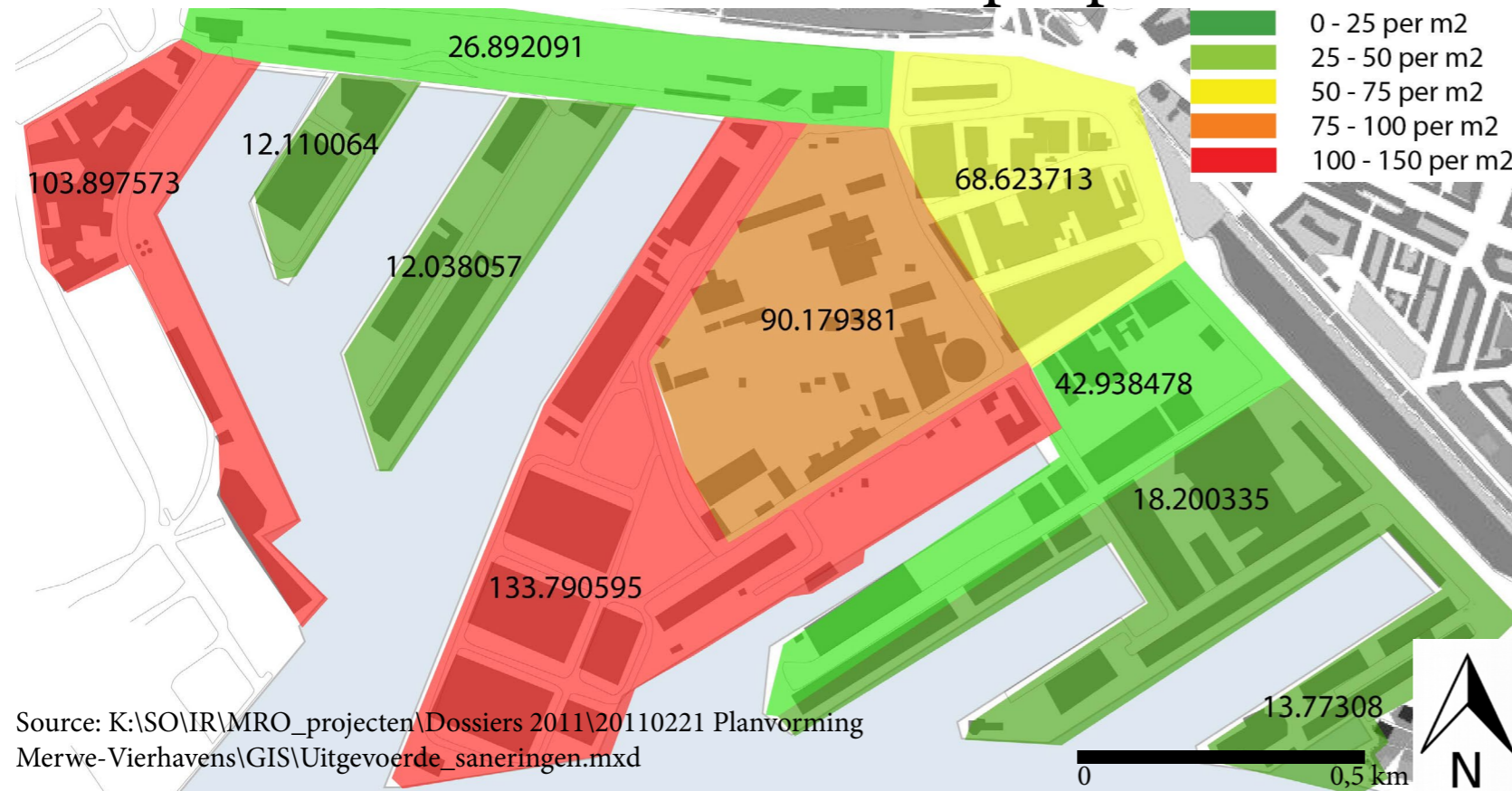


The air quality measured with particulate matters shows almost the same story as that of the NO2 air quality. Less quality air at Marconiplein, but nothing threatening in the Merwevierhaven area.

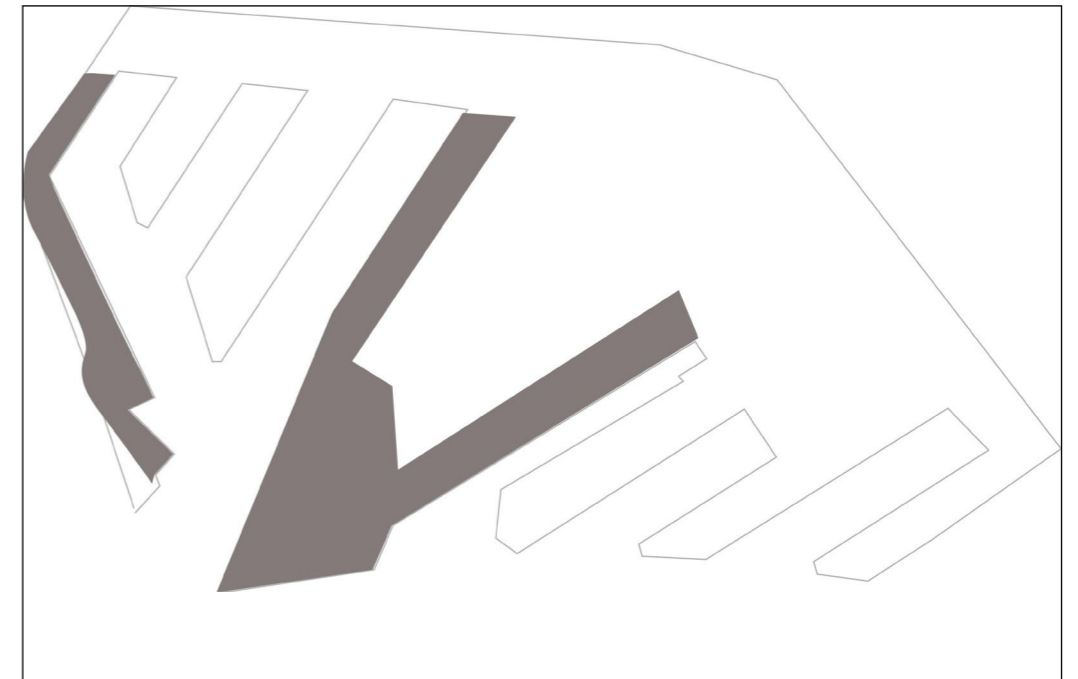
# Harbouremediation

# Merwe Vierhaven

## Remediation costs for residential purpose

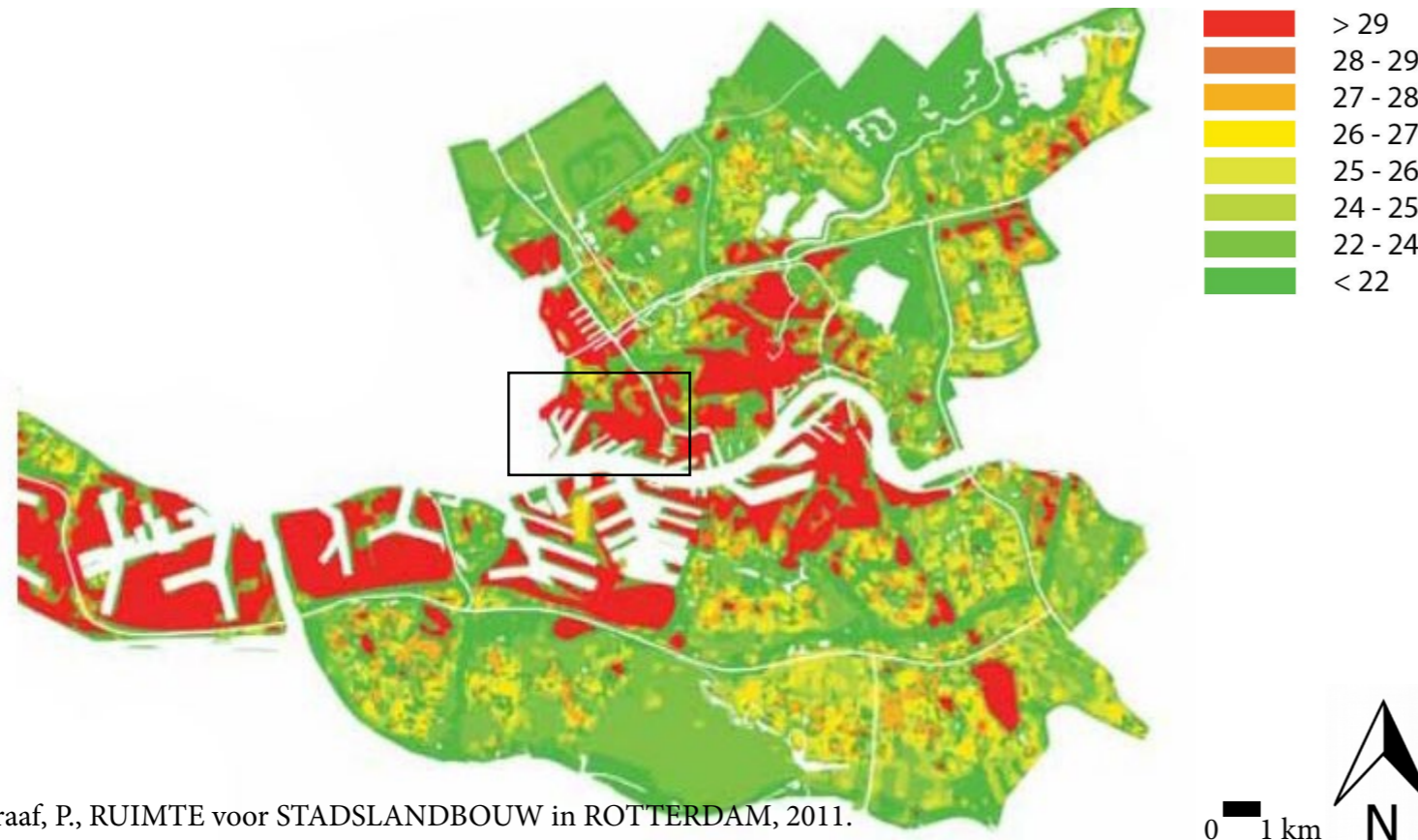


Source: K:\SO\IR\MRO\_projecten\Dossiers 2011\20110221 Planvorming Merwe-Vierhavens\GIS\Uitgevoerde\_saneringen.mxd

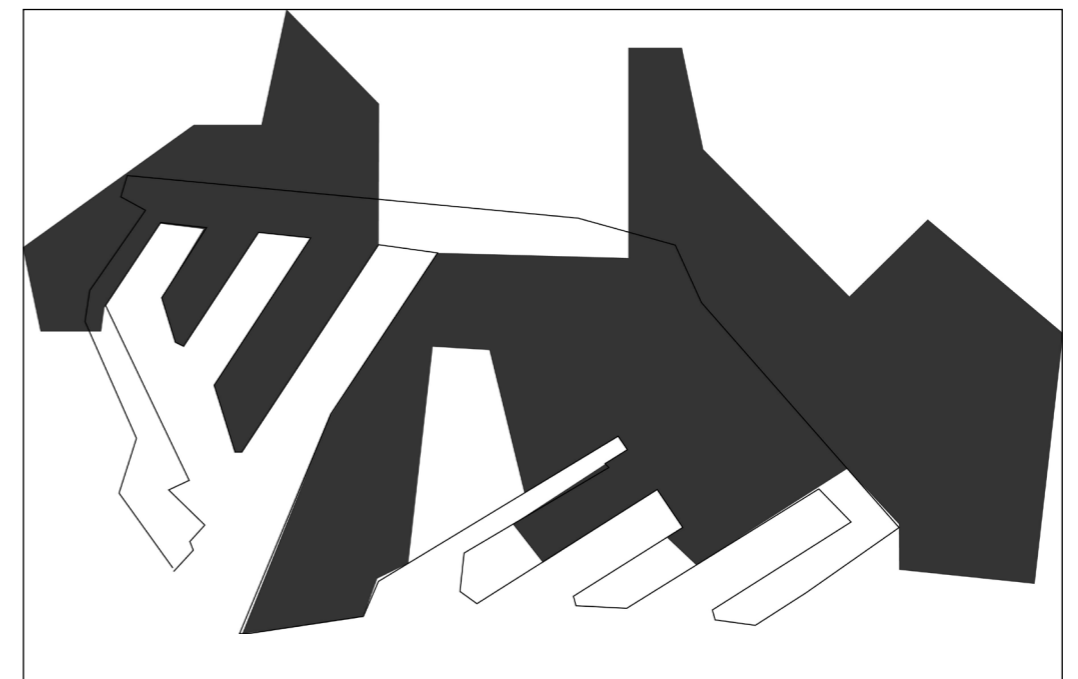


The map on the left shows the differences in preparation costs to make the Merwevierhaven area suitable for residential use. Especially the middle part of the Merwevierhaven area is very expensive because of the current industrial use.

## Heat island effect



Source: De Graaf, P., RUIJTE voor STADSLANDBOUW in ROTTERDAM, 2011.



The heat island effect is a big issue in the city of Rotterdam. Also in a dominant part of the Merwevierhaven area this effect is occurring.

An aerial photograph of an industrial harbor area, showing various buildings, structures, and waterways. A large white oval is superimposed over the center of the image, containing the text 'SUBSURFACE AND SUBSOIL'. The background image is faded and serves as a backdrop for the text.

## SUBSURFACE AND SUBSOIL

# Harbouremediation

## Trees



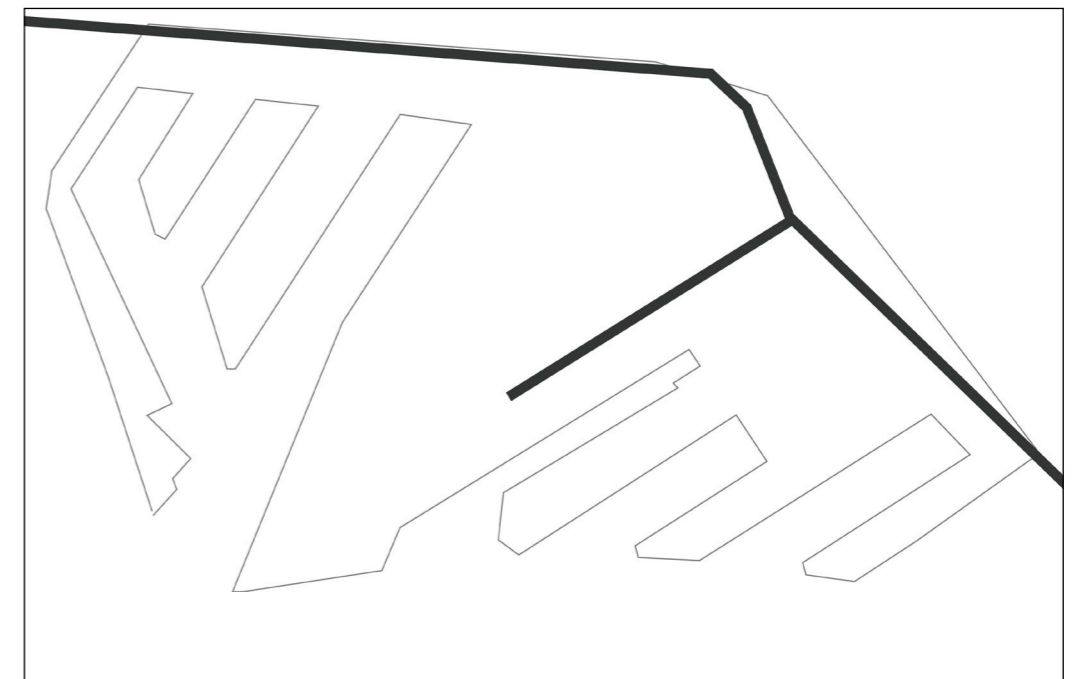
Source: [www.gis.rotterdam.nl](http://www.gis.rotterdam.nl)

## Urban agriculture potentials

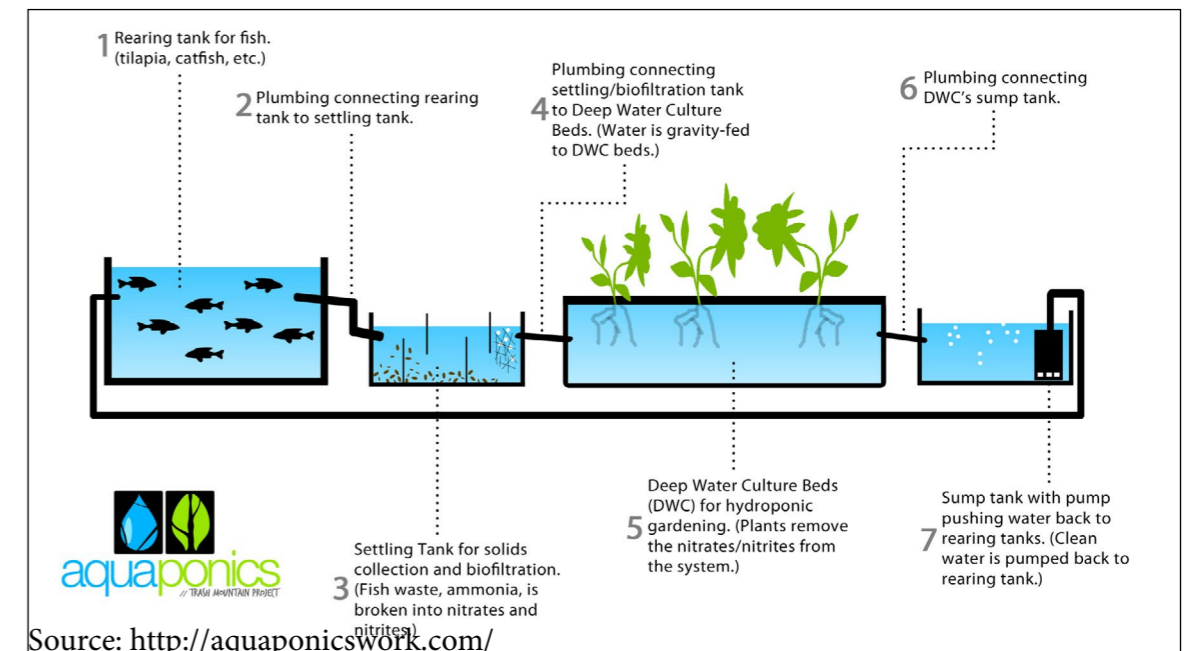


Source: De Graaf, P., RUIIMTE voor STADSLANDBOUW in ROTTERDAM, 2011.

# Merwe Vierhaven



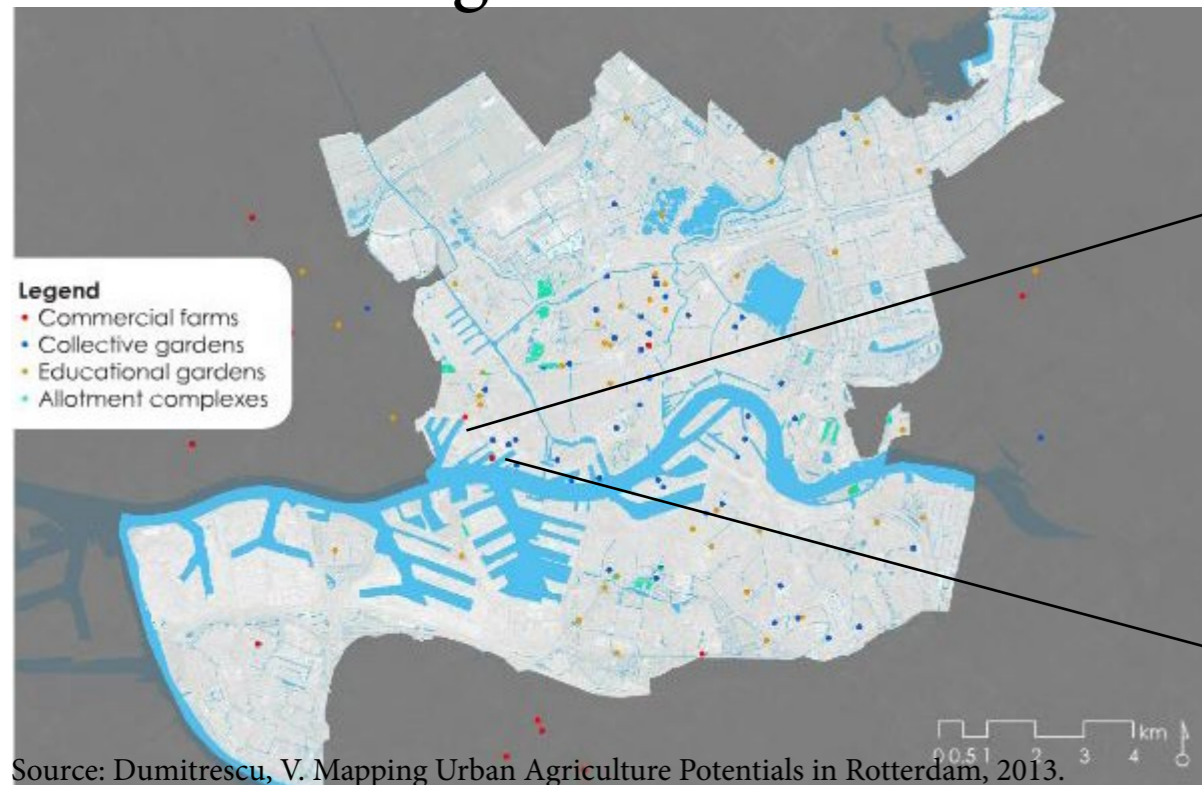
The Merwevierhaven area is very industrial and has almost no greenery. Trees are only to be found along the road that discloses the area in the north.



Source: <http://aquaponicswork.com/>

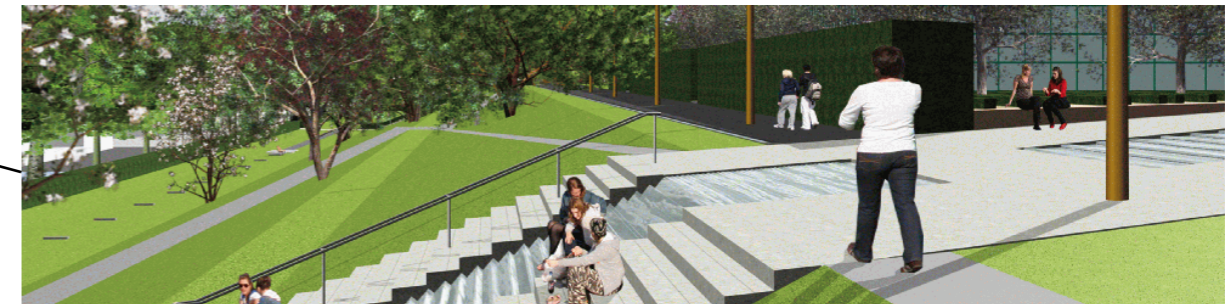
The map on the left shows a research of the potential for urban farming in the city of Rotterdam. The Merwevierhaven area is very suitable for aquaponics; a food production system that combines conventional aquaculture (raising aquatic animals in tanks) with hydroponics (cultivating plants in water) in a symbiotic environment ([en.wikipedia.org](http://en.wikipedia.org)).

## Urban farming initiatives

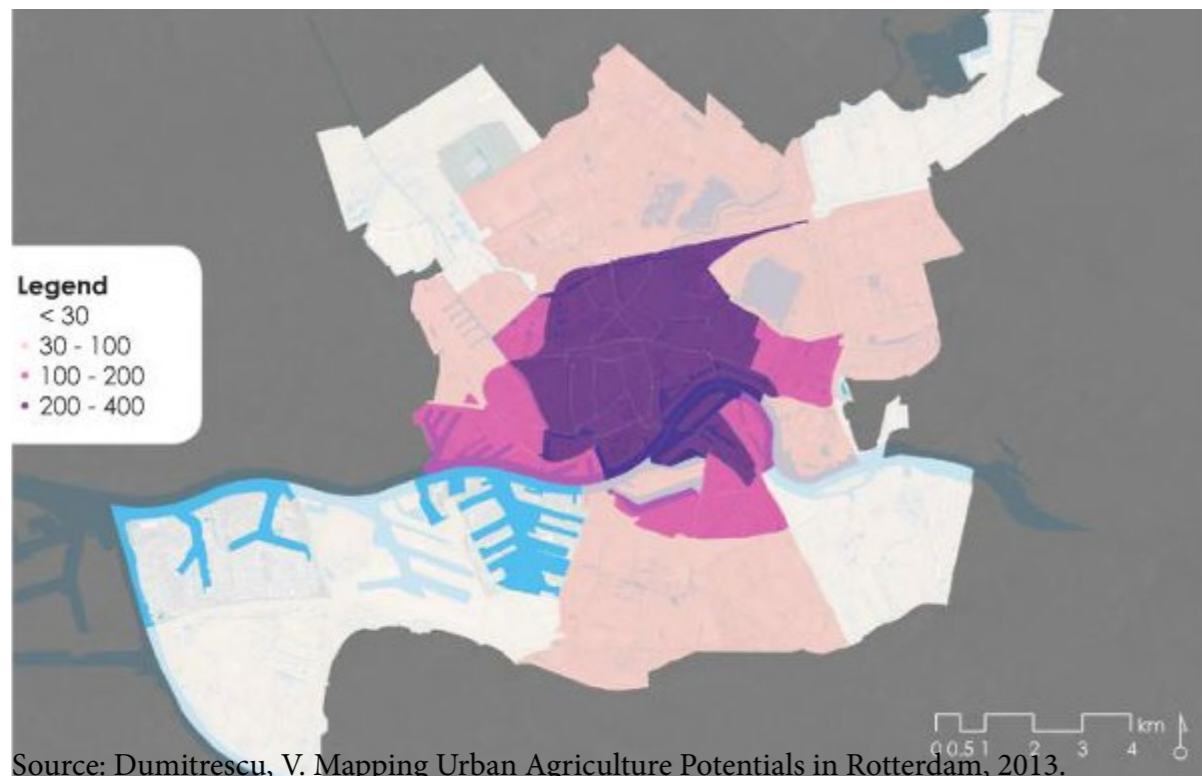


Source: Dumitrescu, V. Mapping Urban Agriculture Potentials in Rotterdam, 2013.

There are a lot of urban farming initiatives in Rotterdam. Two big ones in the Merwevierhaven area are 'Uit Je Eigen Stad' and 'Dakpark'.



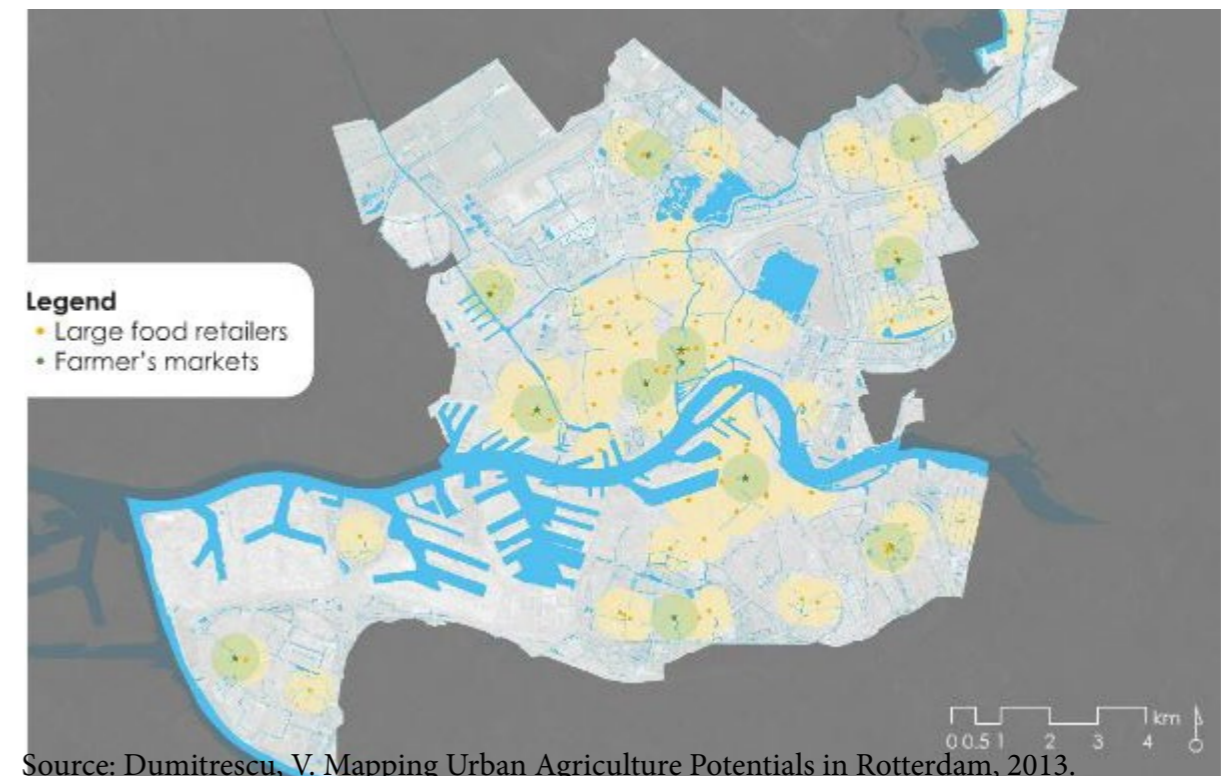
## Restaurants within 3 km



Source: Dumitrescu, V. Mapping Urban Agriculture Potentials in Rotterdam, 2013.

Because the Merwevierhaven area is close to the centre of Rotterdam, there are a lot of restaurants in the surrounding the urban agriculture could produce for.

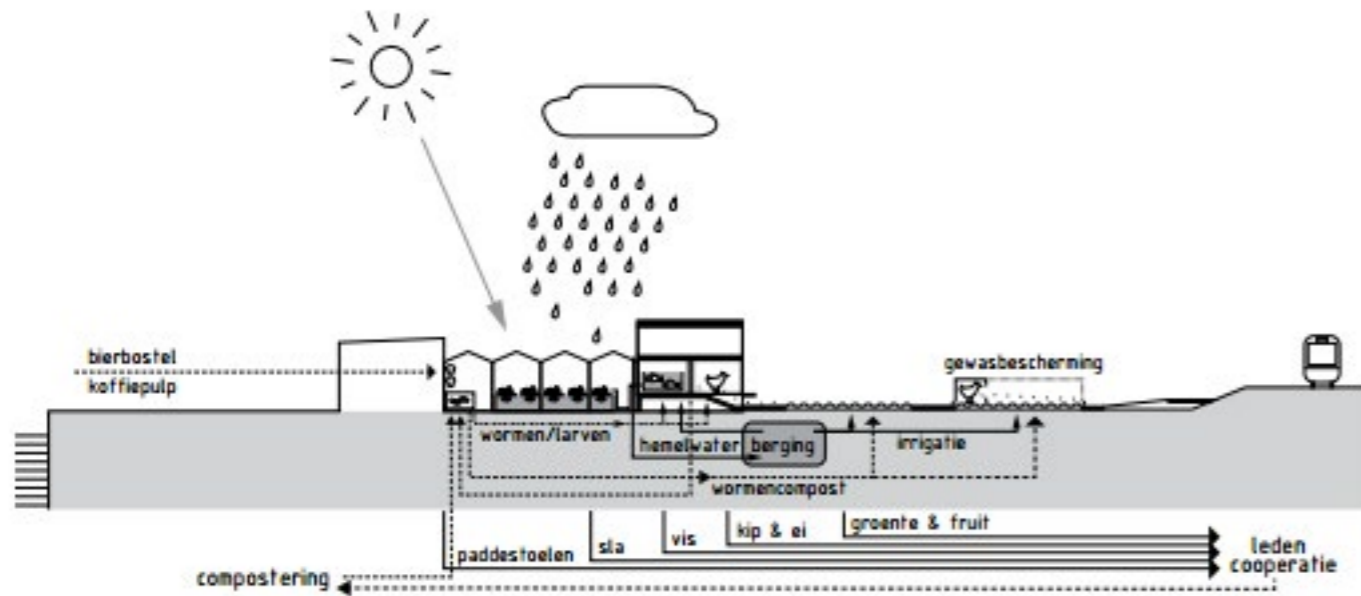
## Location food retailers



Source: Dumitrescu, V. Mapping Urban Agriculture Potentials in Rotterdam, 2013.

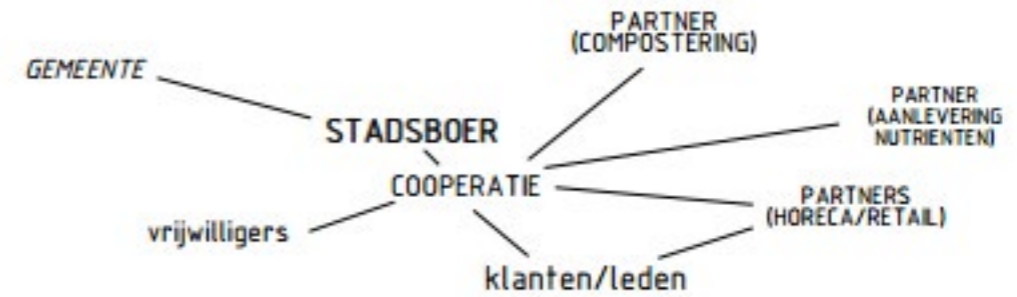
Most of the large food retailers and farmer's markets are in the city centre, close to the Merwevierhaven area.

## Marconistrip

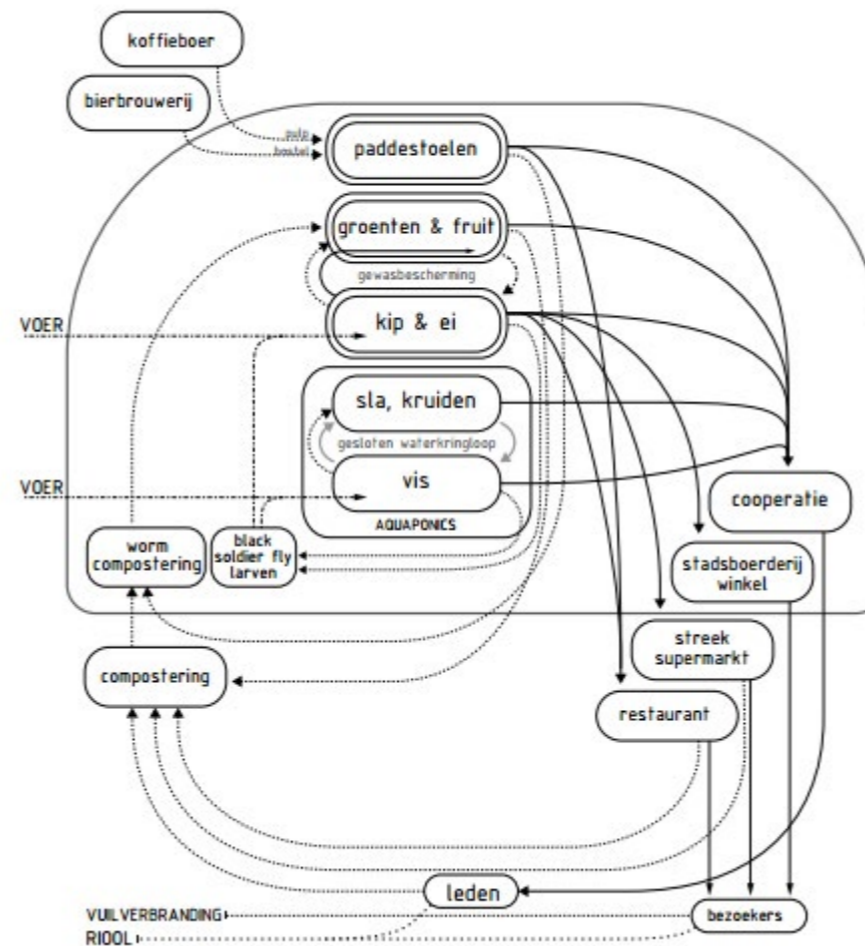


### ACTORENWEB

63



Source: De Graaf, P., RUIJME voor STADSLANDBOUW in ROTTERDAM, 2011.



The urban farming initiative 'Uit Je Eigen Stad' is situated on the Marconistrip, in the north of the Merwevierhaven area.

The initiative at the Marconistrip is very important for the city of Rotterdam because of;

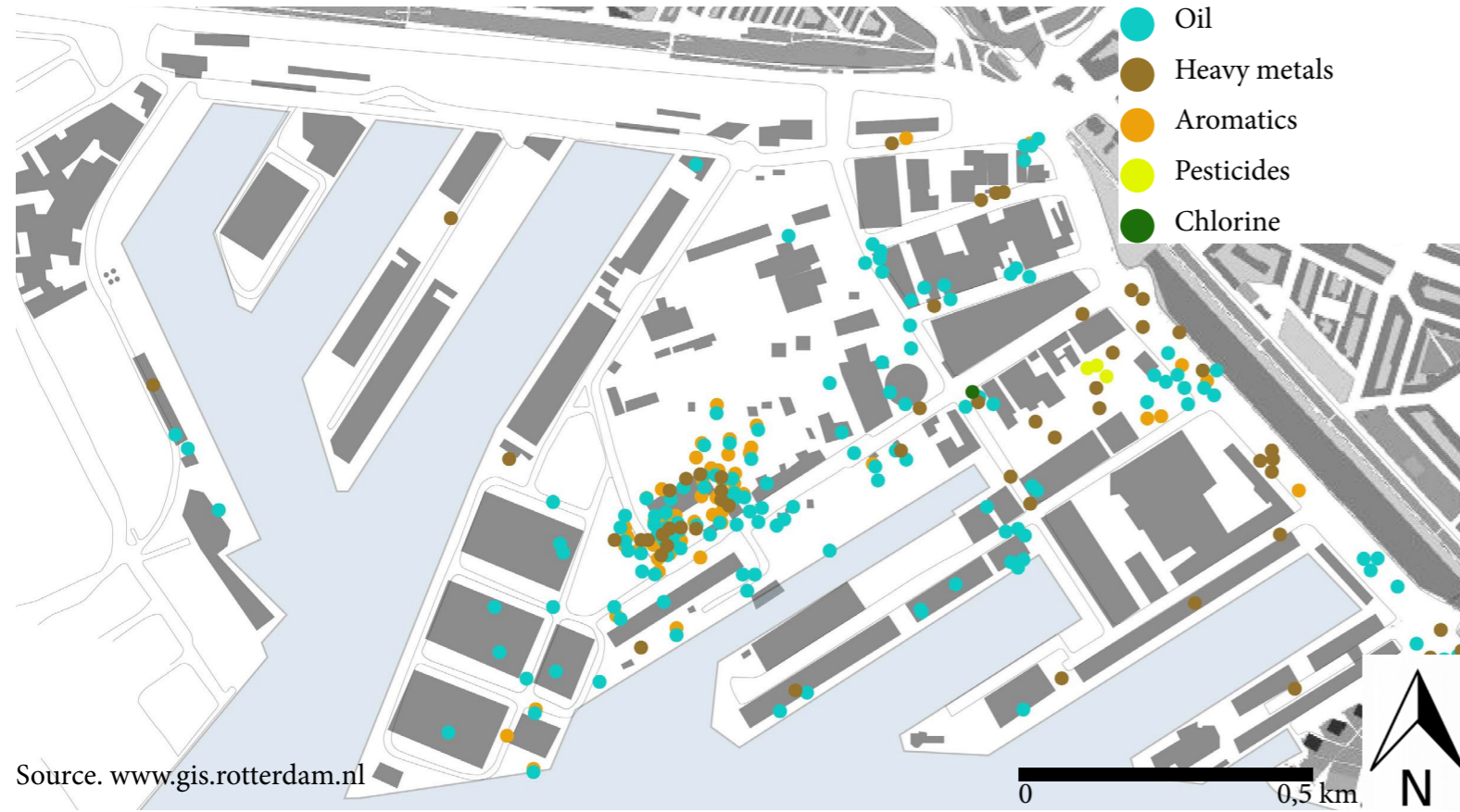
- The use of vacant land and buildings,
- Creating places for learning and working,
- A visible fresh food production,
- Accessible greenery,
- The closing of production cycles,
- The use of residual waste.



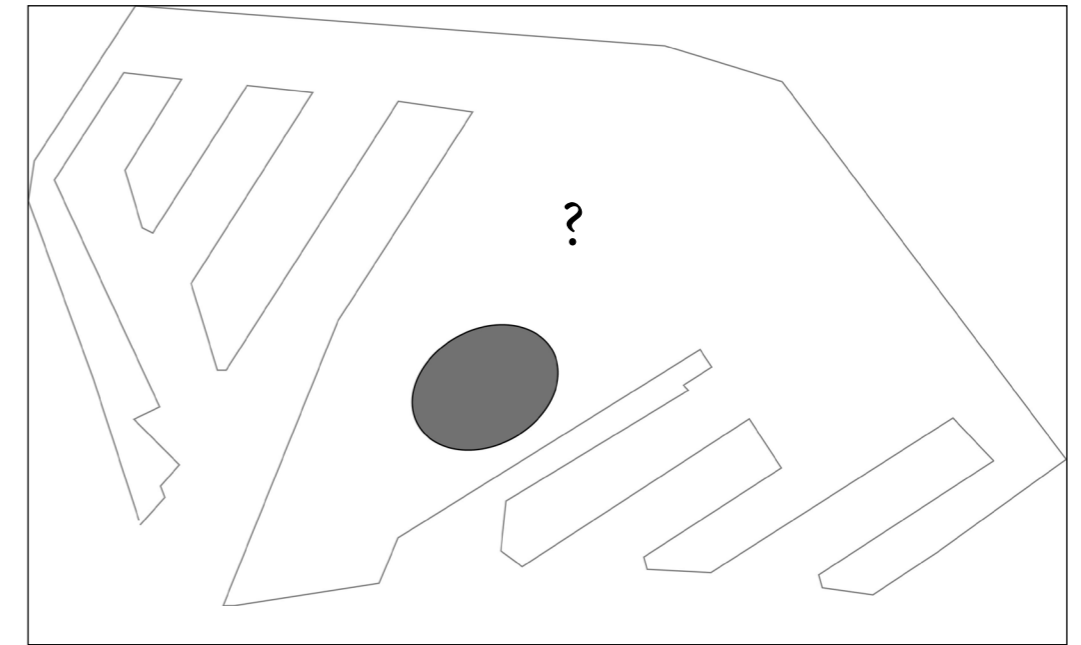


# Harbouremediation

## Groundwater contamination

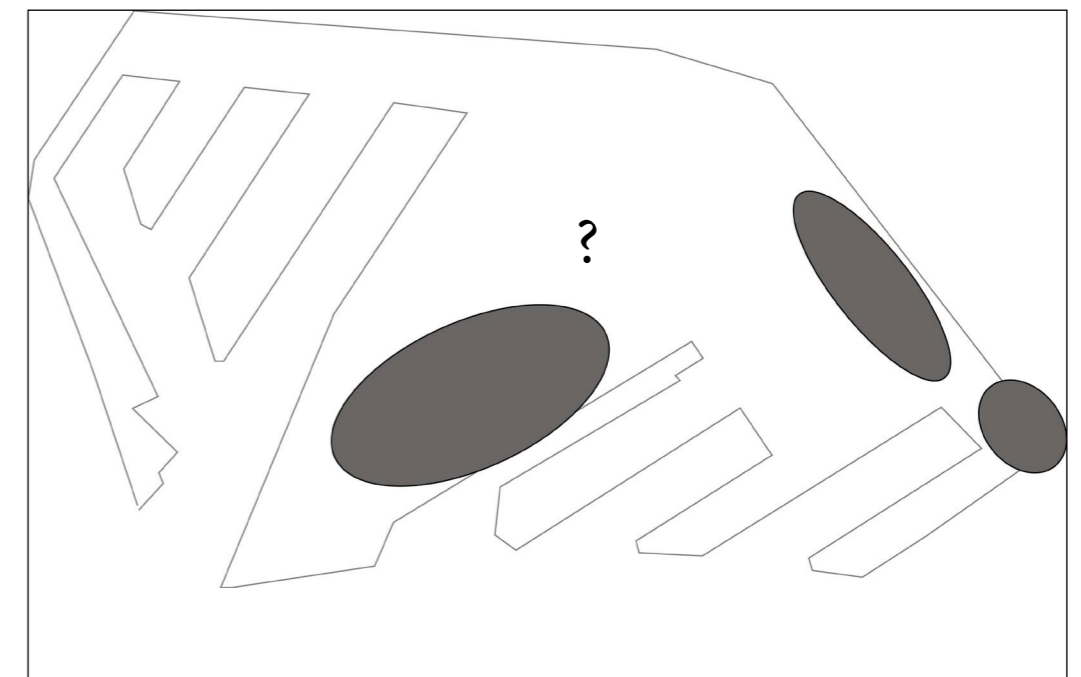
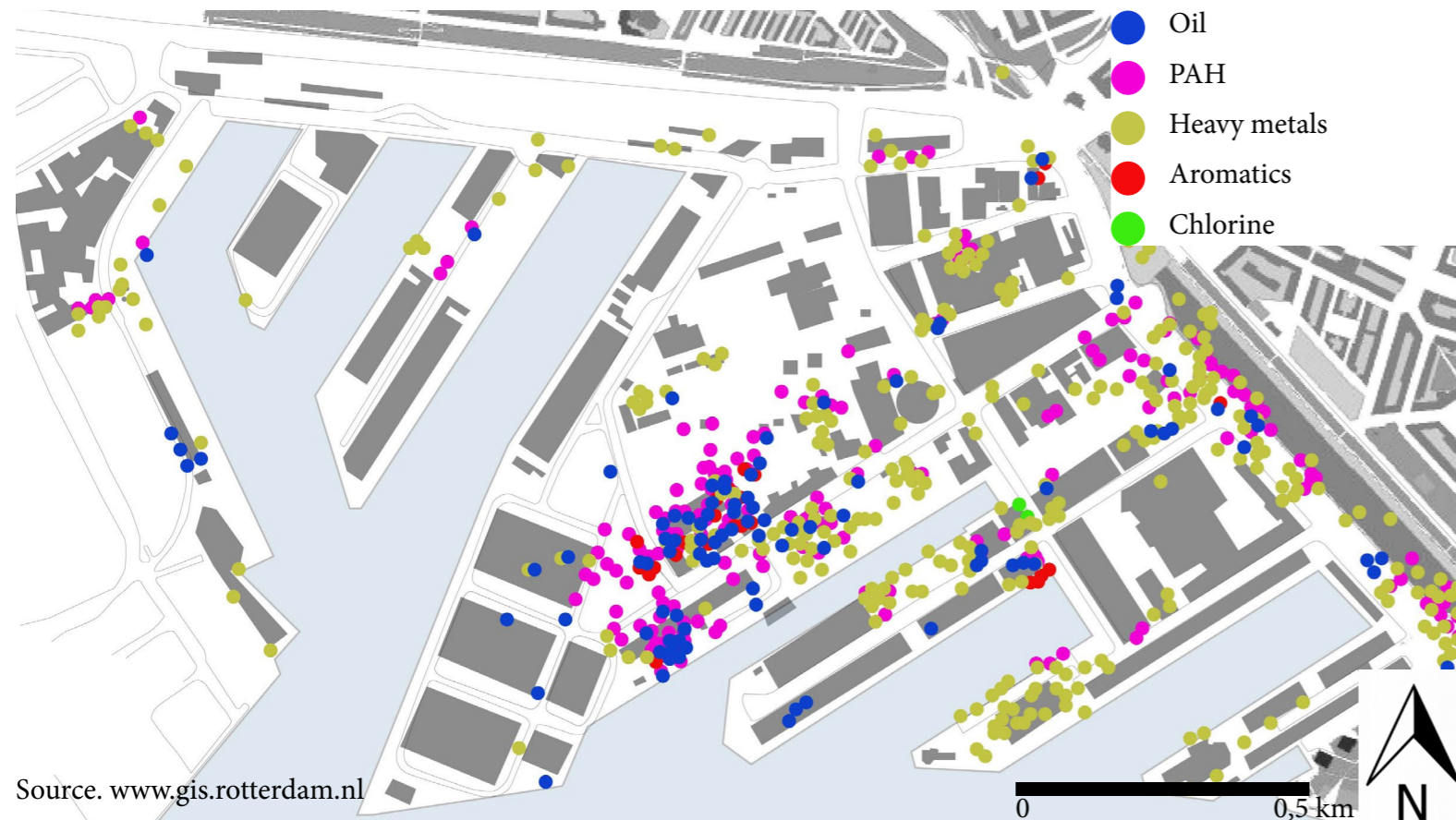


# Merwe Vierhaven



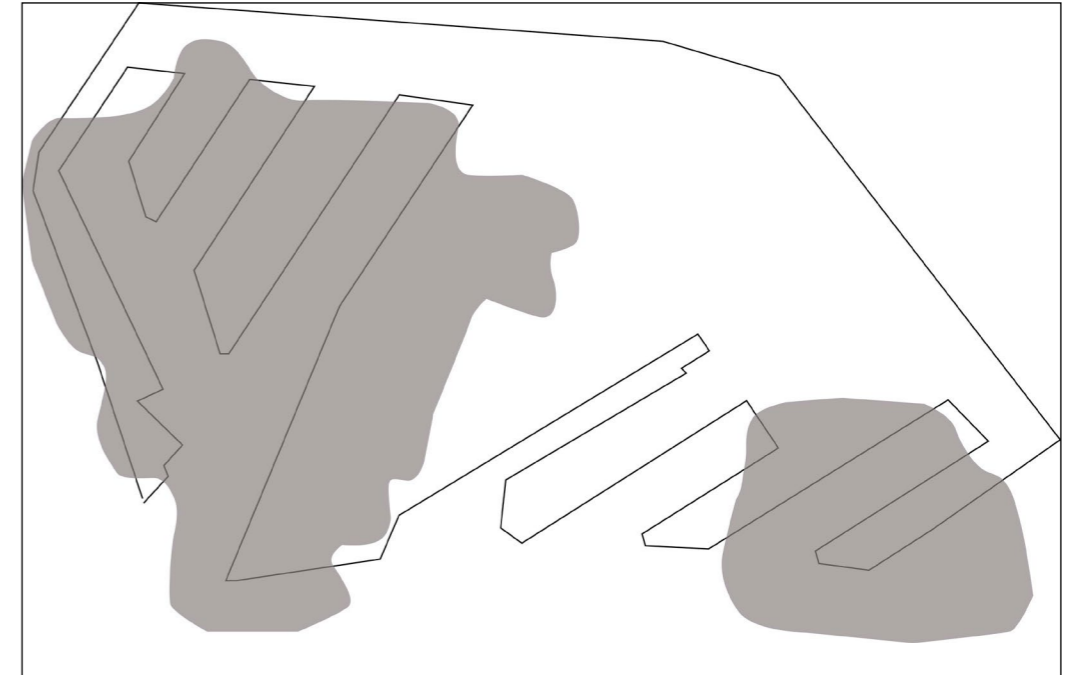
Most groundwater contamination in the Merwevierhaven area is focused on one spot. There is no information available about the EON site, but we can assume that the groundwater in that area is rather contaminated.

## Soil contamination



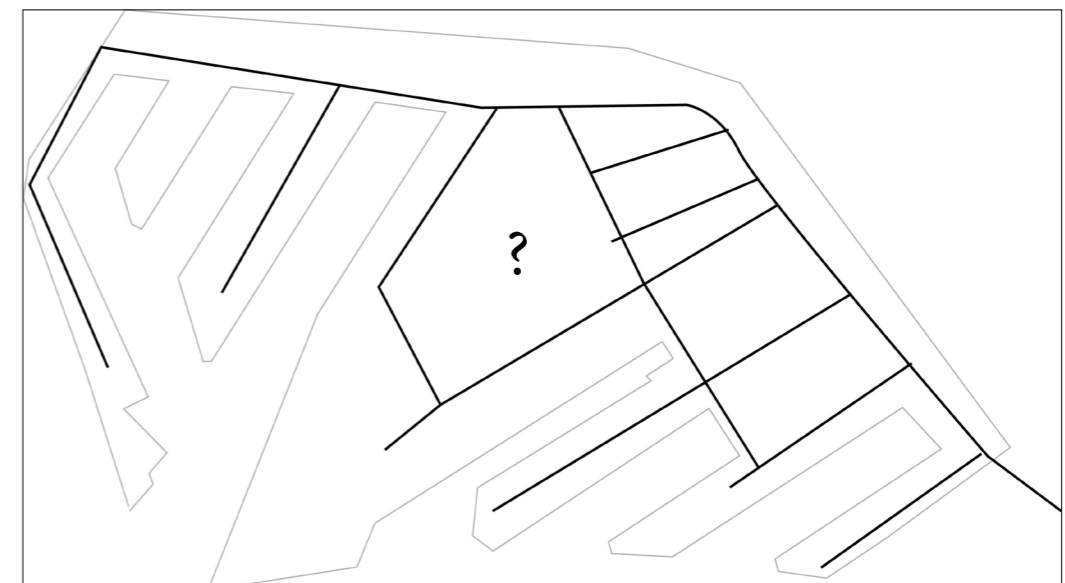
The soil contamination in the Merwevierhaven area is more spread out than the groundwater contamination, because of the industrial character of the area. The biggest contamination is on the same spot as the groundwater contamination.

## Infiltration



The infiltration in the Merwehaven is more than 1mm a day. The rest of the Merwevierhaven area has just a little bit infiltration a day.

## Cables and pipes

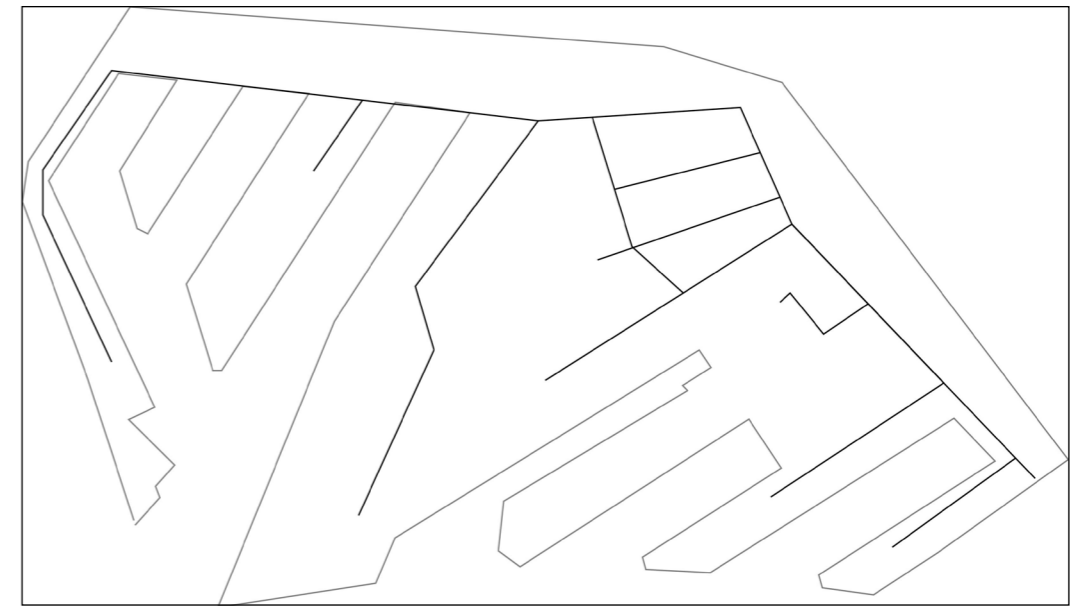


In the ground there is a chaotic system of cables and pipes. Most cables and pipes run under the streets. The same story here is that we do not know what there is to be found in the subsurface of the EON company area.

## Gas and heating

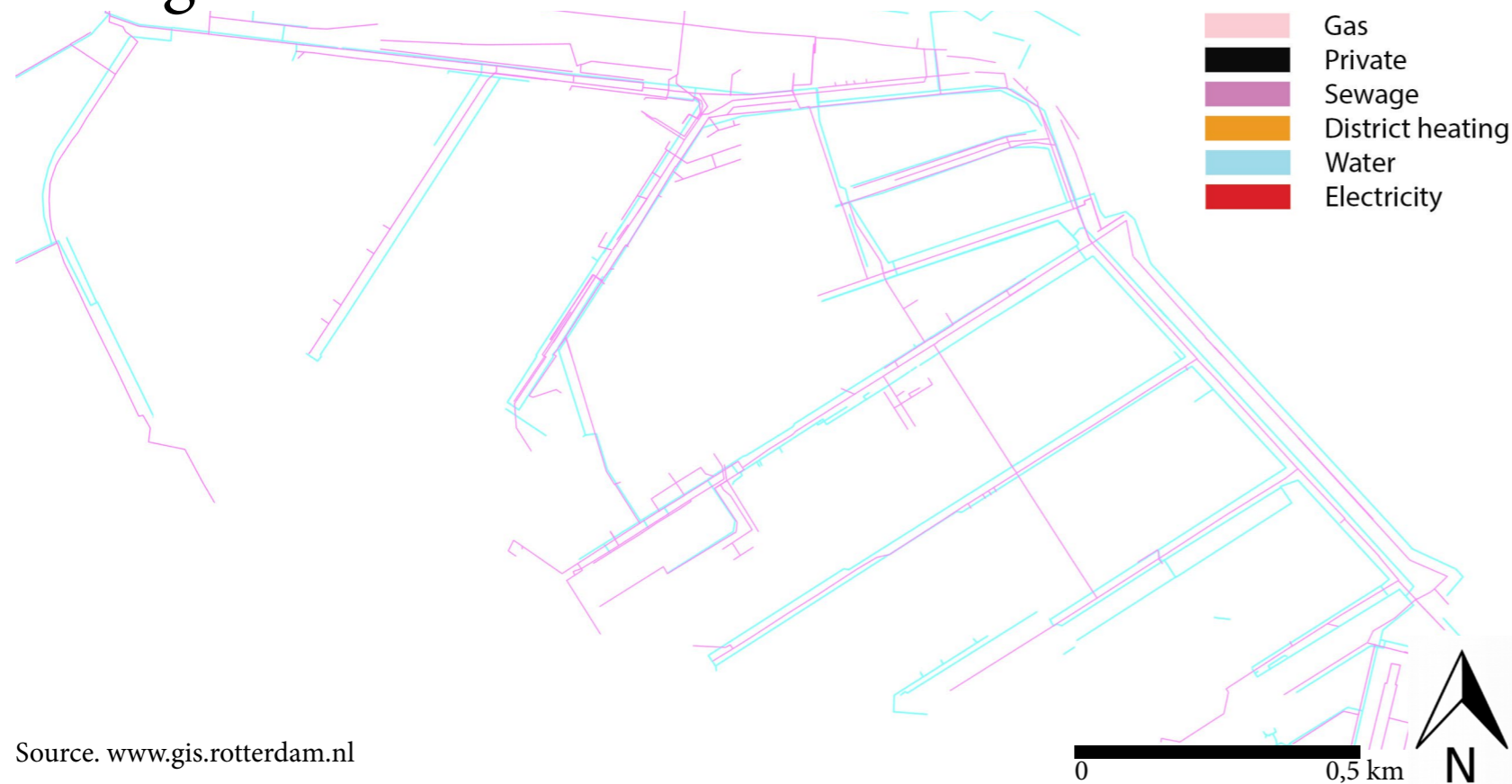


Source. [www.gis.rotterdam.nl](http://www.gis.rotterdam.nl)

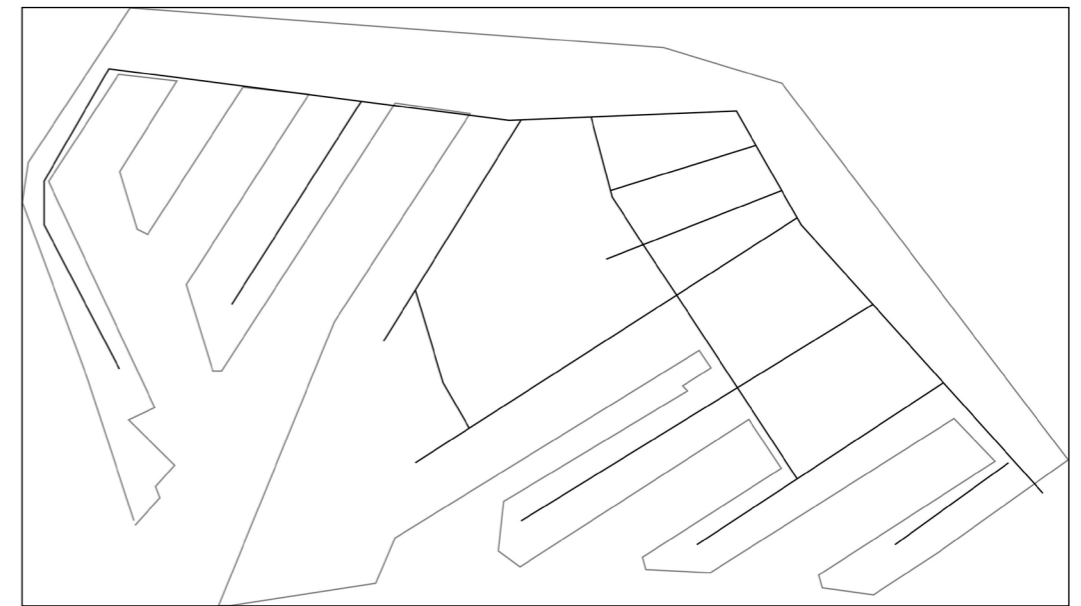


Gas and heating pipes are not to be found in the whole project area. There are just a few that extend into the harbour arms.

## Sewage and water

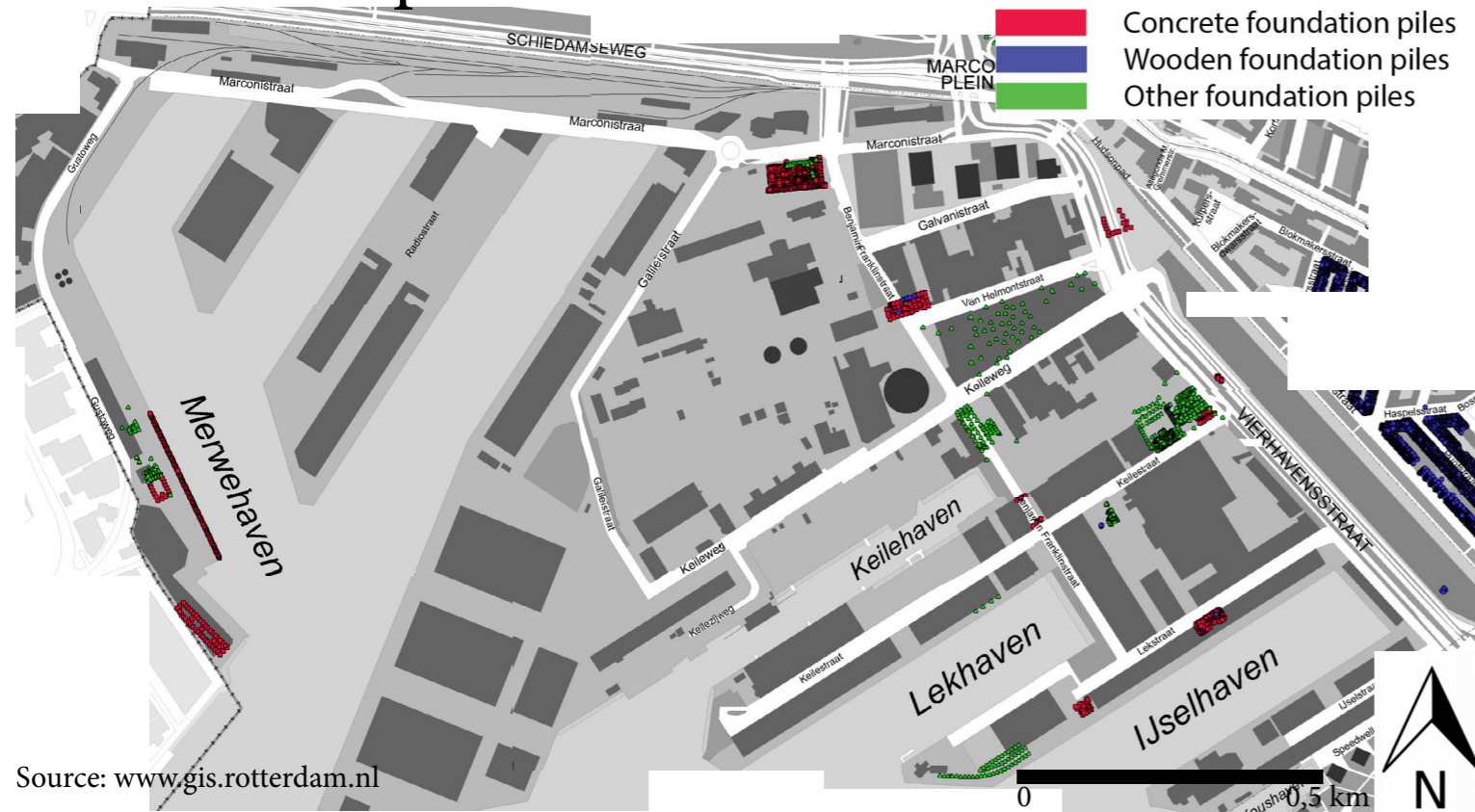


Source. [www.gis.rotterdam.nl](http://www.gis.rotterdam.nl)

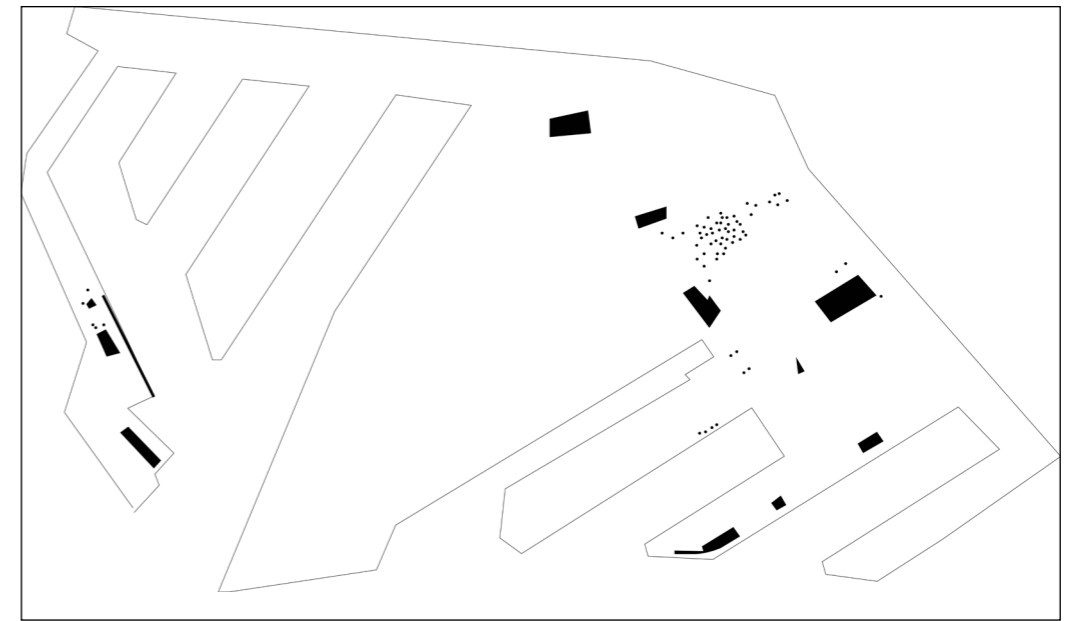


The sewage and water pipes are better structured through the area. There is just one harbour arm that is not connected to the network.

## Foundation piles


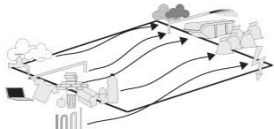
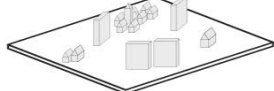
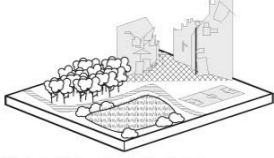
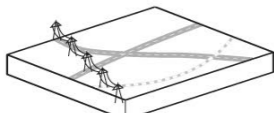
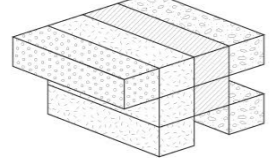
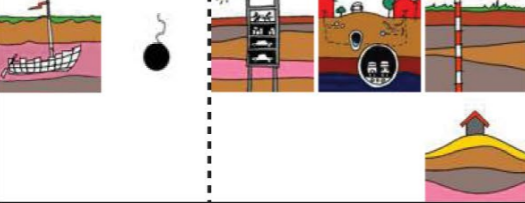
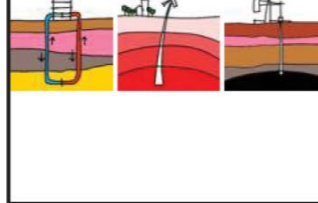
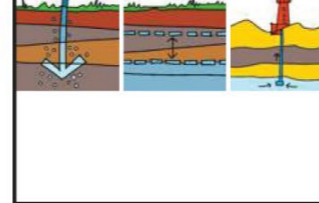



Source: [www.gis.rotterdam.nl](http://www.gis.rotterdam.nl)



The old foundation piles that are found in the Merwevierhaven area are mainly from concrete or another material, but no wooden once.



SUBSURFACE / SUBSOIL	CIVIL CONSTRUCTIONS					ENERGY			WATER			SUBSURFACE						SUBSURFACE / SUBSOIL
	archaeology	explosives	underground building	cables and pipes	carrying capacity	ATES (aquifer thermal energy)	geothermal energy	fossile energy resources	water filtering capacity	water storage capacity	drinking water resources	clean soil	subsoil life / crop capacity	geomorphological quality and landscape type	ecological diversity	sand/clay/gravel resources	subsurface storage	
<b>LAYERS</b>																		
 <b>PEOPLE</b>	○						○			○		⊗	○					PEOPLE social structure (neighbourhood typology) social behaviour labour productivity labour capital
 <b>METABOLISM</b>	○			×			○			○		⊗	○		○			METABOLISM energy / food water waste air (building) material products
 <b>BUILDINGS</b>		×	⊗	×	×		○			○								BUILDINGS offices housing utility culture
 <b>PUBLIC SPACE</b>	○			⊗					⊗	○		⊗	○	✓				PUBLIC SPACE living environment culture nature agriculture
 <b>INFRA STRUCTURE</b>	×	×		⊗	×													INFRA STRUCTURE mobility network
 <b>SUBSURFACE</b>																		SUBSURFACE subsurface subsoil water energy civil constructions
<b>SUBSURFACE</b>	<b>CIVIL CONSTRUCTIONS</b>					<b>ENERGY</b>			<b>WATER</b>			<b>SUBSURFACE</b>						<b>SUBSURFACE</b>

⊗ Negative relation

✓ Positive relation

○ New relation

## STRENGTH

Close to the city center of Rotterdam  
Quays  
Typical harbour shape  
Image (stoer, vrij, ruig, ruw)  
Accessibility  
Rich history

## WEAKNESS

Contaminated soil  
Northern barrier  
Outerdike area  
Weak relation with surrounding  
Vacant buildings  
Outdated infrastructure  
Unacesable character

## OPPORTUNITY

Position on the Maas  
Rich history and possible archeology  
Geothermal energy producer  
Showcase from industrial to residential  
-Utility duct-  
-Underground parking-

## THREAT

Flooding Maas  
Old bombs  
Soil subsidence  
Phasing/ current industry  
Amount of stakeholders



## Goal

Transform the MerweVierhaven in a coherent and vital part of the city of Rotterdam, where the cohesion between top- and subsoil is visible and tangible.

### Natural Remediation

Bottom-up

Example

History

Location specific

Characteristic

Holistic

Wetlands

‘Urban’

Mixed-use

Phasing

Top-Down

Gradual transformation

Urban Agriculture

Self build

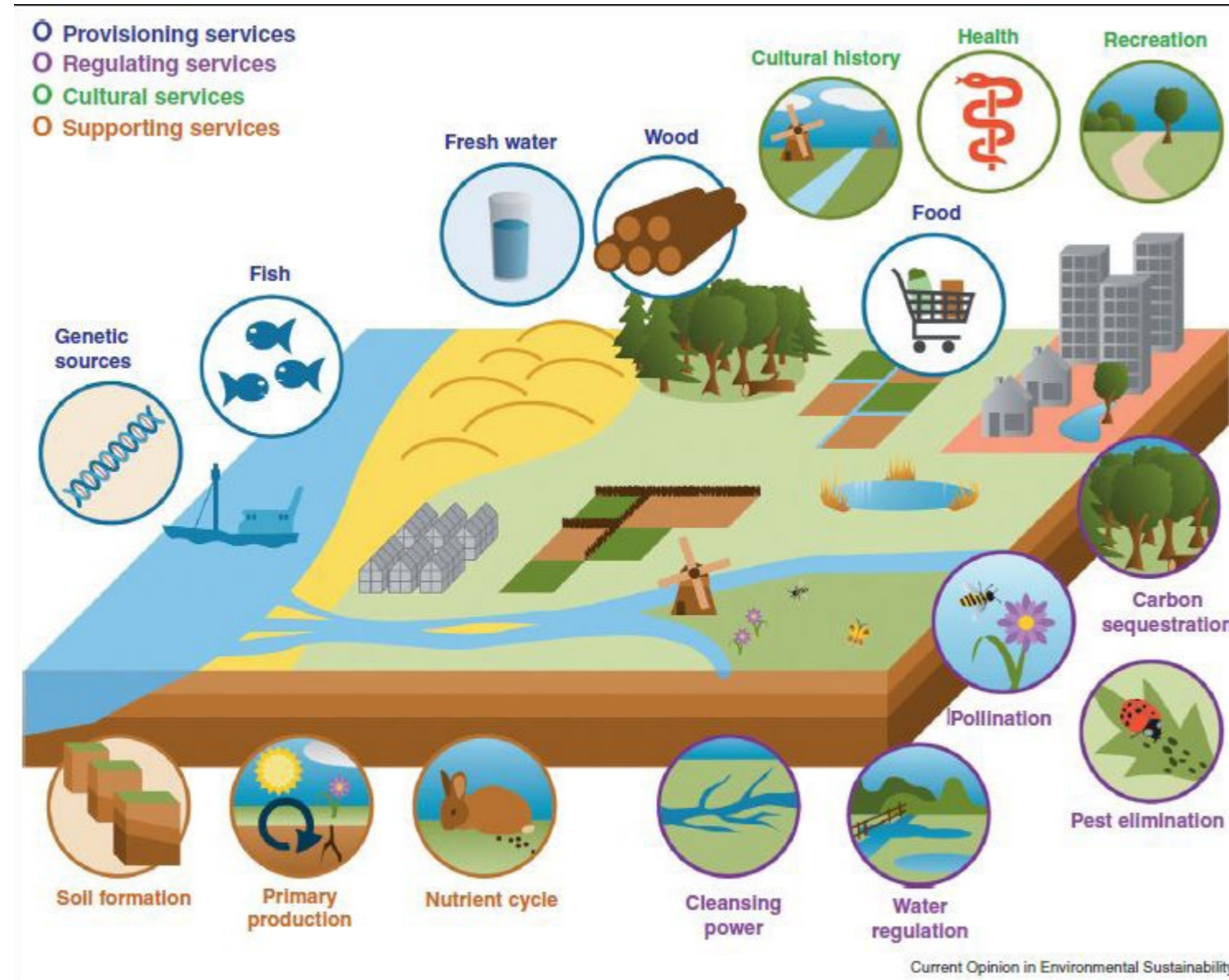
Interaction

Identity

Waterstorage



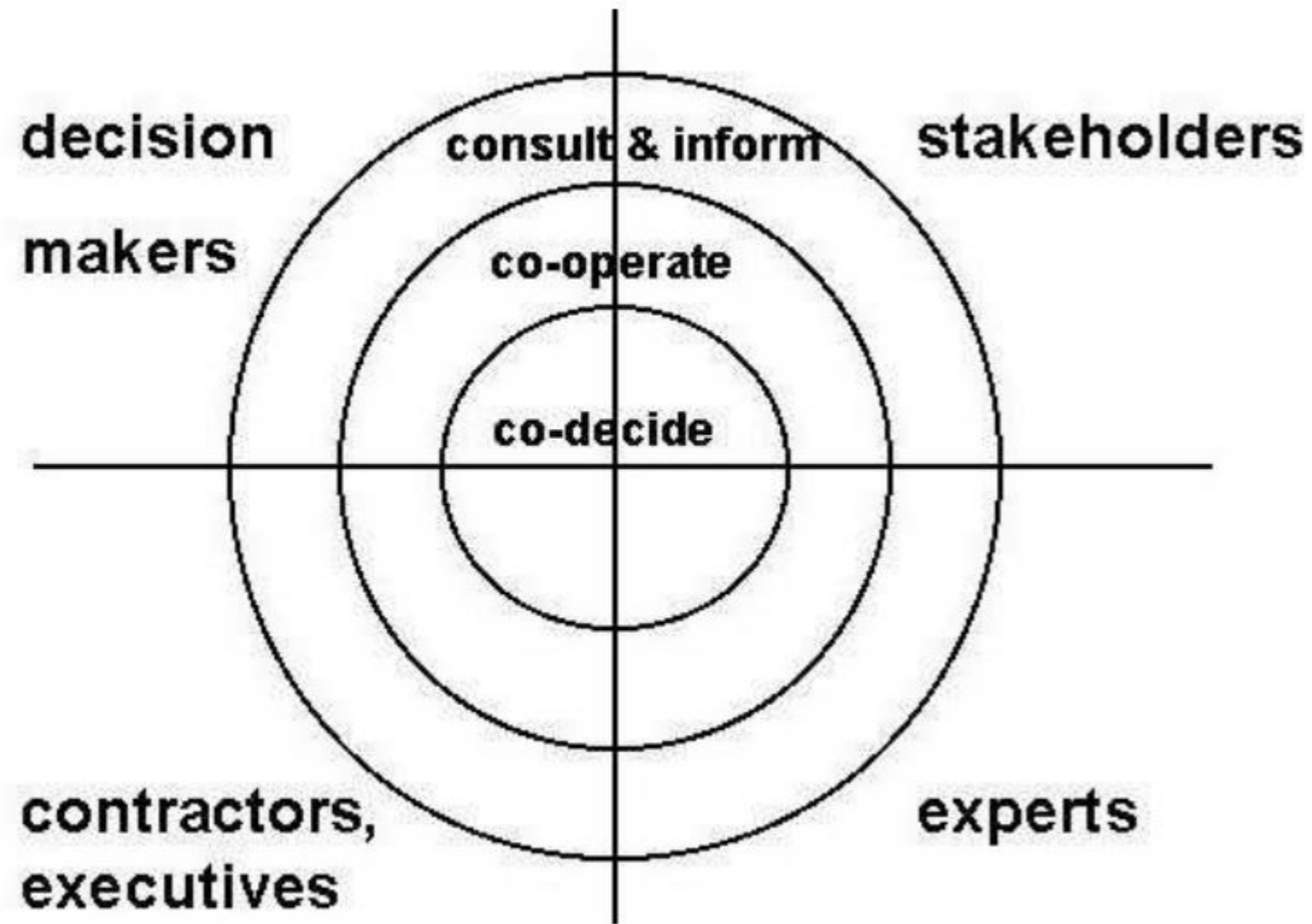
## The role of the subsurface in the planning and design processes



- Awareness of the opportunities that the subsurface offers and a shift to sustainable use of the soil and water ecosystem services.
- **The soil- water system offers a variety of possibilities to contribute to solutions for global and regional societal challenges by means of an effective and sustainable use of soil services.**
- The concept of ecosystem services connects actions and measures regarding soil management by the different stakeholder over the scales.
- The use of land and subsoil should be tailored to meet the integral humans needs related to water, food, shelter, labour, health, energy and recreation.

Transition in soil policy and associated knowledge development. L. Maring et al., 2012

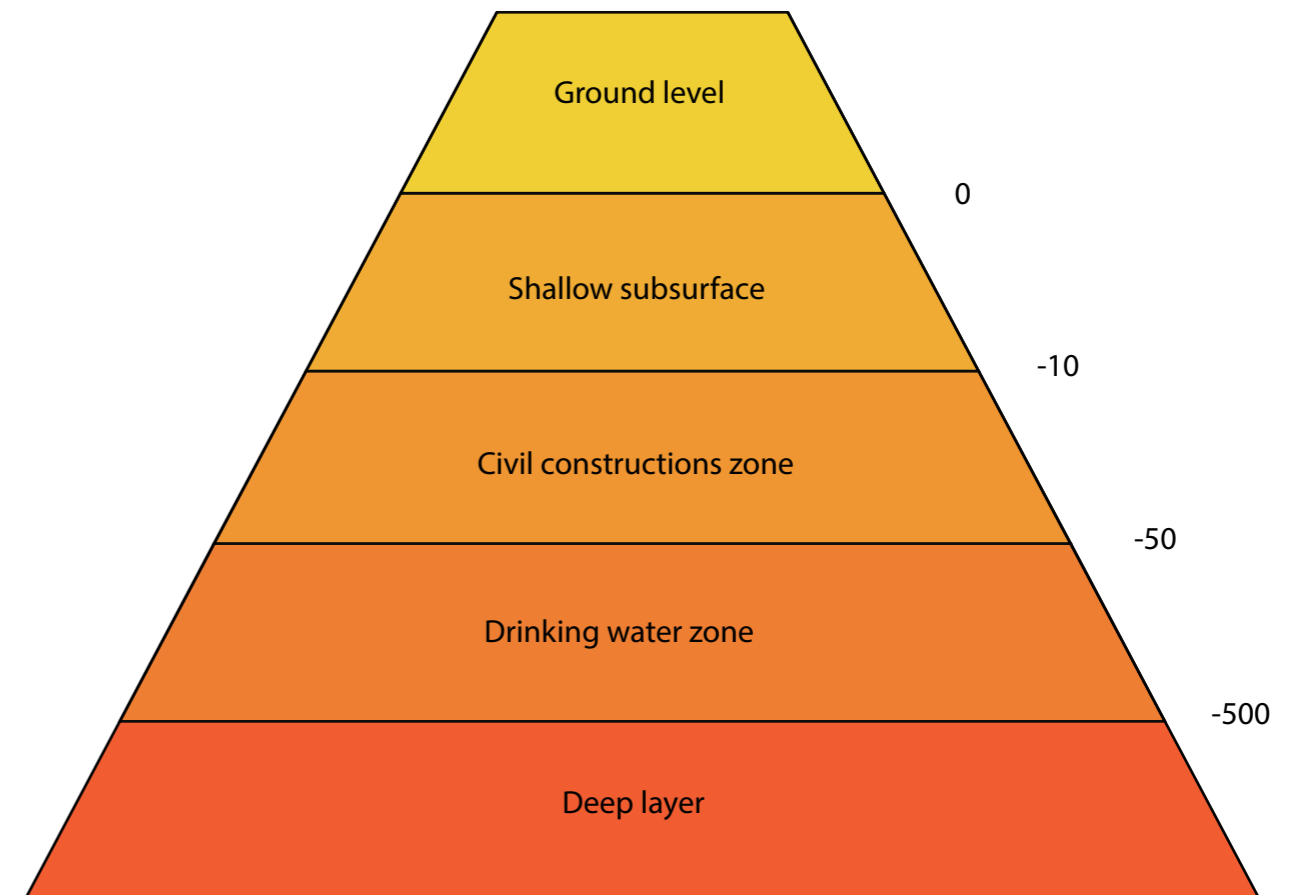
The role of stakeholders in the planning and design process



Frans van der Ven lecture Urban Watermanagement  
24 April 2014

‘Stakeholders are part of the planning process on multiple levels.’

Layers of the subsurface



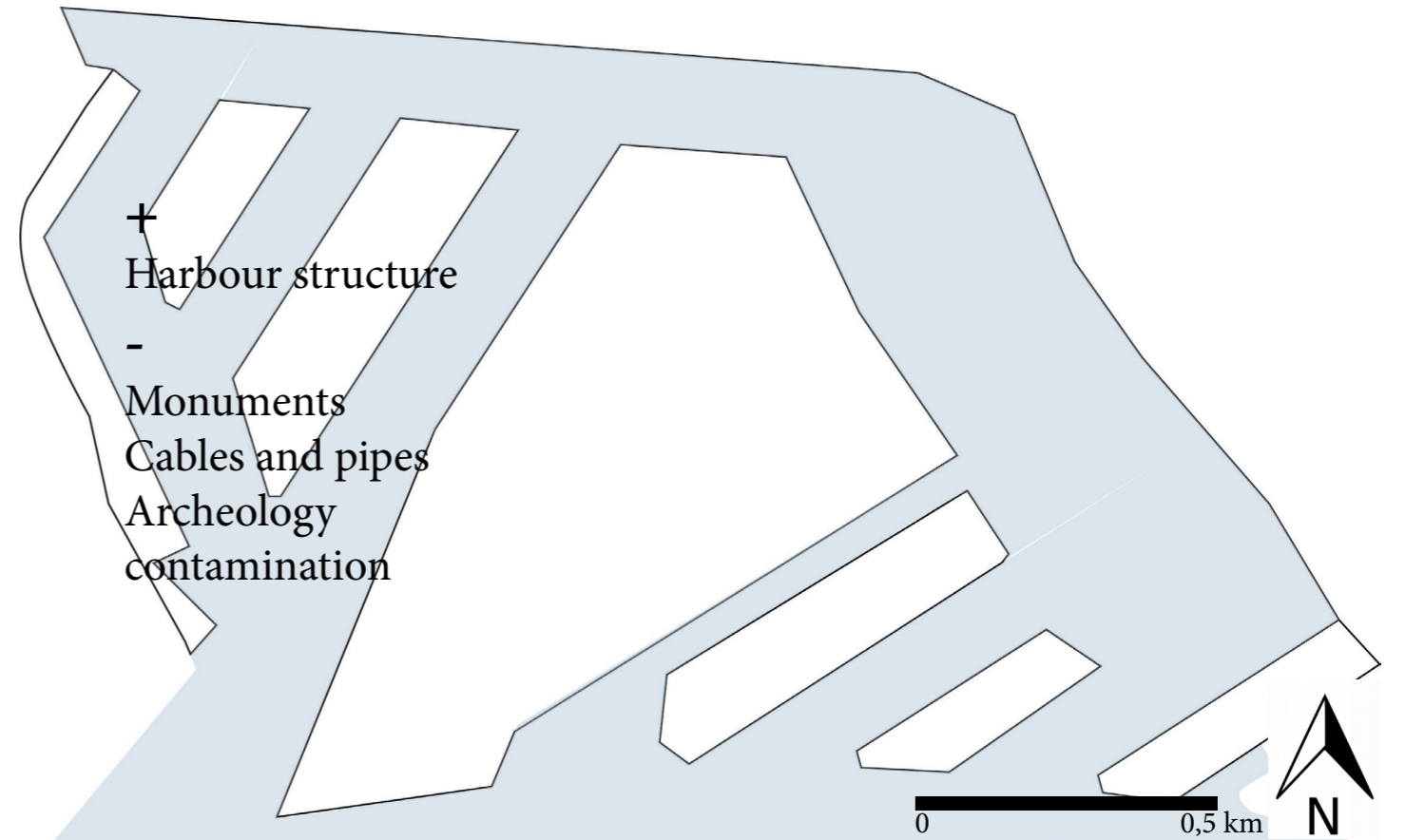
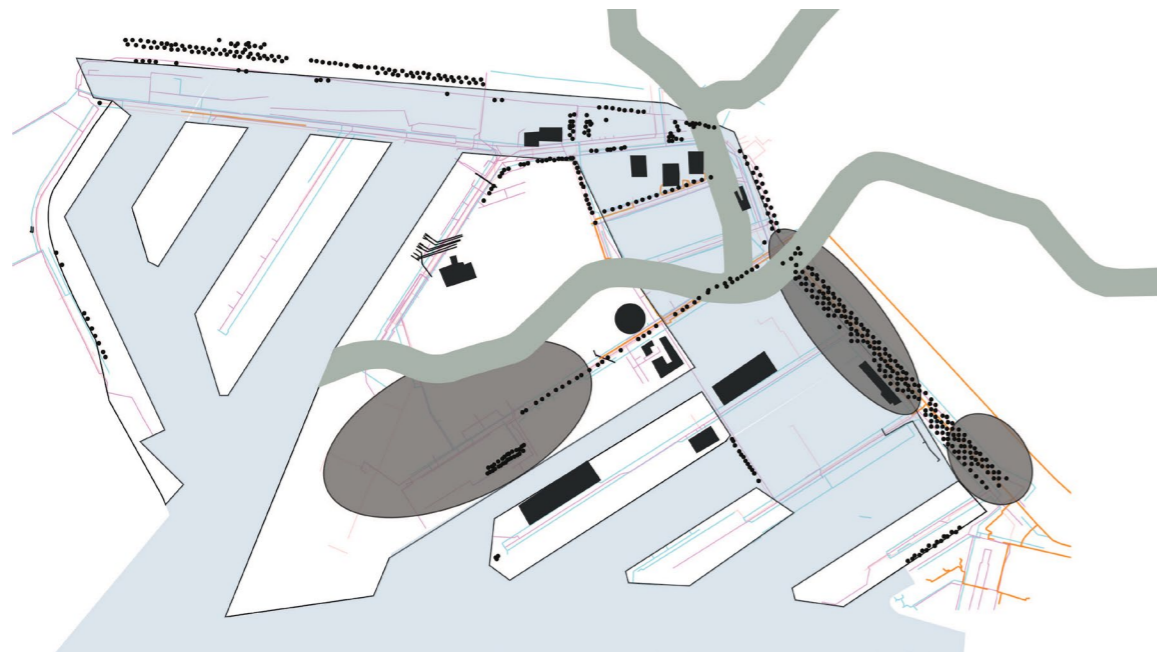
Workshop Gemeente Rotterdam  
8 May 2014

‘Look at the subsurface not as one layer, but as a system of different layers with different possibilities.’

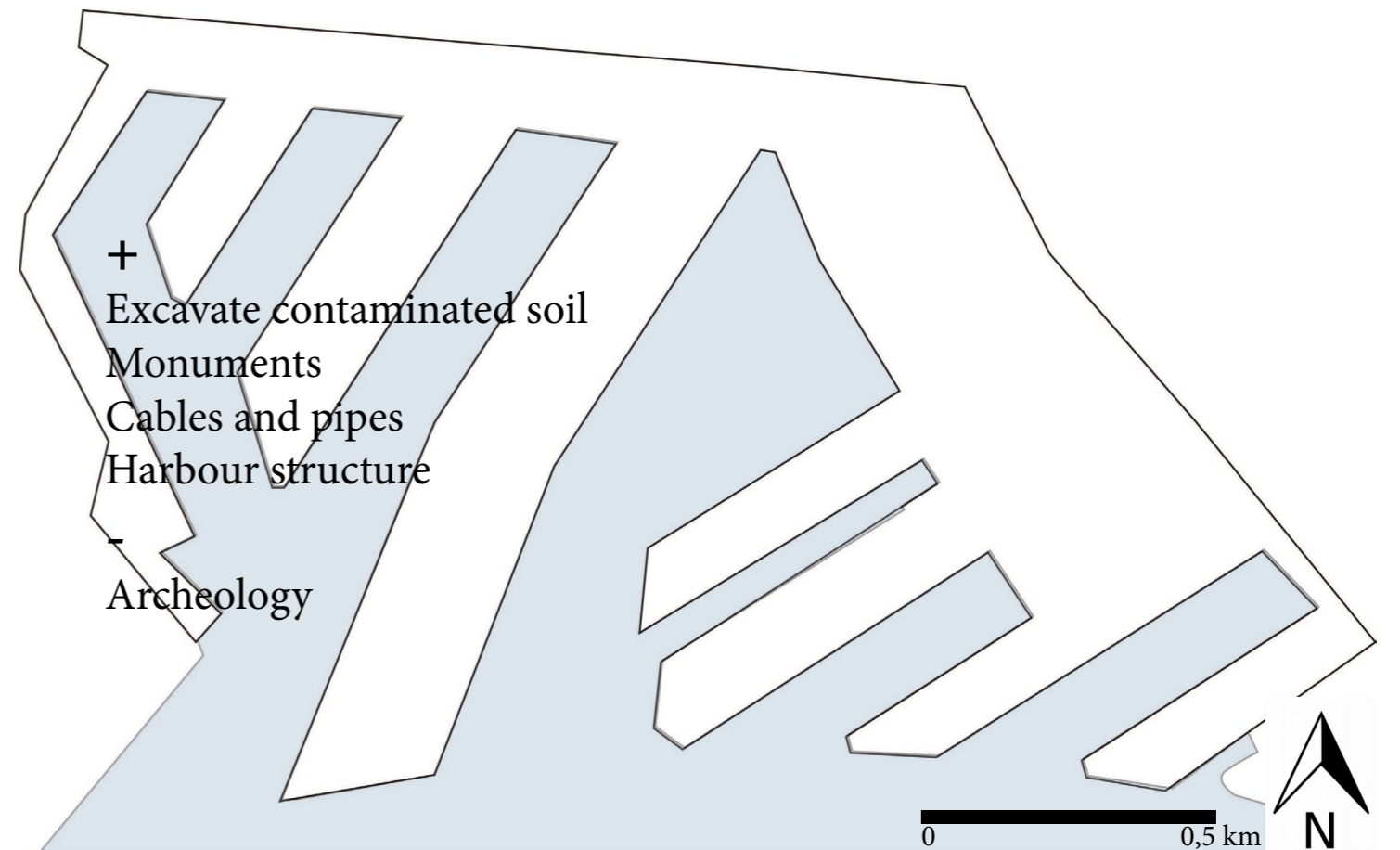
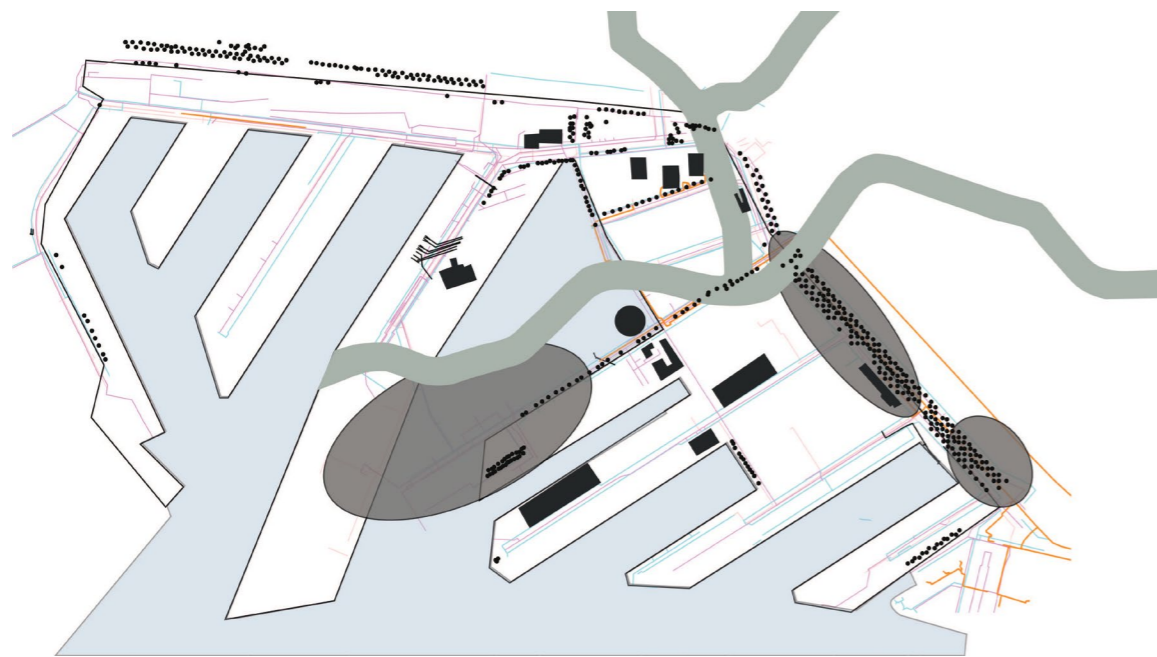


## URBAN FORM

## Version 1

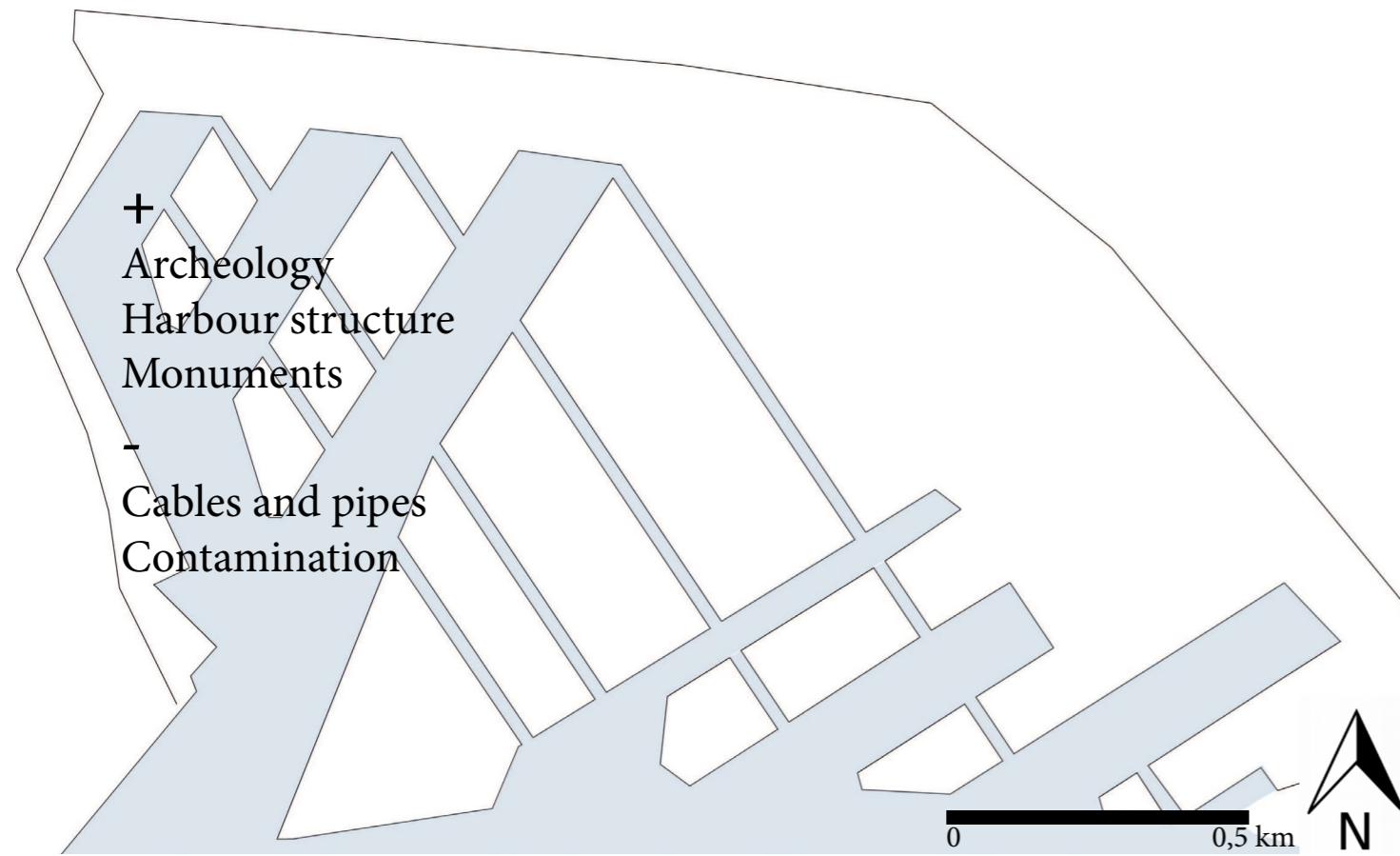


## Version 2

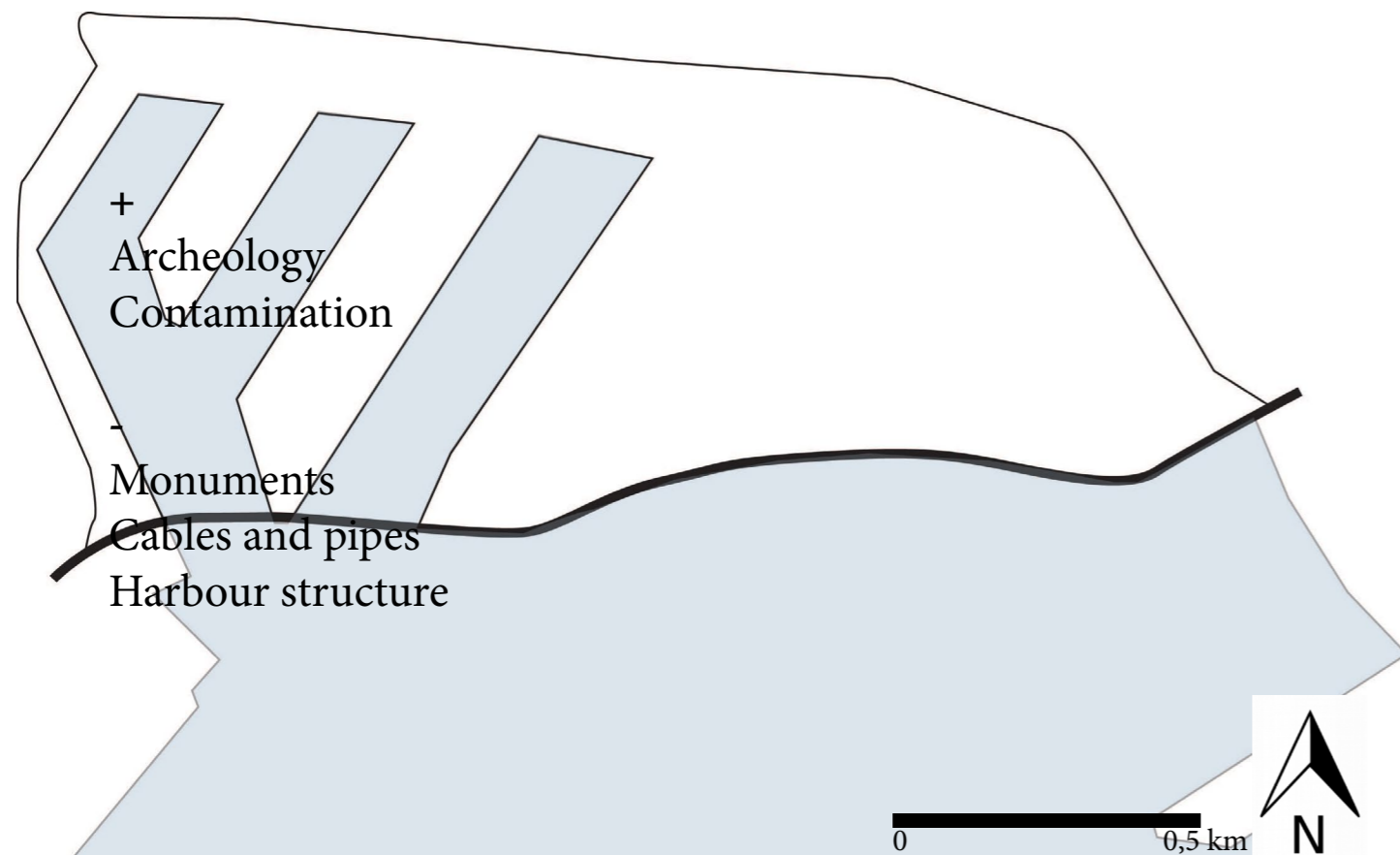
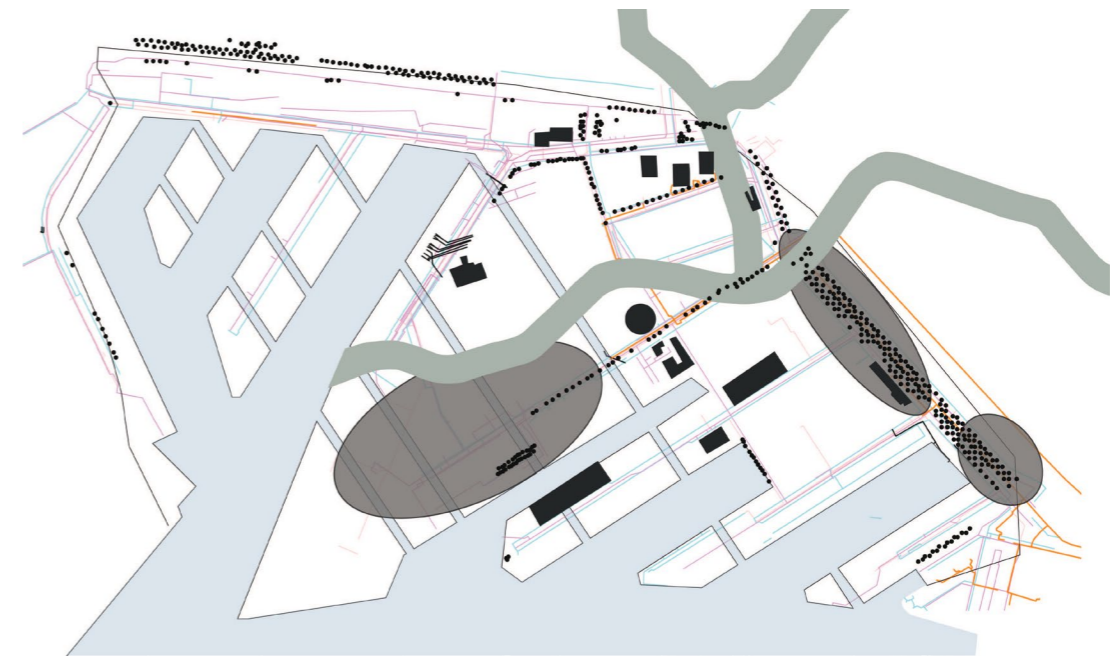


# Harbouremediation

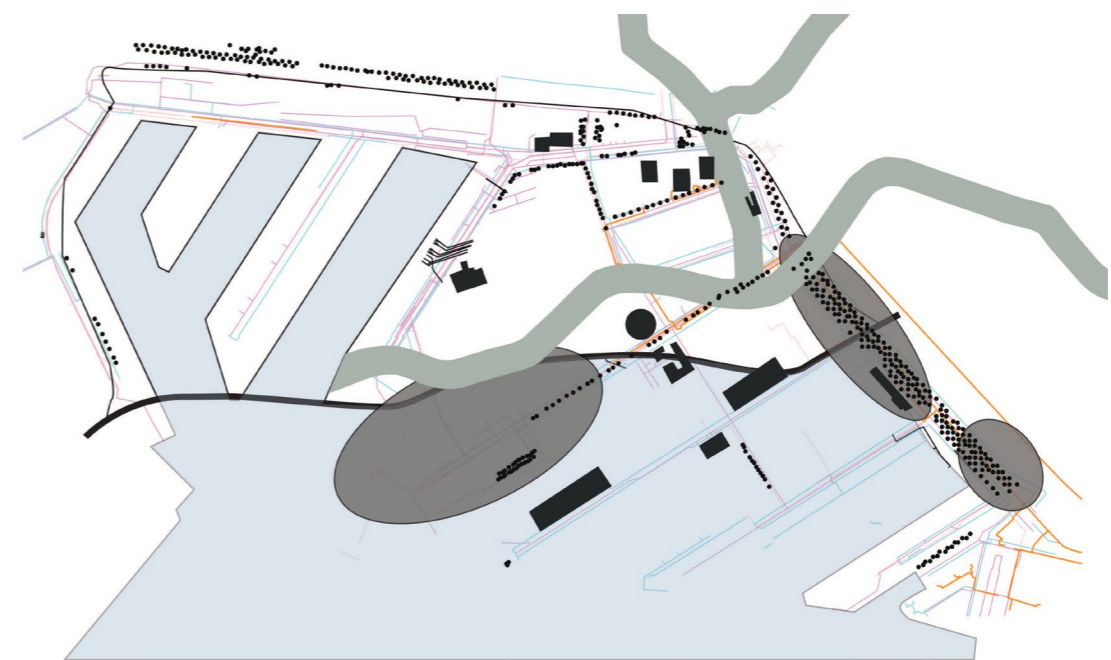
# Merwe Vierhaven



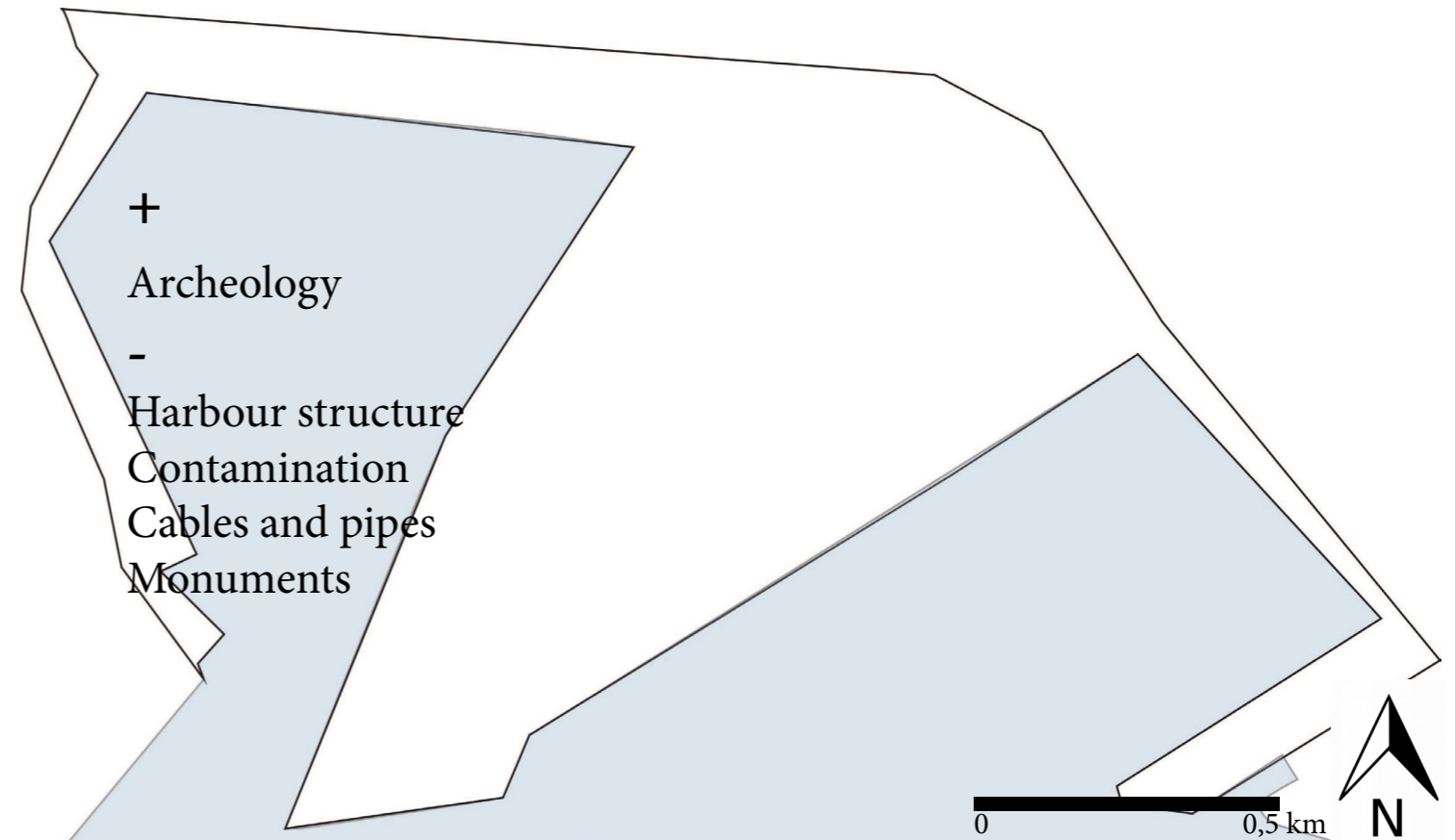
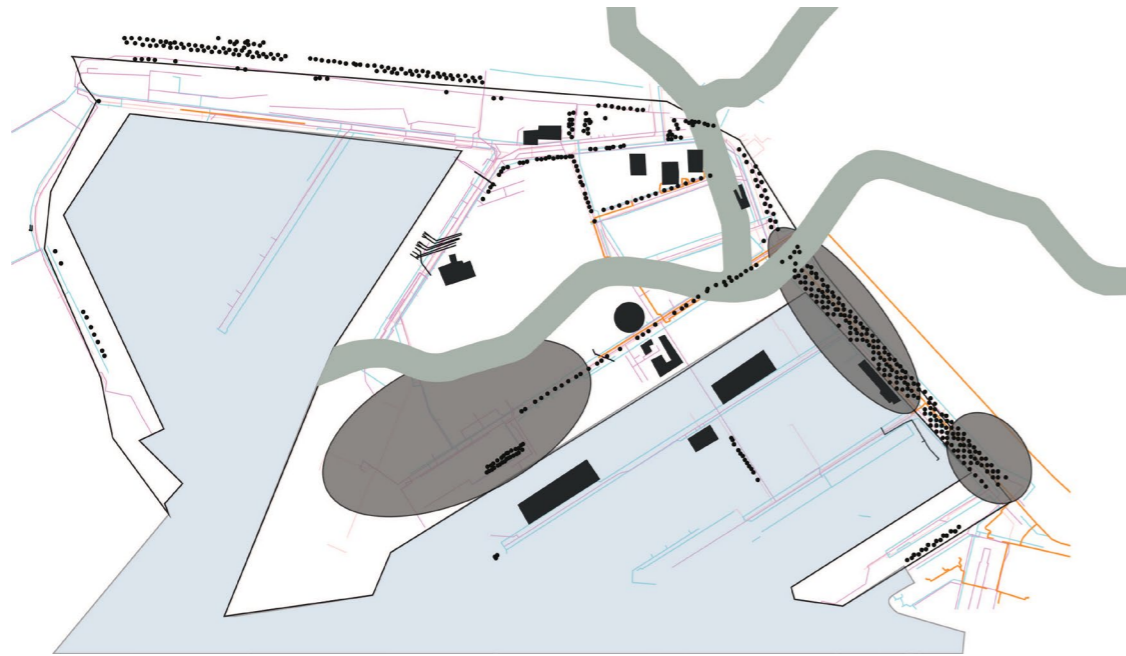
Version 3



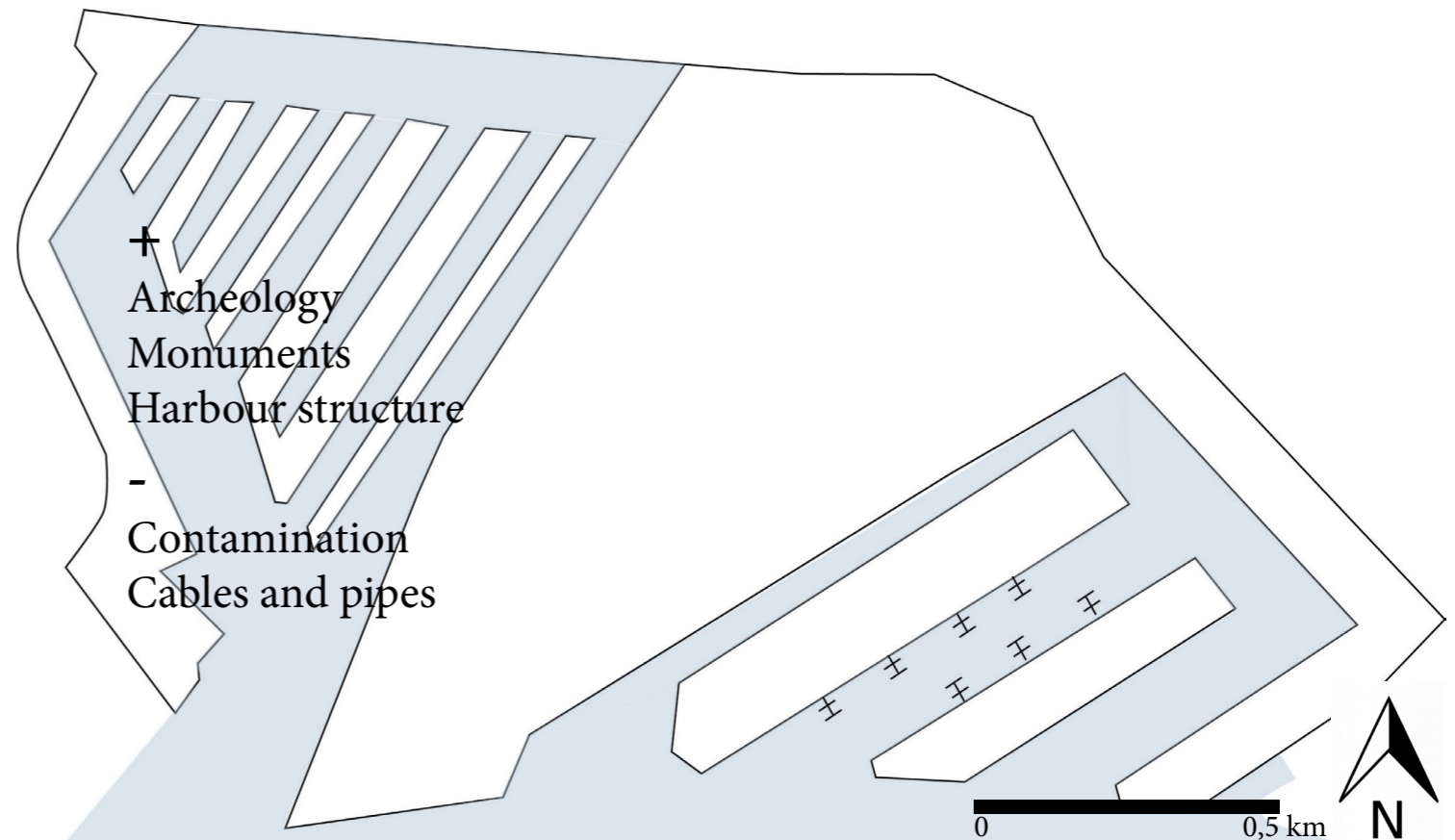
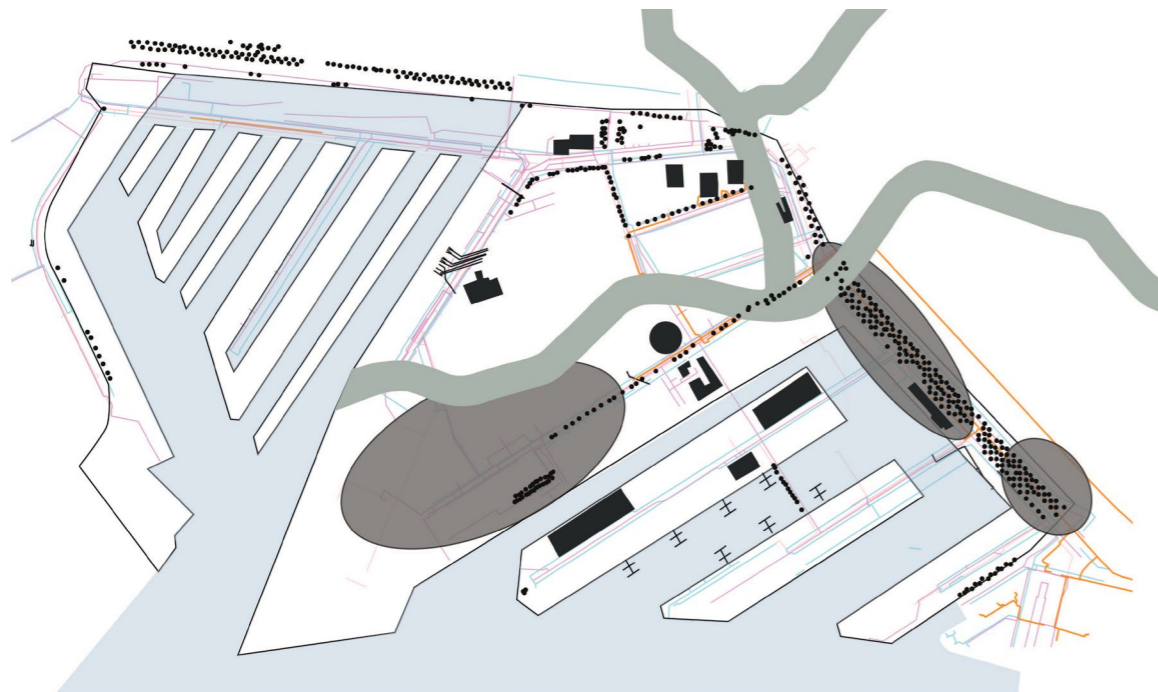
Version 4



Version 5

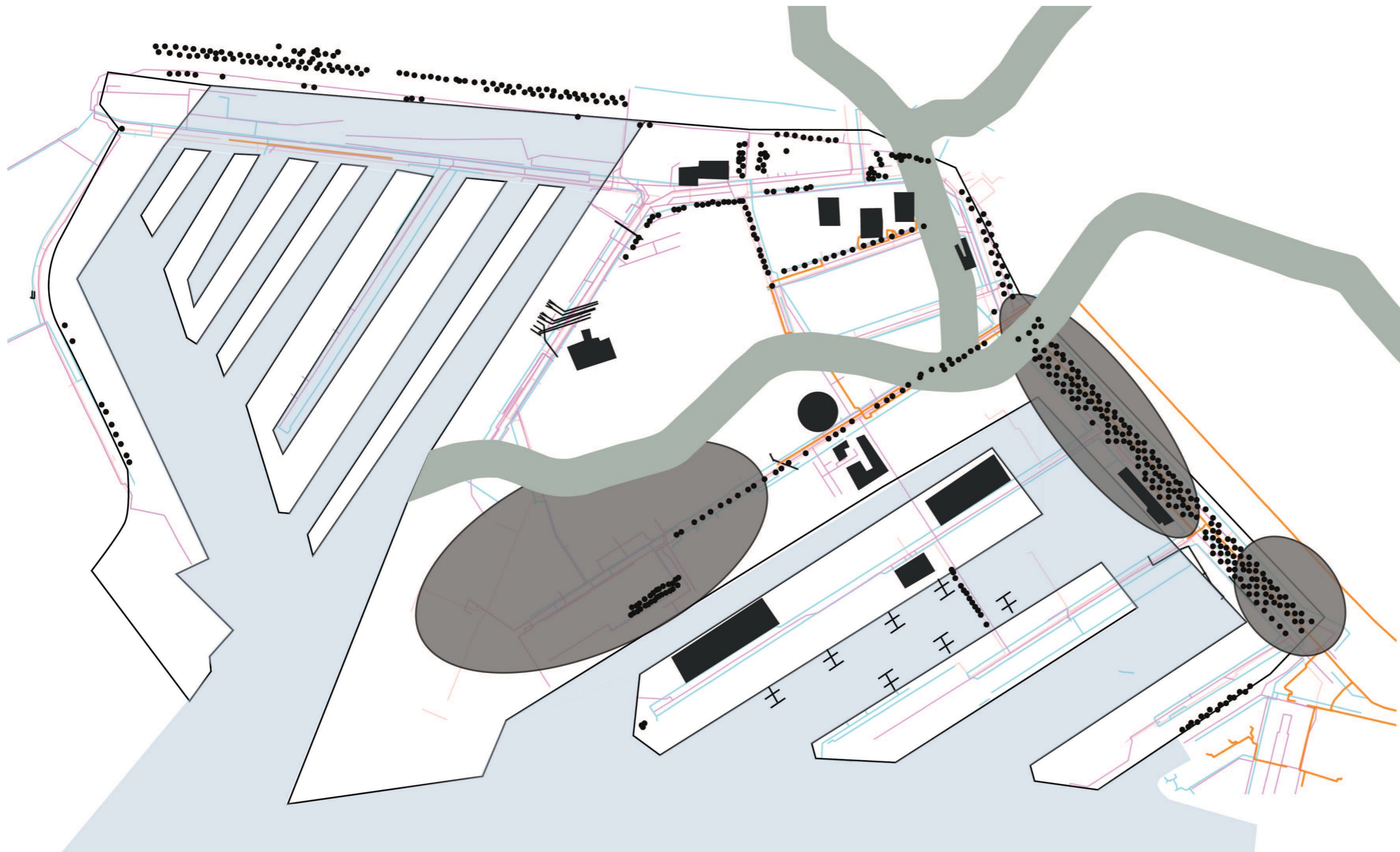


Version 6





## Best version

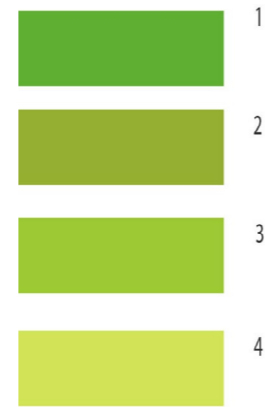


After testing 6 versions on the 5 most relevant topics for the Merwevierhaven area found in the analysis, namely 1. archeology, 2. monuments, 3. harbour structure, 4. contamination and 5. cables and pipes, version 6 came out as the most suitable urban form. This urban form takes all the topics into account. There is space to bring back to structure of the old dike. The monument can all remain in this urban form and the so characteristic harbour structure of Rotterdam will stay intact. The contaminated soil and groundwater will need to be remediated and the cables and pipes will probably need to be moved partially. So this is where the main focus of the design should be on.

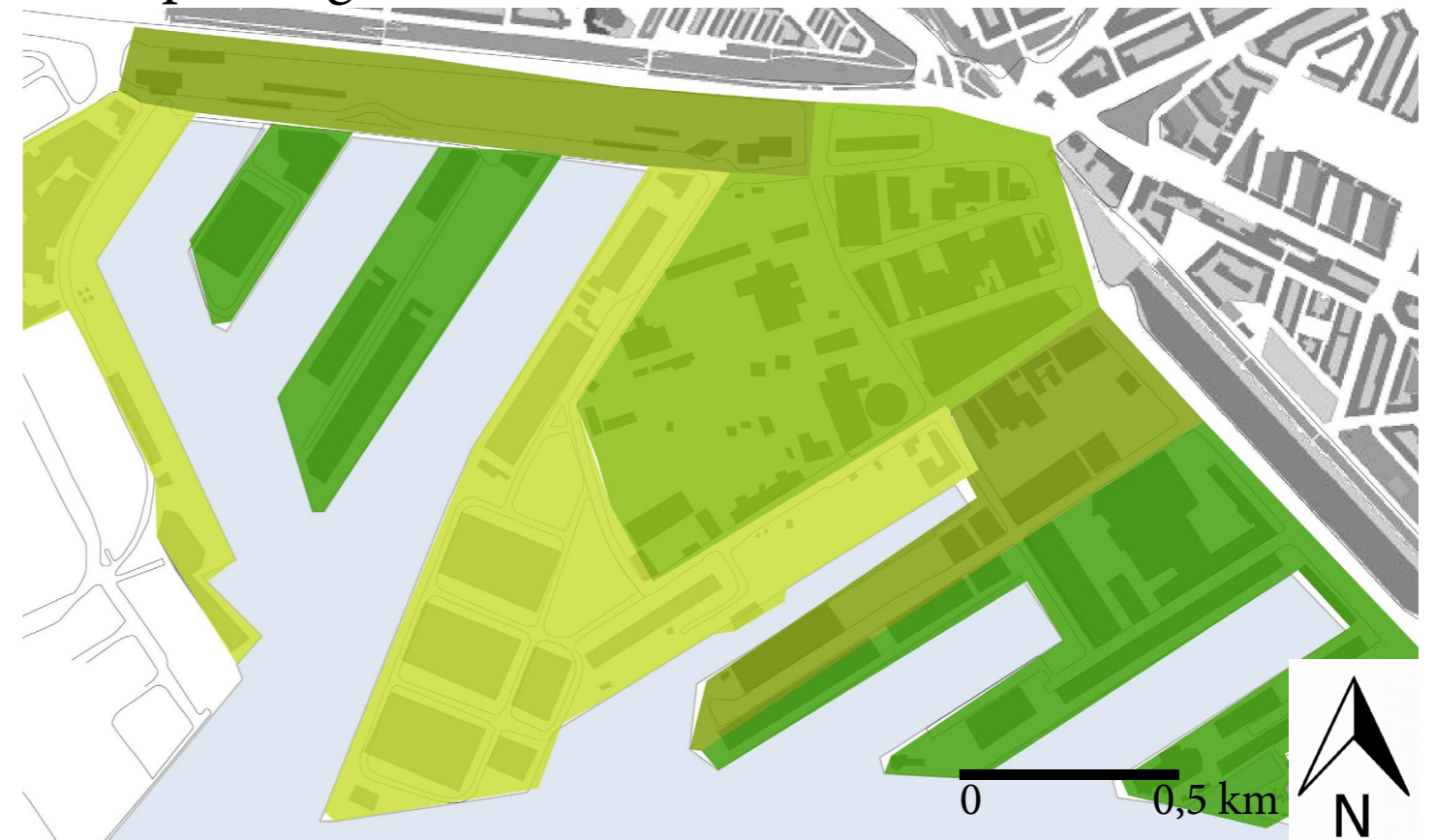


IDEAL PHASING

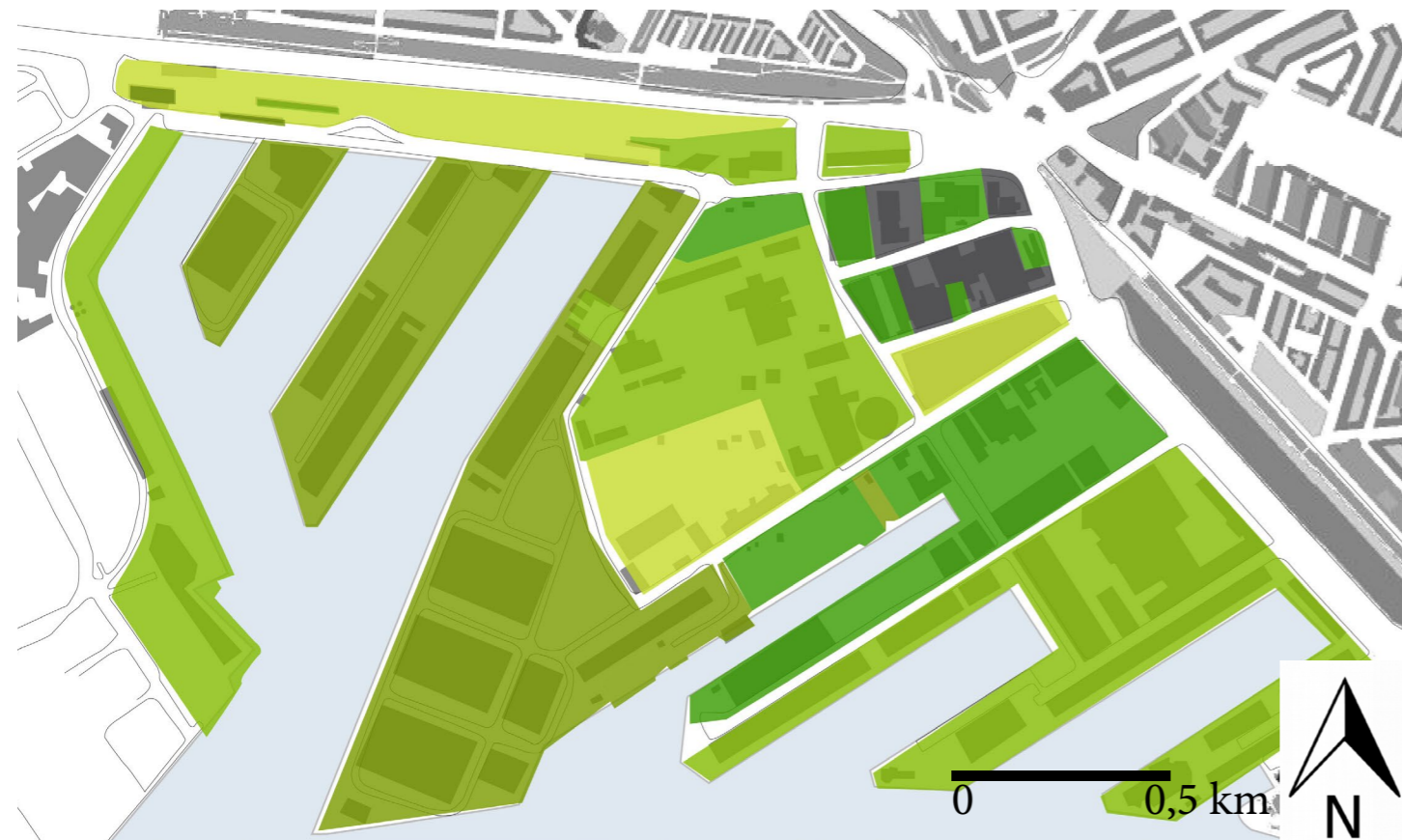
After analysing the area and the search to different urban forms, I took a look at the analyses and the consequences of the possible phasing for the redevelopment of the Merwevierhaven area. There are different things that will have an influence on the phasing, and they vary slightly from the ideal phasing sequence. I looked at the ideal phasing of 1. remediation, 2. remediation costs and 3. the leaseholds. These I combined into the ideal phasing taking into account all three individual ideal phasings, as can be seen on the next page.



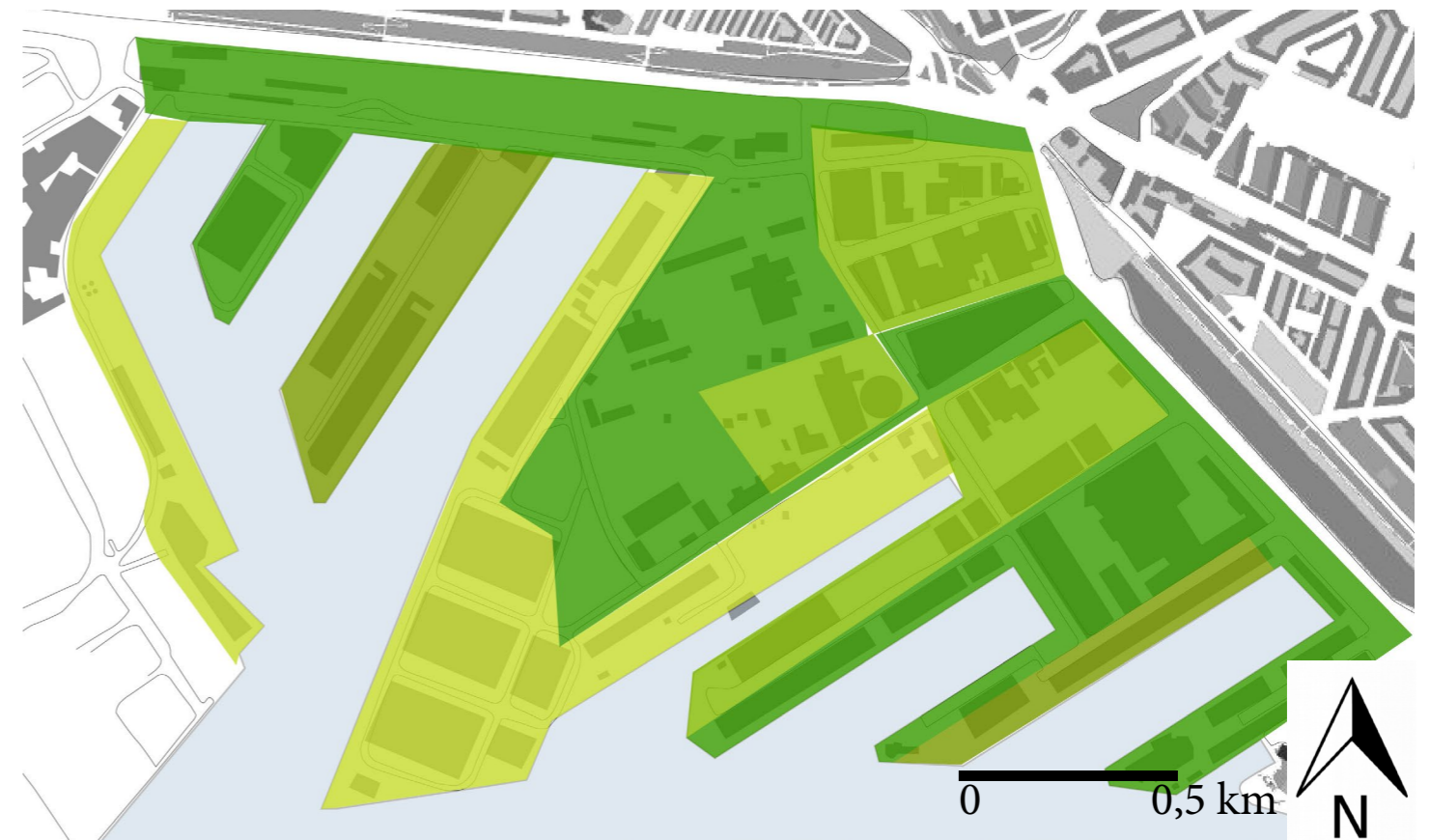
### Ideal phasing remediation costs



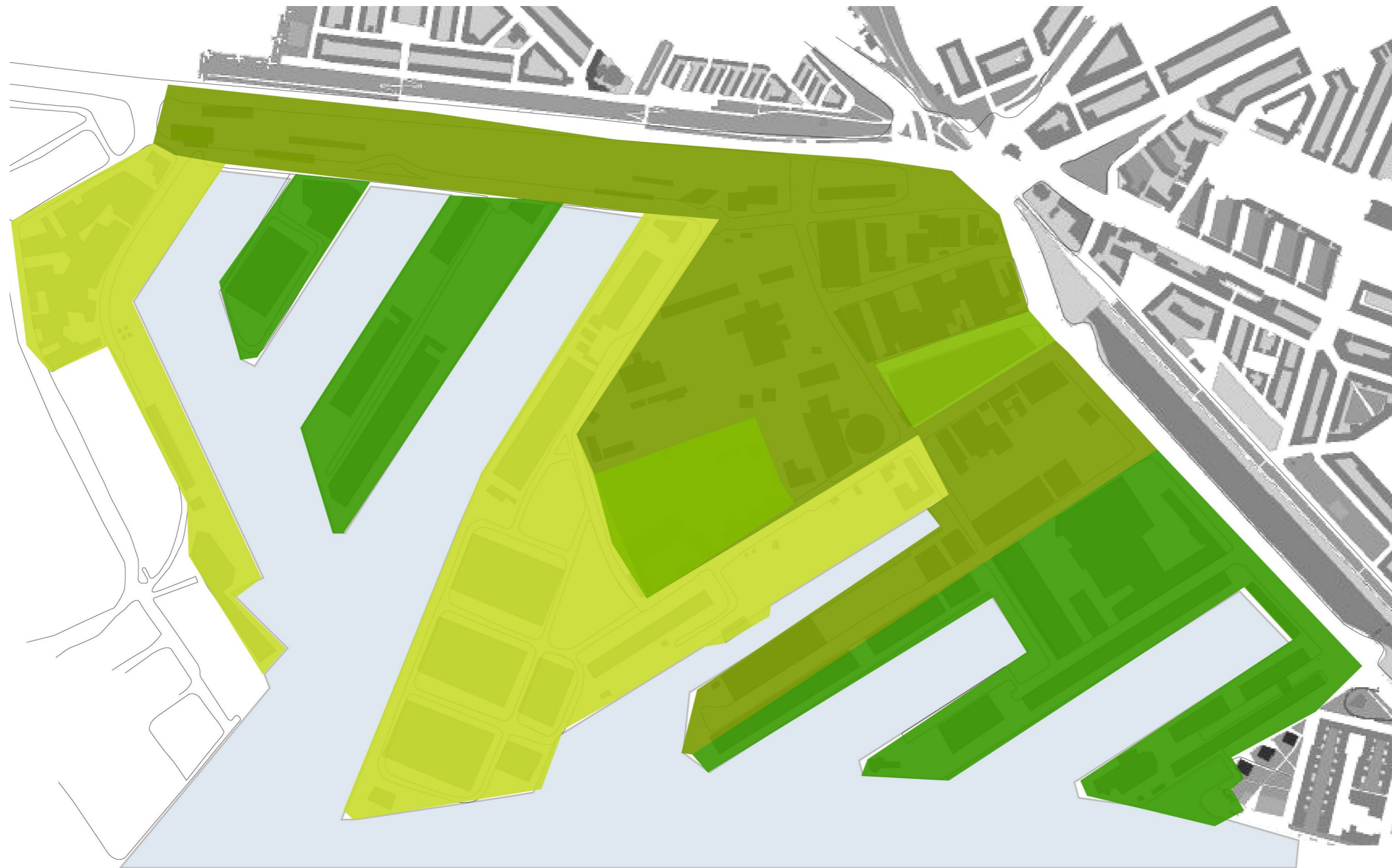
### Ideal phasing leasehold



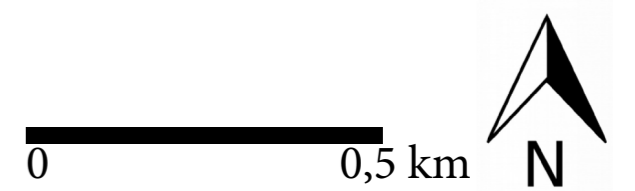
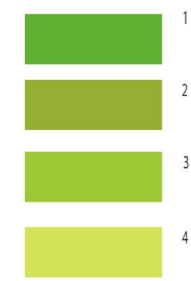
### Ideal phasing remediation



## Ideal phasing

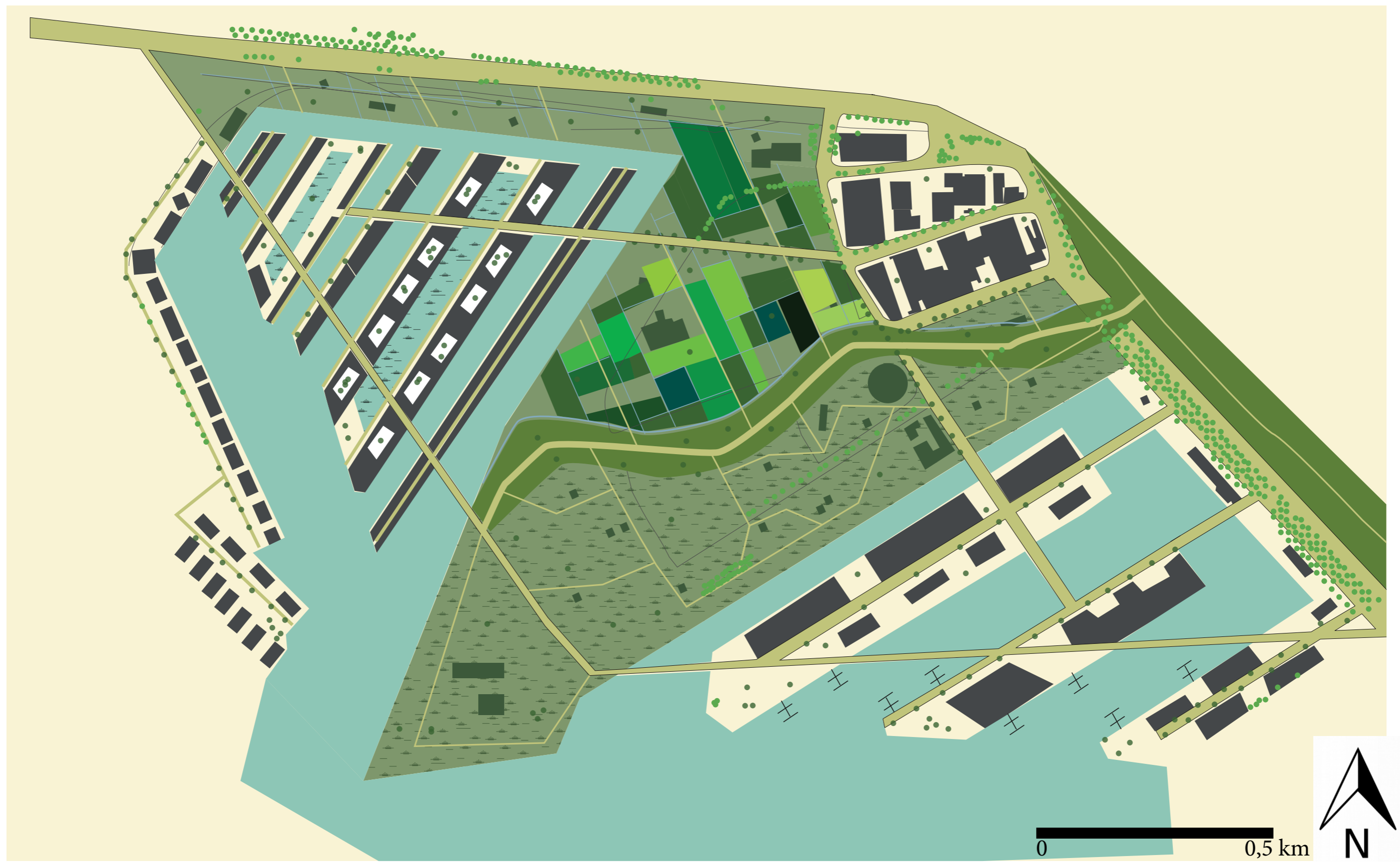


When we combine the conclusions of the ideal phasing for the leasehold, the remediation and the remediation costs a total ideal phasing occurs as is shown on the left side of this page. This phasing was the starting point for the final design.





## Final design

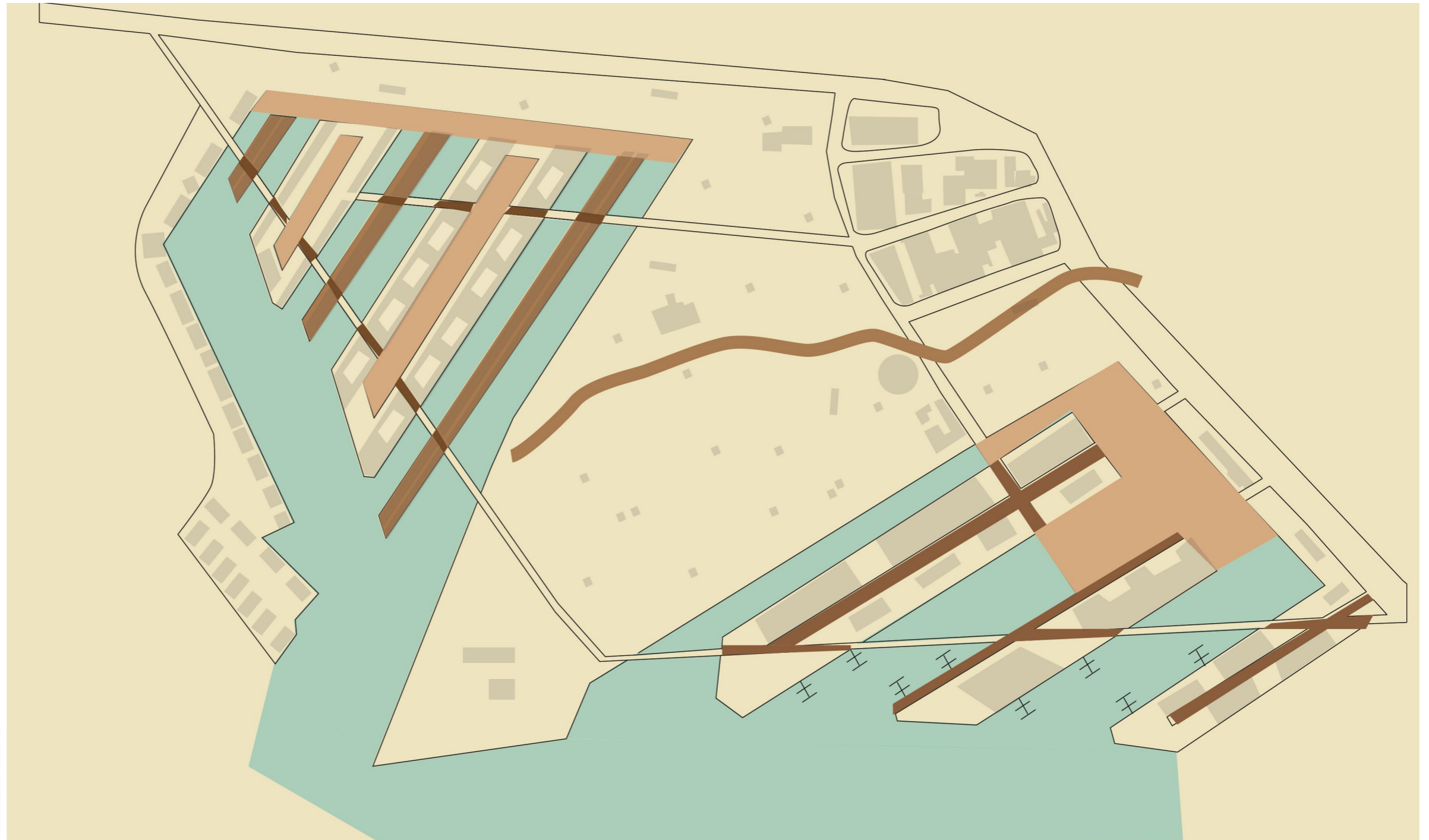
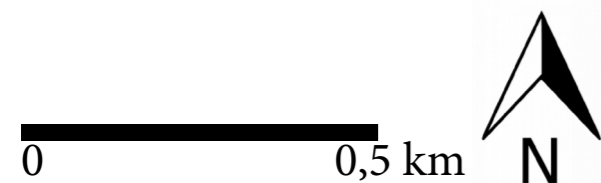


## Excavation

The biggest change for the area will be the excavation and heightening of certain parts of the Merwevierhaven area. The western part will be developed in more small harbour arms instead of two big once. The harbour arms will be cut off from the rest and serve as islands. In the middle the old dike structure will be brought back to the area and serve as the connector with the DakPark. The east of the area will have some excavation as well. The docks will be detached from the land. Streets in the whole area will be 1 meter higher than the terrain of the building blocks to make room for parking garages and the cables and pipes.

Excavated: 206350 m<sup>3</sup>  
Heightened: 237600 m<sup>3</sup>





-  Excavate
-  New land
-  Heighten 1 m



## Remediation



Most contamination is situated in the middle area. Therefore the eastern part does not need any remediation, by redesigning this area with more greenery, the soil and groundwater will be cleaned automatically. In the western part the same will be done, but then with more concentration. The dirty soil that will be excavated will be used in the structuring of the dike. This soil will be wrapped so it cannot contaminate any other soil. The artificial wetland is a different sort of natural remediation. The areas addressed for urban agriculture will be cleaned by the use of enhanced natural attenuation aerobic. The potential of naturally present bacteria to degrade the contamination in an oxic environment is stimulated by optimizing the conditions for biological degradation. The site disturbance is low and it will take up to a few years.

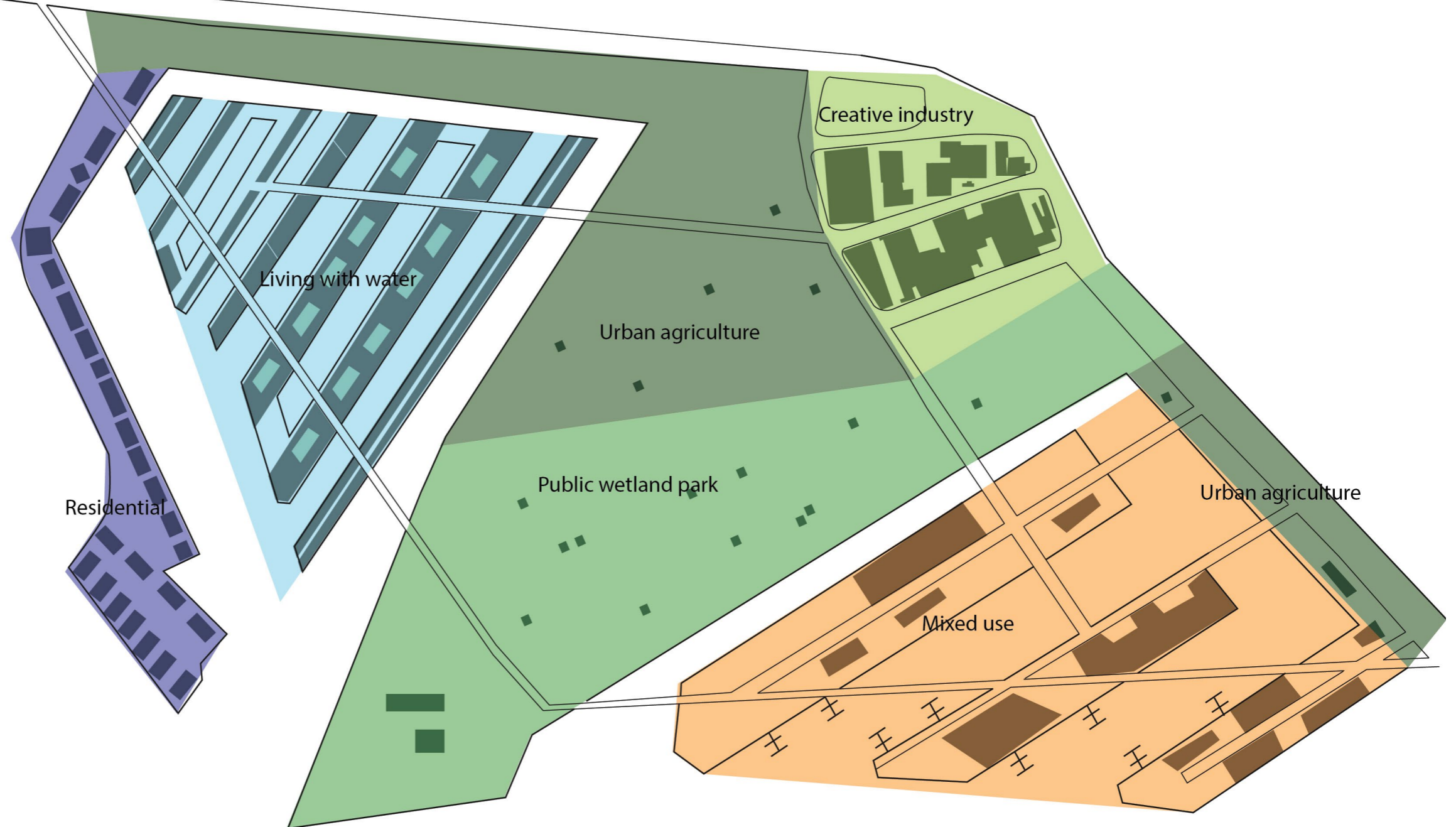
-  No remediation
-  Natural attenuation
-  Artificial wetland
-  Natural remediation



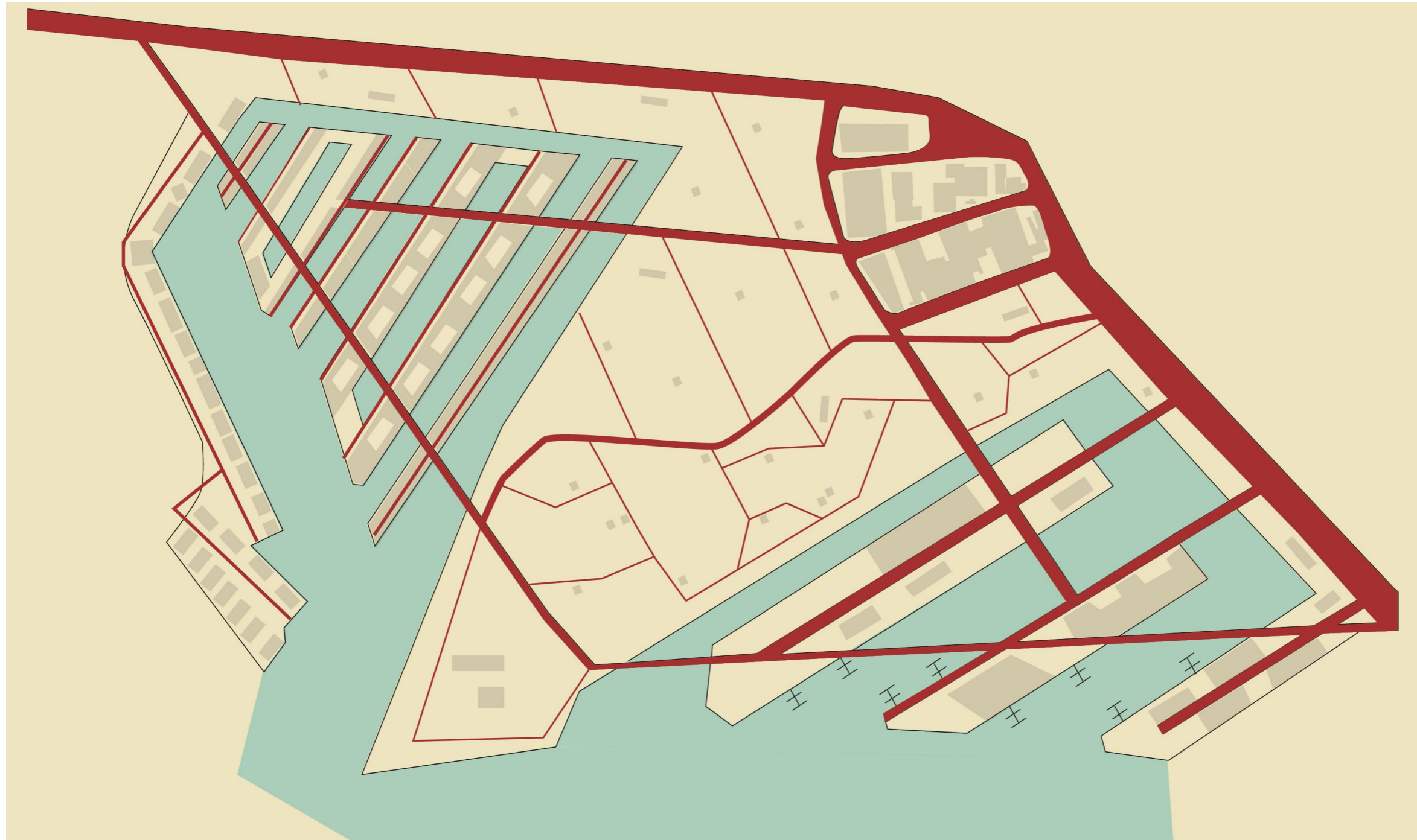
## Functions

The Merwevierhaven area is divided in different sub areas. From east to west:

1. Residential; this part will be transformed into a residential area orientated on the waterfront.
2. Living with water; this will be a quite but dense neighbourhood where people will live with the water and can participate in the construction of their own housing.
3. Urban agriculture; expanding the already existing initiatives to provide for the city of Rotterdam and create a haven of nature in the busy city.
4. Public wetland park; a sustainable and natural way of cleaning the soil with possibilities for temporary use, making people aware of the issues and creating a nice and welcoming park for the whole area.
5. Creative industries; already existing buildings will be renovated into studios for creative industries
6. Mixed use; keeping the industrial character of the area. Businesses and residential housing along side each other.



## Infrastructure

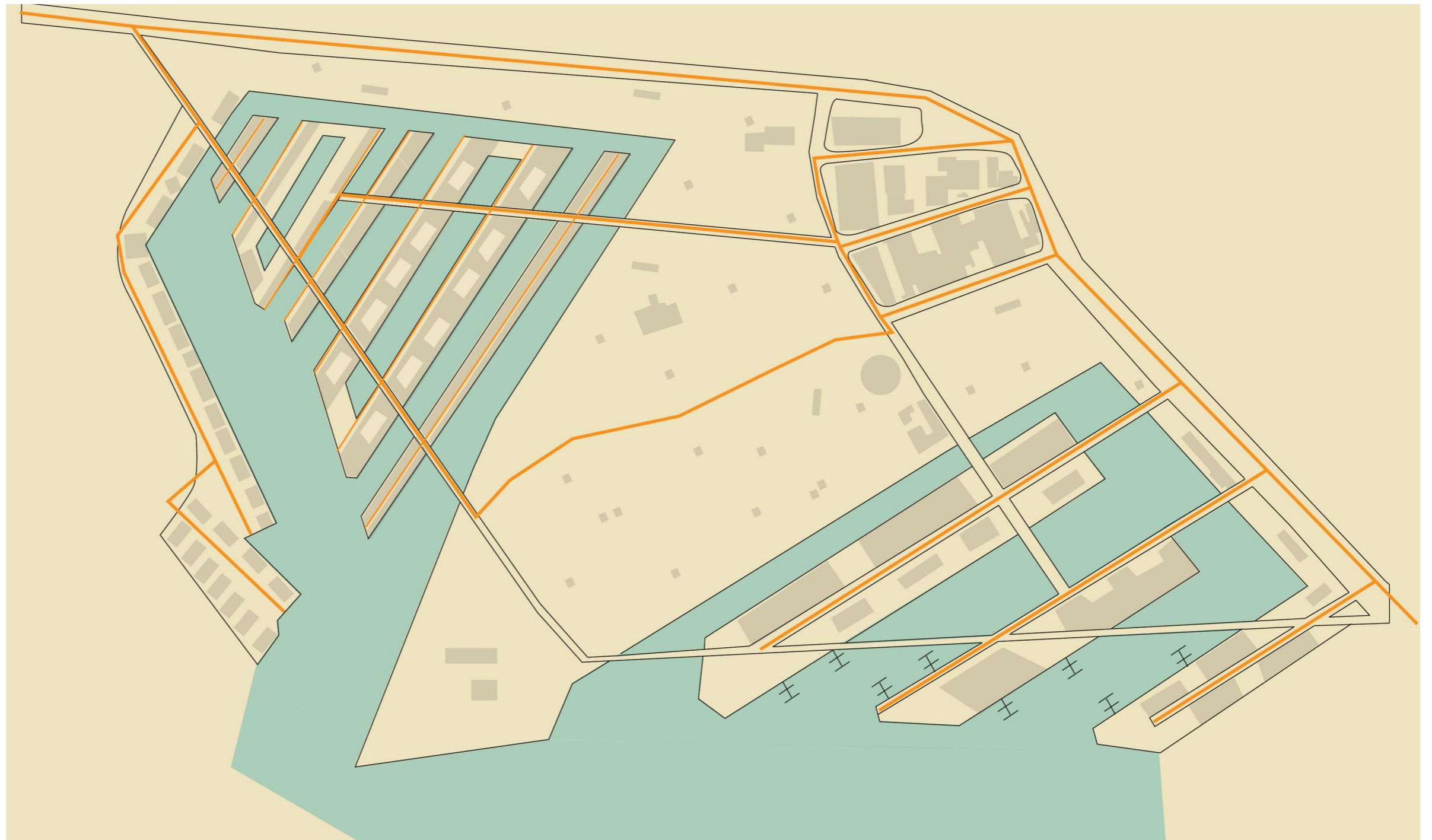


The road structure in the Merwevierhaven area changed along with the urban form. The main roads in the north of the area will stay the main connectors, but where in the east the roads are directly connected for a good accessibility for the businesses, the islands in the western part will not be connected to the main road so easily. Here the roads on the islands will be only for inhabitants and visitors. The middle area is connected with the western and the eastern part, but from that on, it will mainly be by local traffic, bikers or pedestrians enjoying the landscape. The dike will connect the area with the Dakpark so the area will be very well accessible for pedestrians and cyclists. From the top end of the middle part of the harbour a connection will be made with the water taxi to take people across the river Maas.

## Cables and pipes

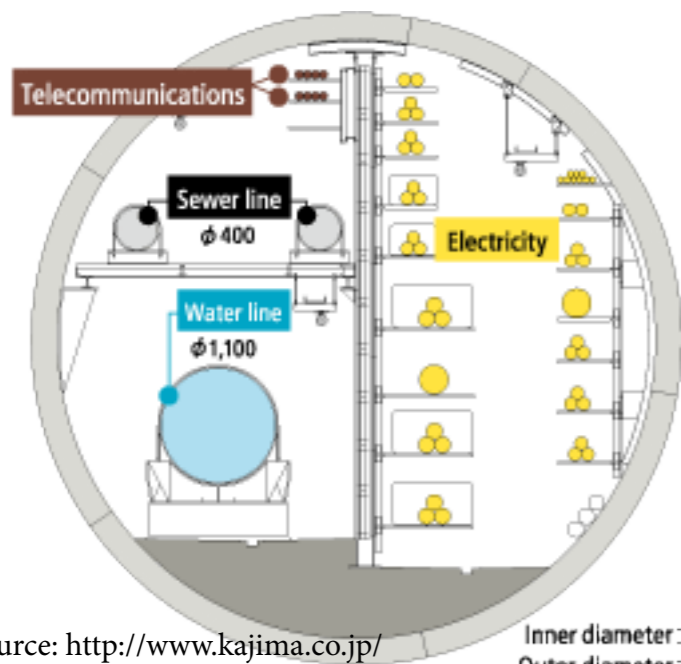
During the analysis I discovered that the cables and pipes structure in the Merwevierhaven area is a mess. First of all we are not sure about the position of the cables and pipes. Second, some cables are old and not even connected to a system anymore and others suddenly stop. This means that the cables and pipes structure had to be replaced almost completely.

Every island will have a main utility duct walking through. Where needed this duct will split off into a smaller duct. The middle area will not need a big structure of cables and pipes, so by focusing them on the dike, the ground will be open for other developments, but still have the possibility to connect to the duct when needed.



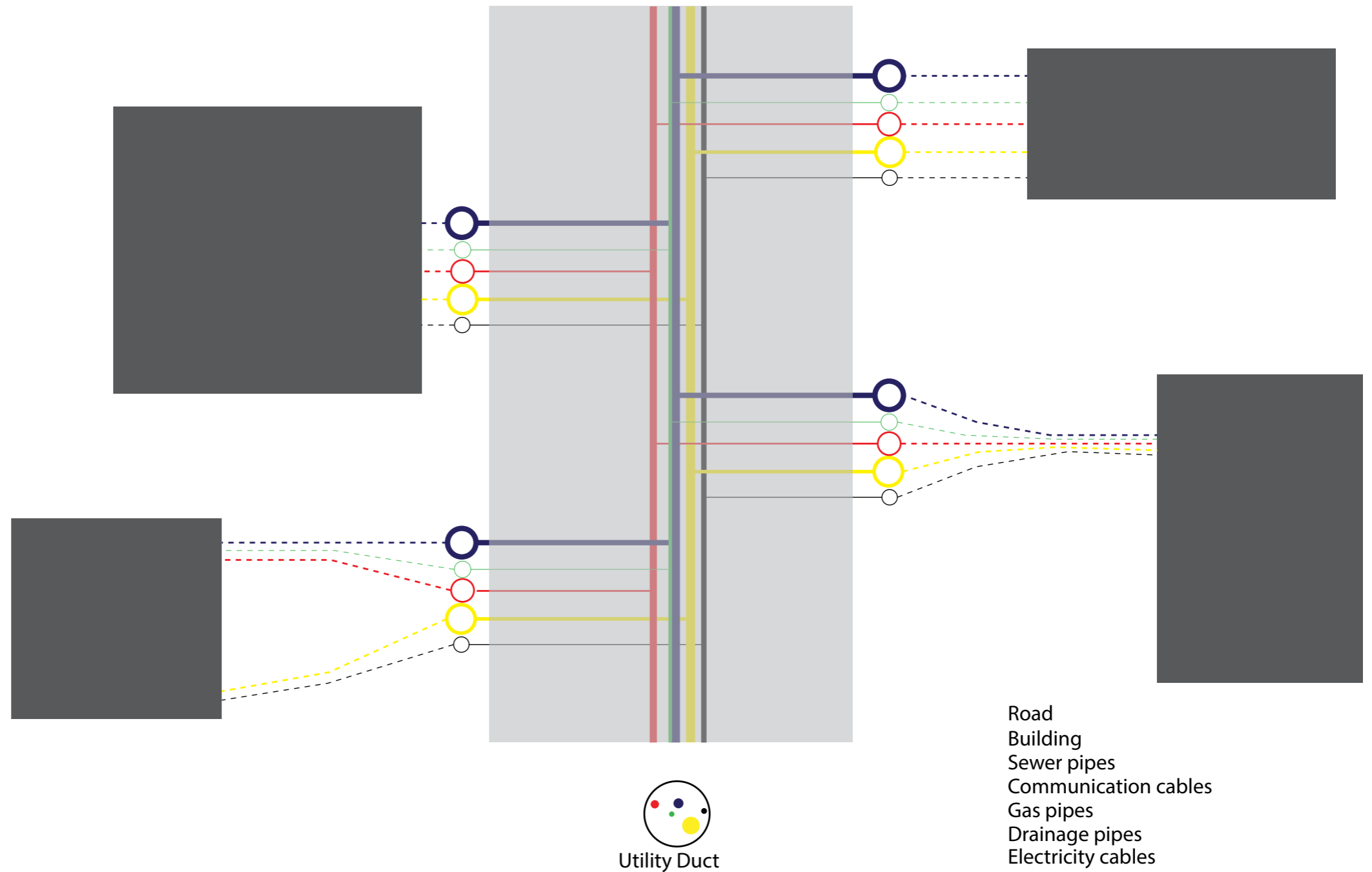
## Utility Duct

To clear out the mess in the soil and not getting the problem again, the cables and pipes will all be collected in an utility duct. These ducts are very easy to access for maintenance. To keep the site open for transformation, the utility ducts will be placed under the permeable roads, with once in a while an access point. The connection to the utility duct has to be made by the future inhabitants of the area or project developers. This way, every building or block will have the choice how to connect to the utility duct and gains freedom in designing.



Source: <http://www.kajima.co.jp/>

Inner diameter: 5.7 meters  
Outer diameter: 6.2 meters



## Monuments



At the location of the old dike the surface level will be heightened and the dike will be brought back into the landscape. The quays are an important feature of the harbour and will remain in the new structure. This makes a difference between the old quays and the new quays what will show the rich development history of the Merwevierhaven area. All the monuments and also the buildings that will probably be listed as a monument will remain and where needed restored. A part of the old train tracks will remain in the middle area. This due to the fact that the soil will be left as it is, and this way people will be remembered to the industrial history of the area.

- Old Train Tracks
- Monumental Buildings
- Old Dike
- Quays



## Sustainability

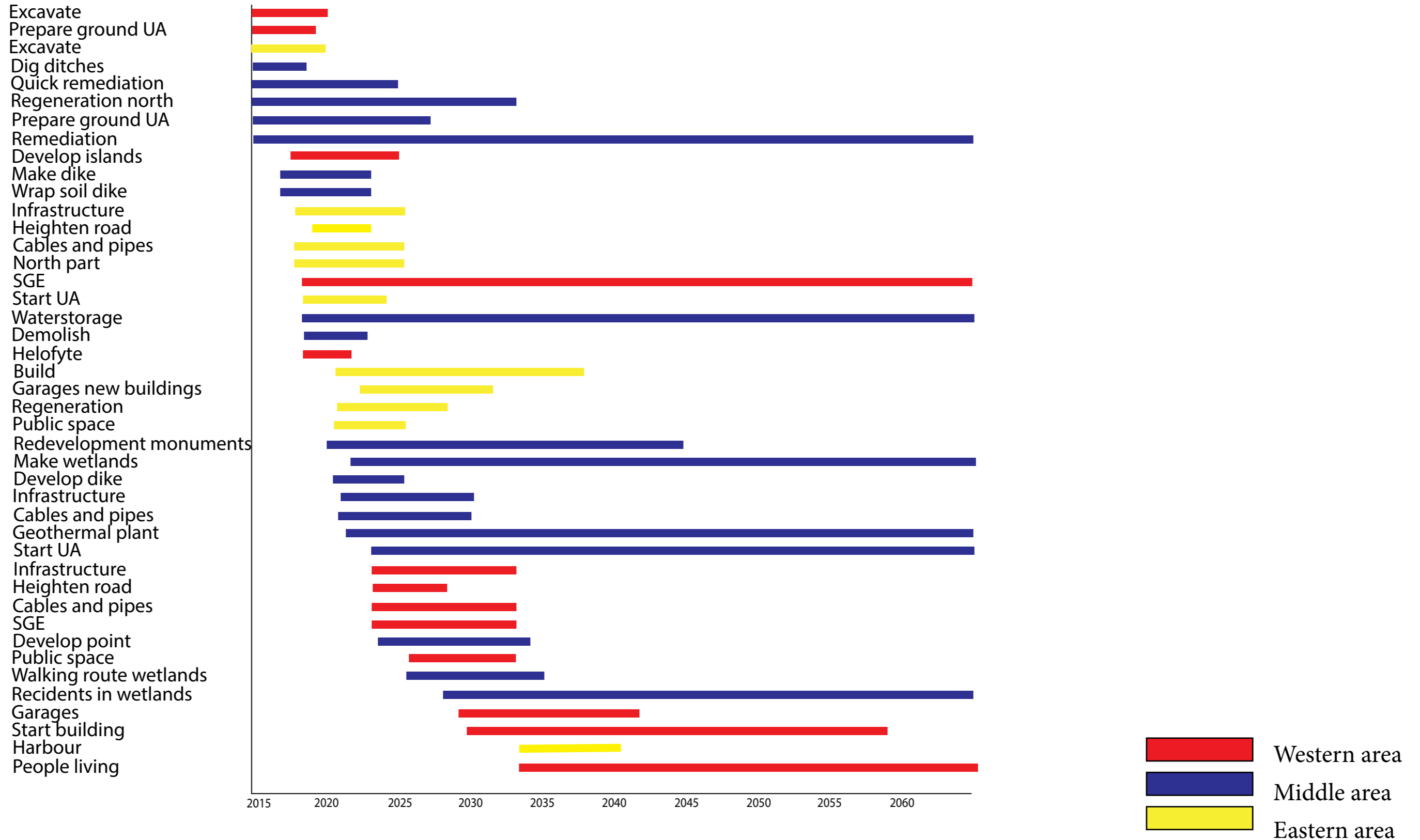




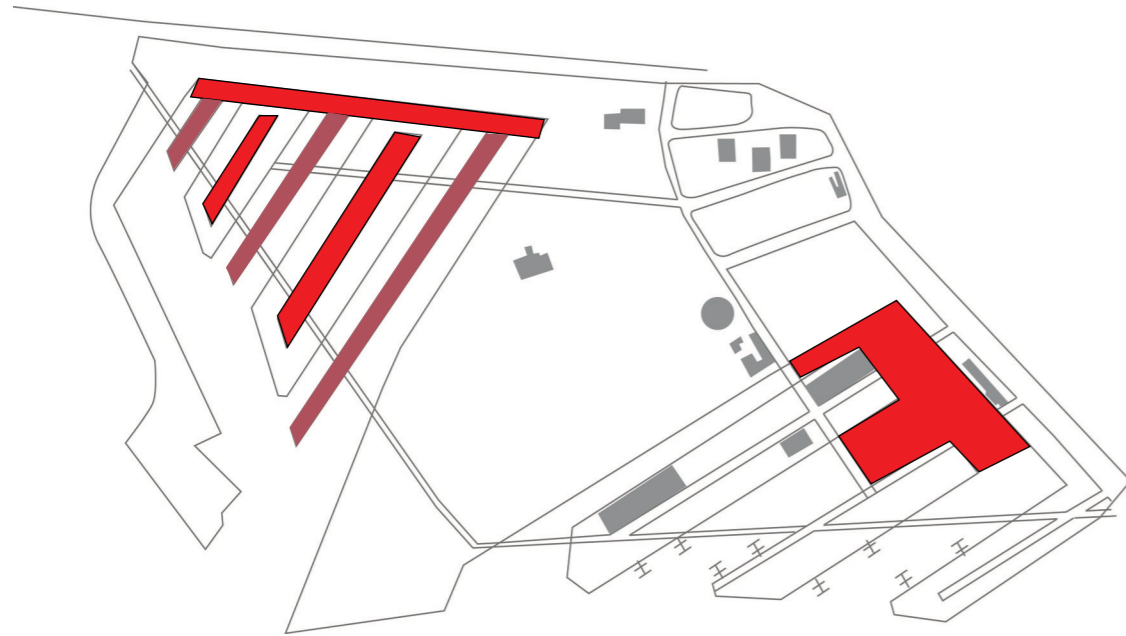
PHASING

The word cloud within the oval features the following terms: remediation, usual, approach, case, brownfields, framework, take, assessment, management, analysis, developed, participated, assessment, contaminated, development, different, integrating, practice, case-specific, under-considered, ESS, regeneration, instead, opportunity, packages, impacts, land, soil, renewal, tools, activities, use, business, Final, projects, sciences, well, Balancing, Urban.

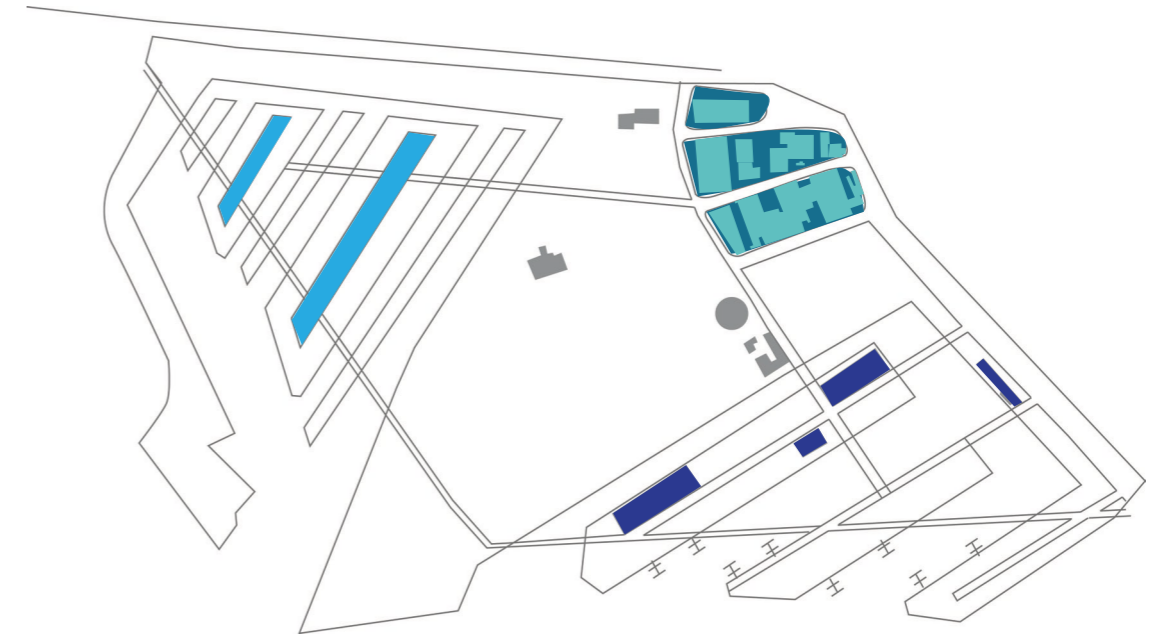
## Phasing



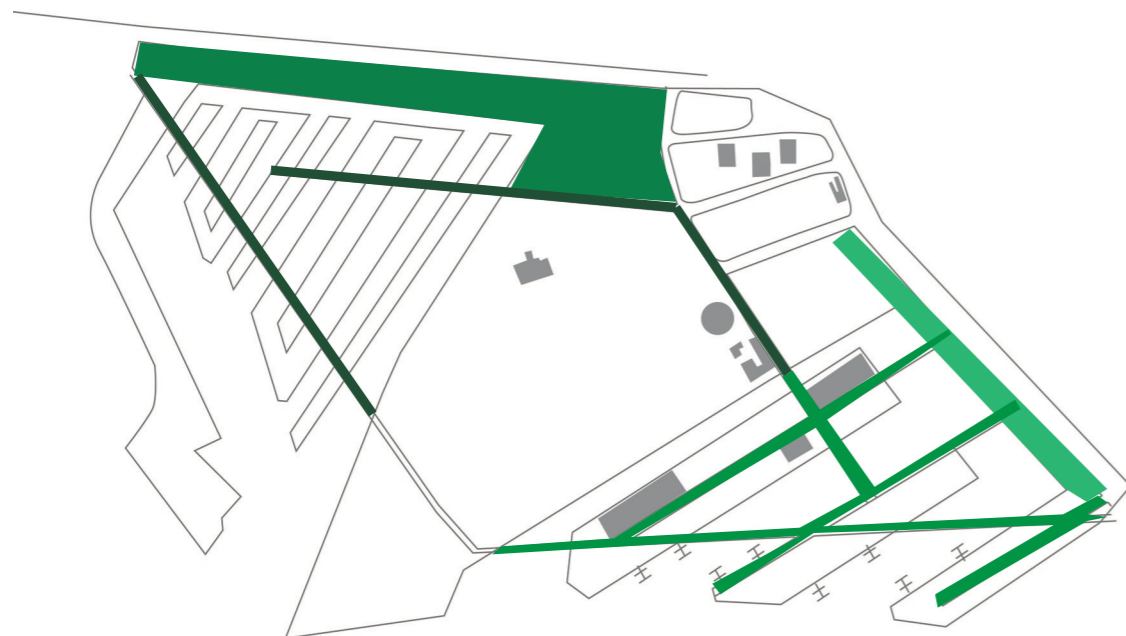




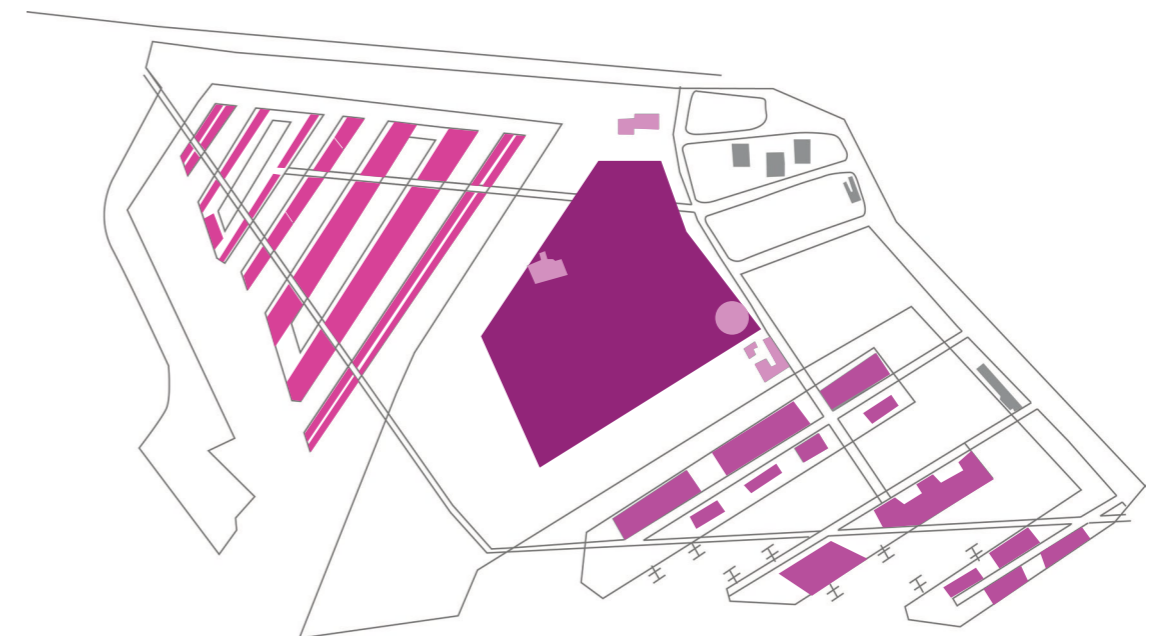
1. Excavation. Creating islands.



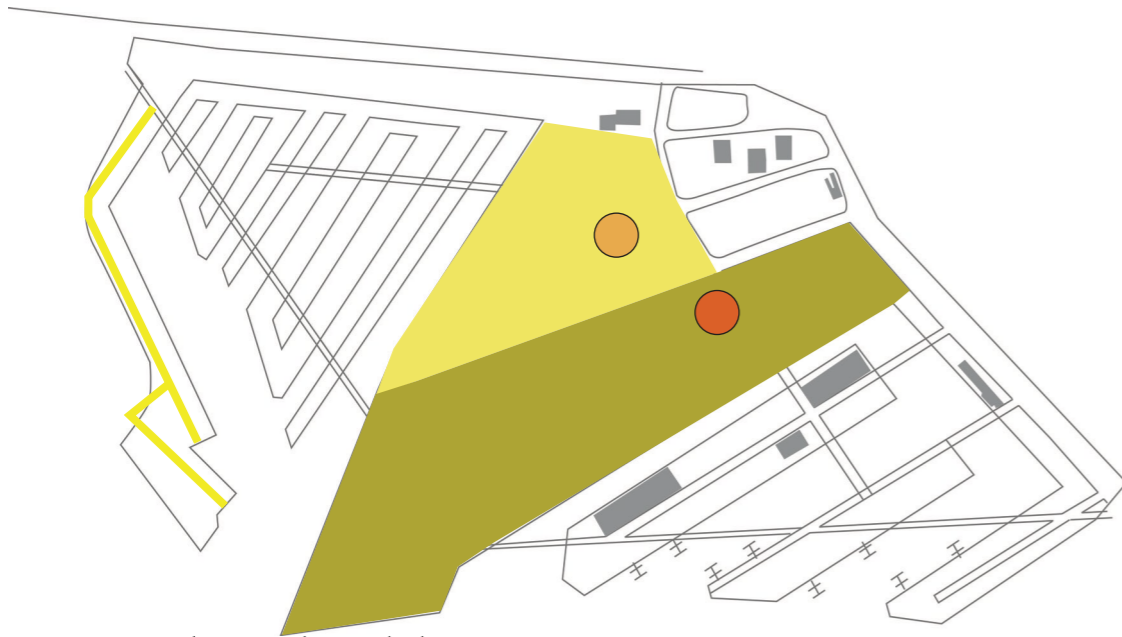
2. Redevelopment creative industry. Renovation monuments west. Helofyt lakes.



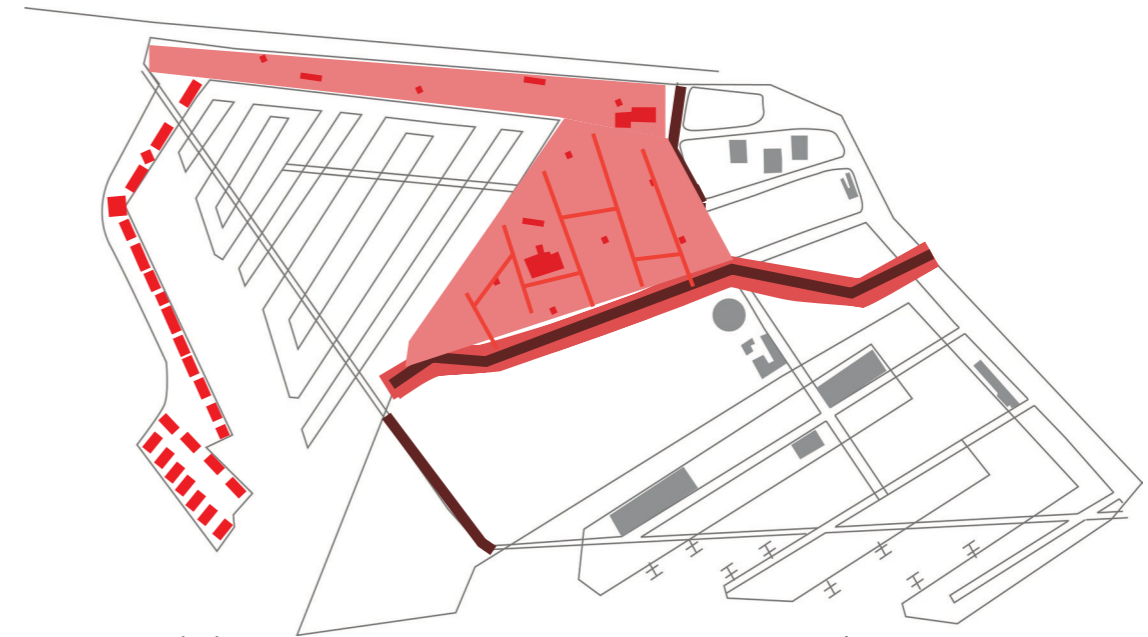
3. Prepare ground urban agriculture. Roads and cables east and west.



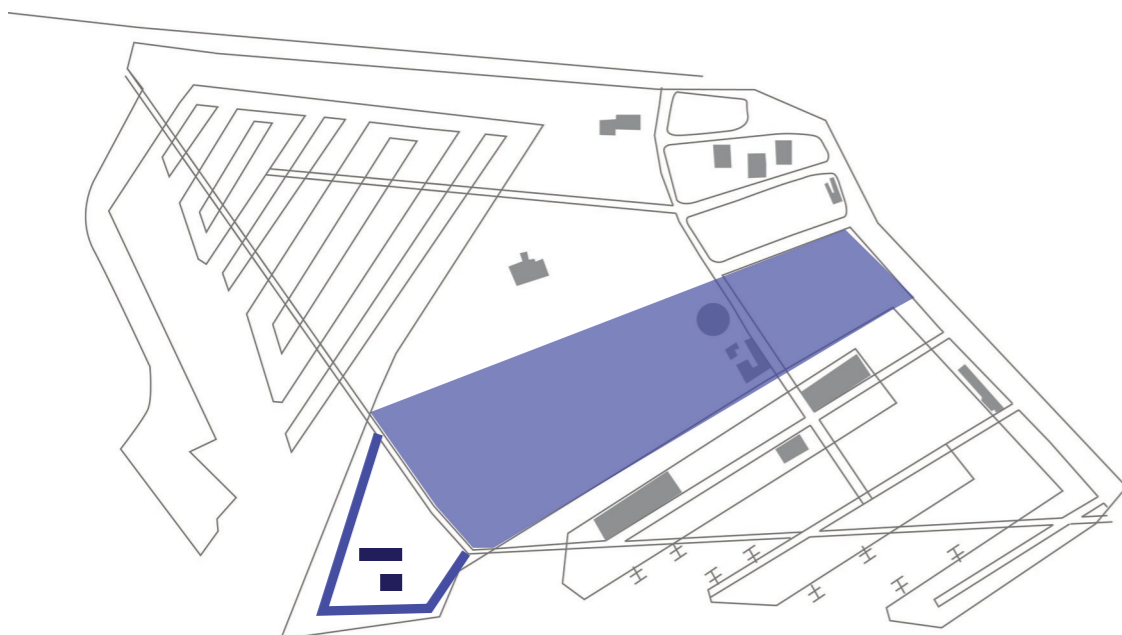
4. Renovation monuments middle. Demolish EON site. Buildings and garages east and west.



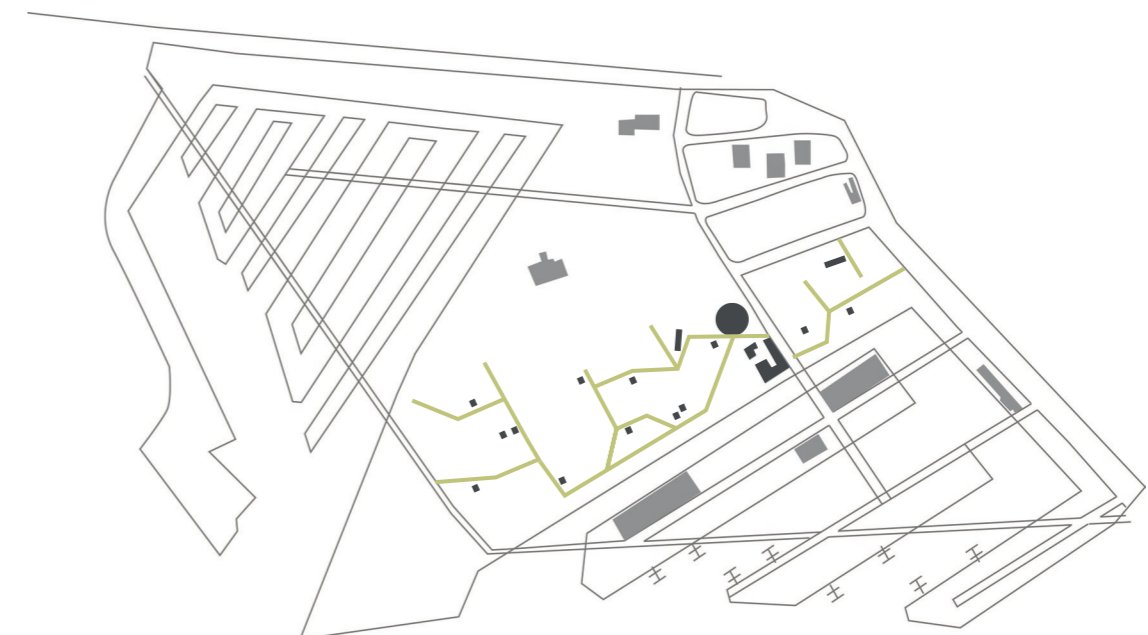
5. Road and cables east. Waterstorage. Geothermal plant. Prepare ground wetlands.



6. Building en garages east. Ditches urban agriculture. Roads and cables middle. Dike. Buildings urban agriculture.



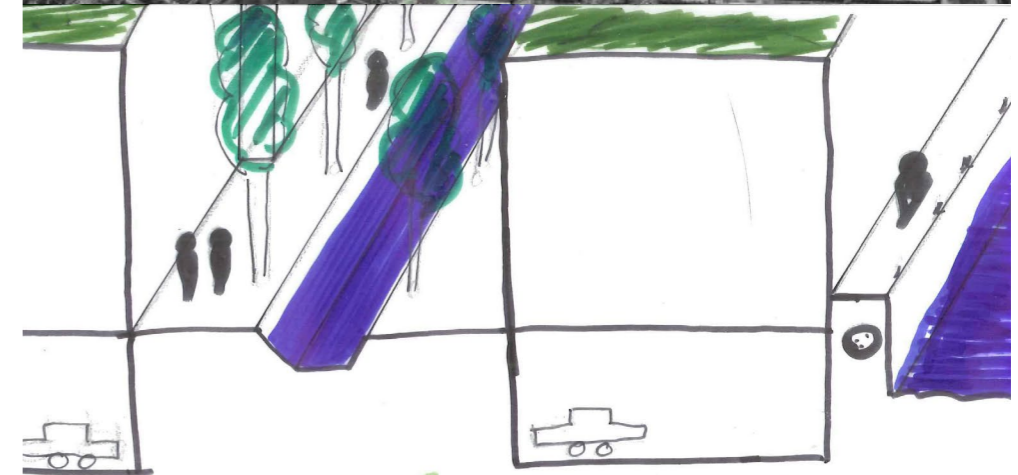
7. Wetlands. Harbour head.

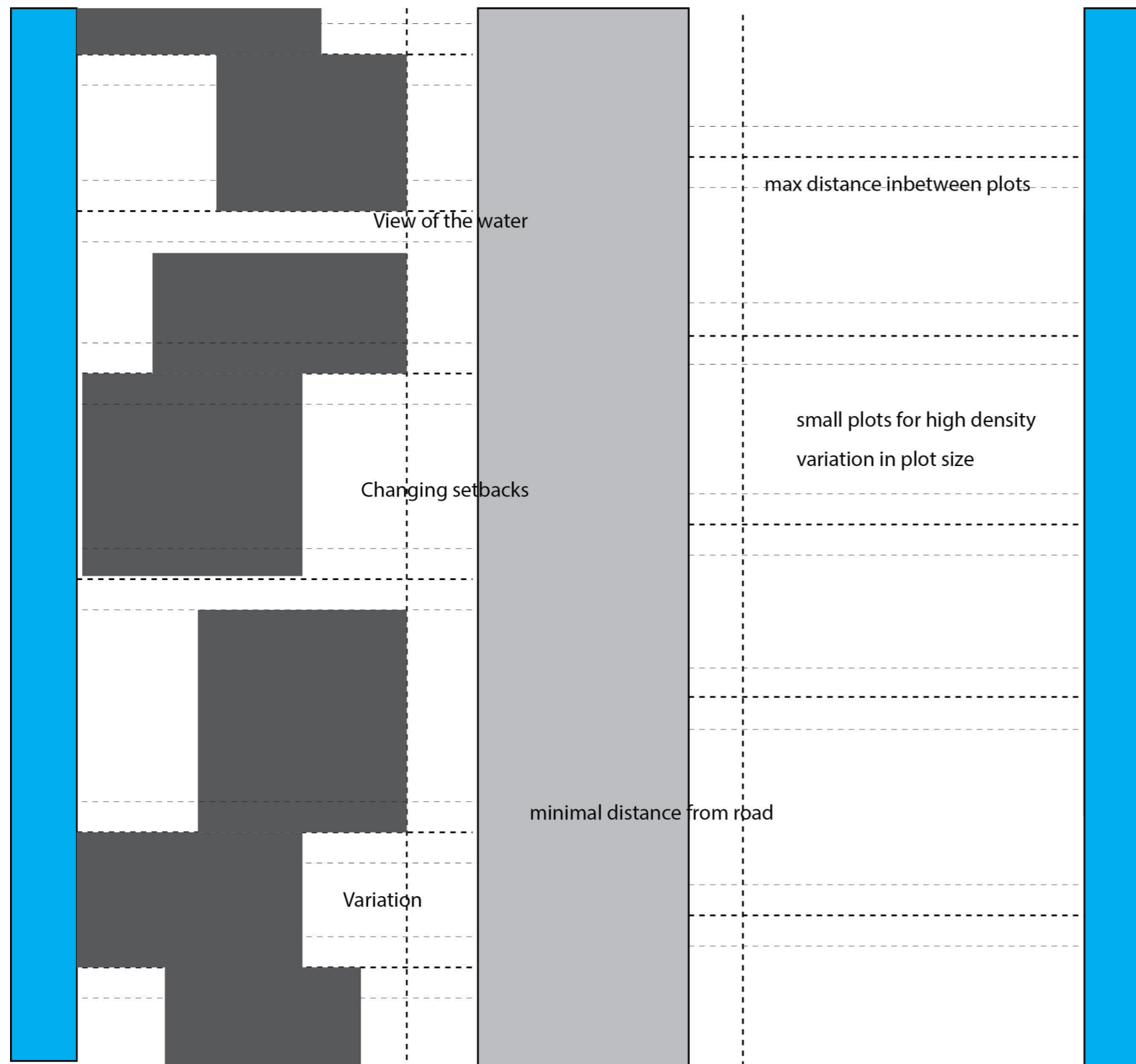


8. Roads and buildings wetlands.



DETAILED DESIGN

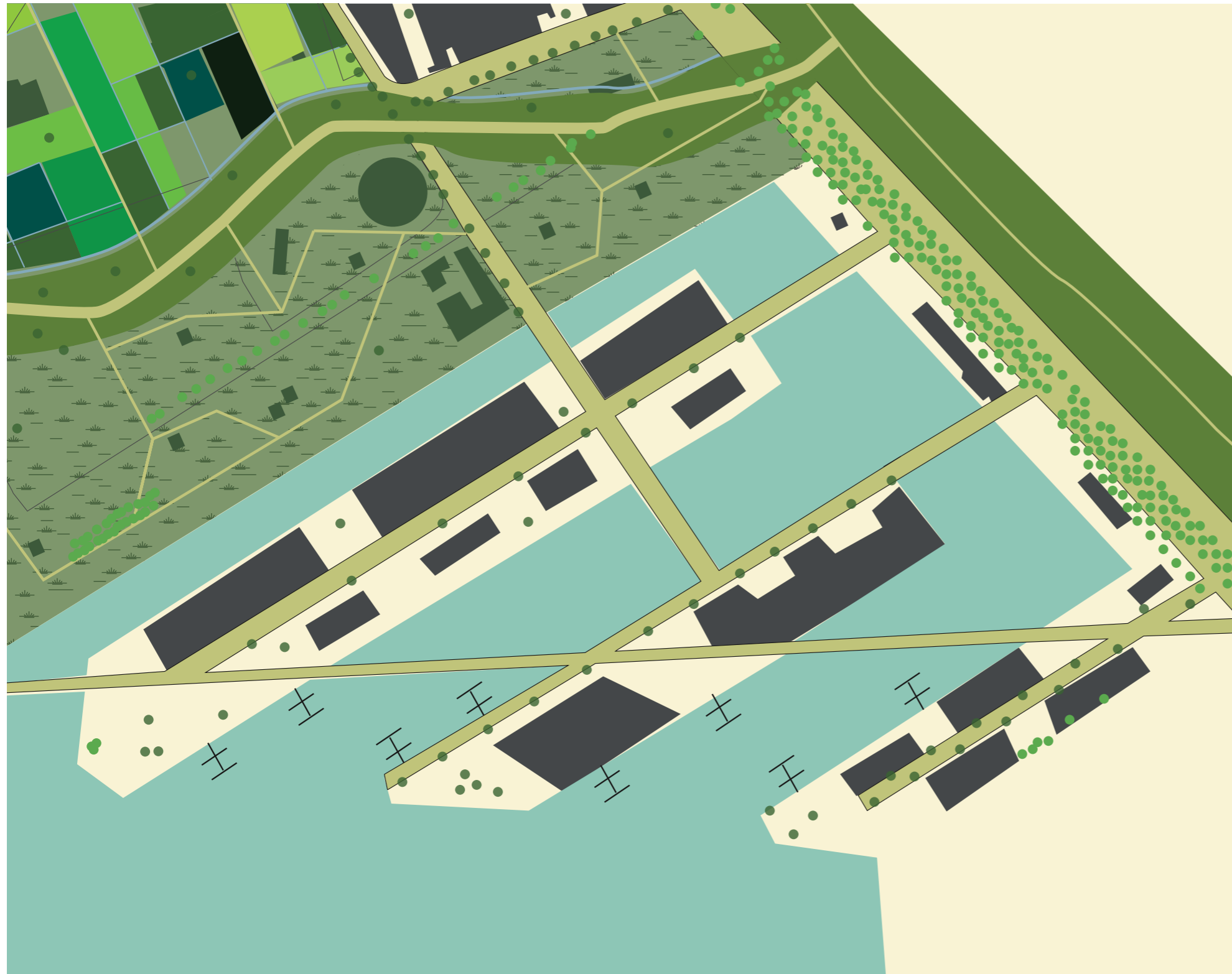




## COMMUNITY OPEN SPACES

LANDSCAPES FOR RECREATION, SOCIAL LIFE, AND SMALL-SCALE FOOD CULTIVATION

- PLAYGROUNDS
- NEIGHBORHOOD PARKS
- SPORTS FIELDS
- REGIONAL PARKS
- PLAZAS
- RECREATION CENTERS
- TRAILS / GREENWAYS
- URBAN GARDENS
- FARMERS MARKETS
- CEMETERIES (EXISTING)



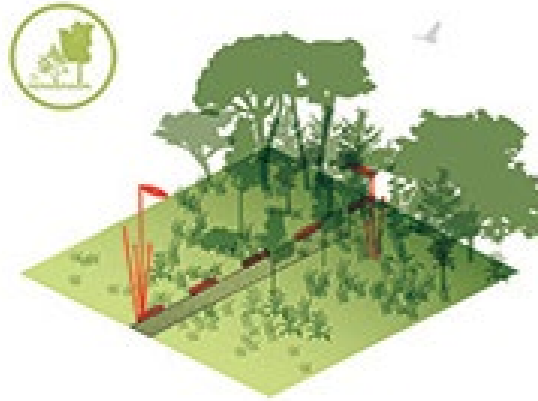


Source: <http://deceugel.tumblr.com/>



Source: <http://inhabitat.com/>

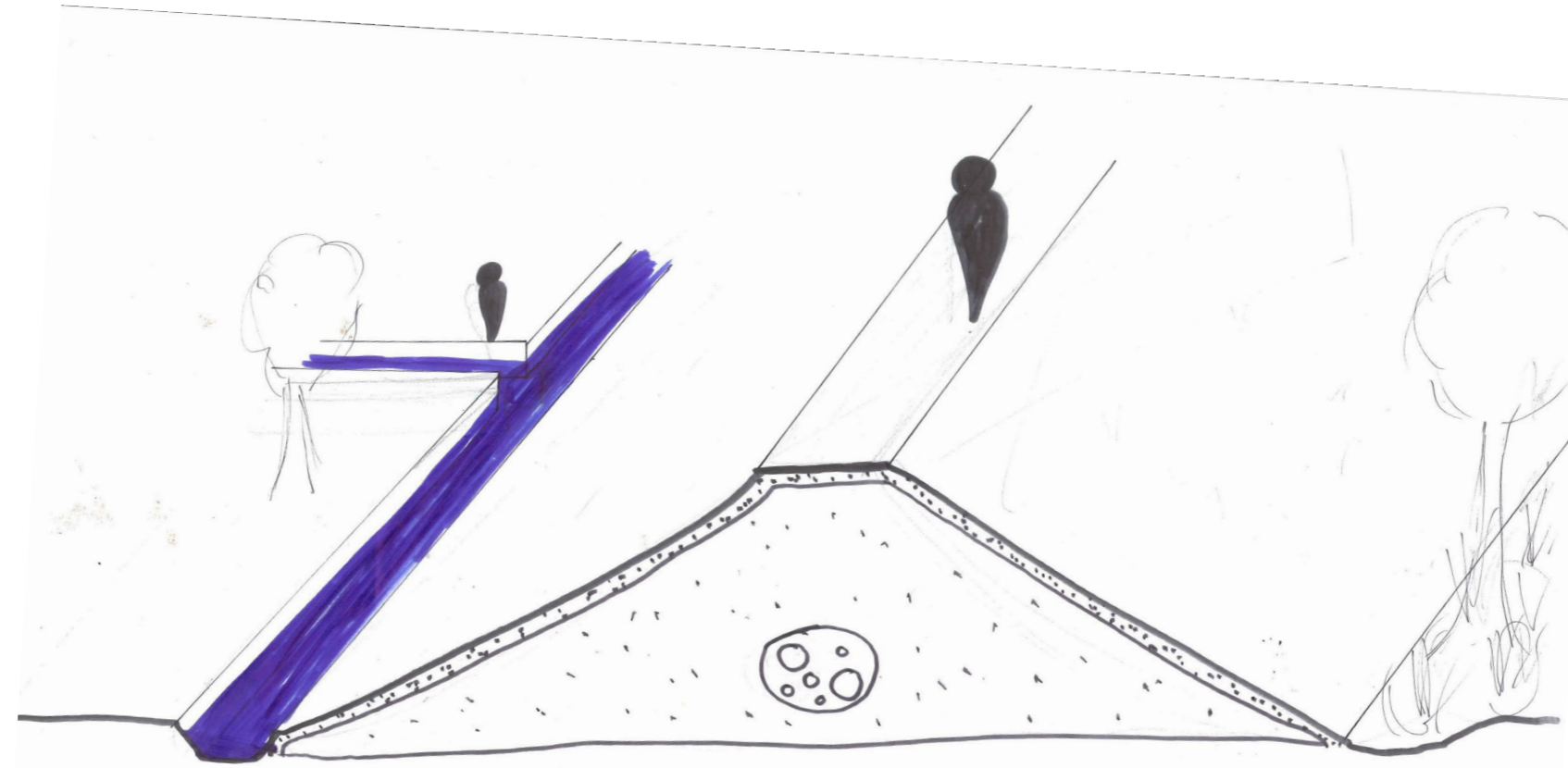
## Dike



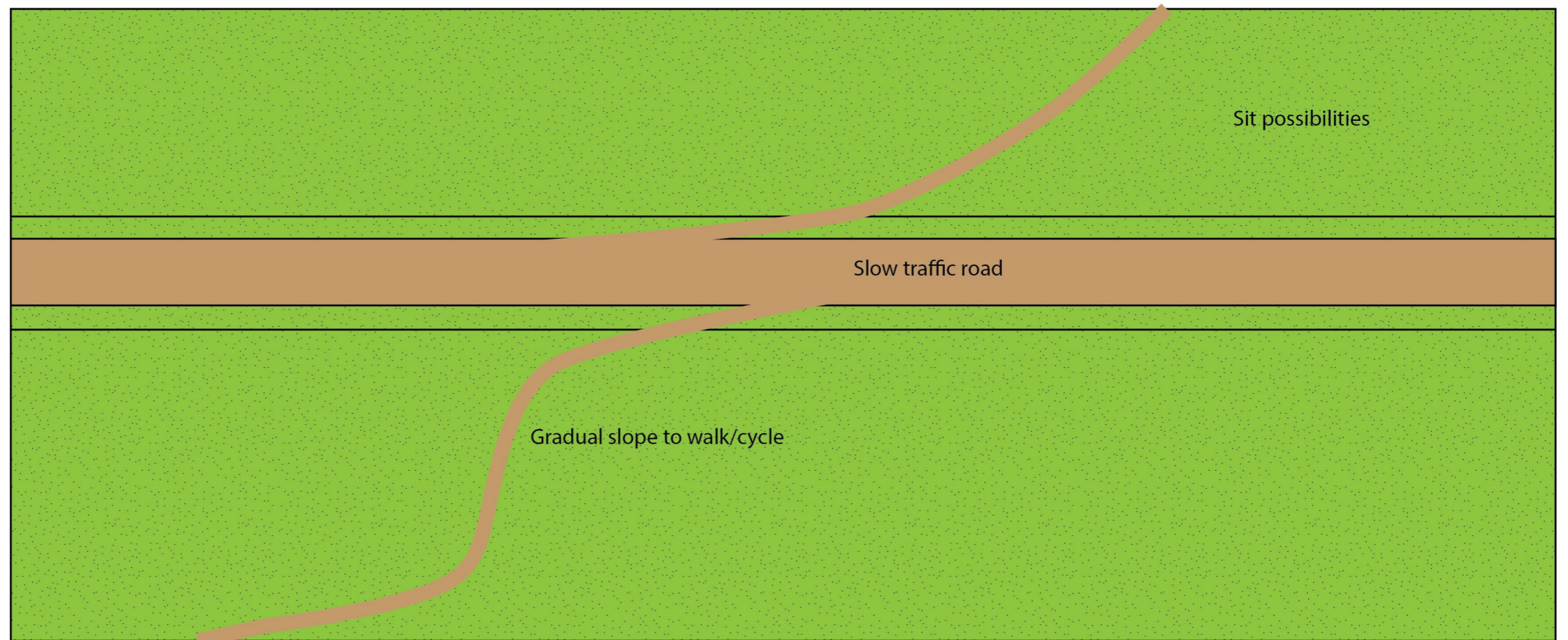
### ECOLOGICAL LANDSCAPES

MEADOWS AND FORESTS THAT PROVIDE HABITAT AND OTHER ENVIRONMENTAL BENEFITS

- NATURE PARKS
- INDUSTRIAL NATURE PARKS
- RAPID REFORESTATION
- SUCCESSIONAL ROAD
- ROADS TO RIVERS

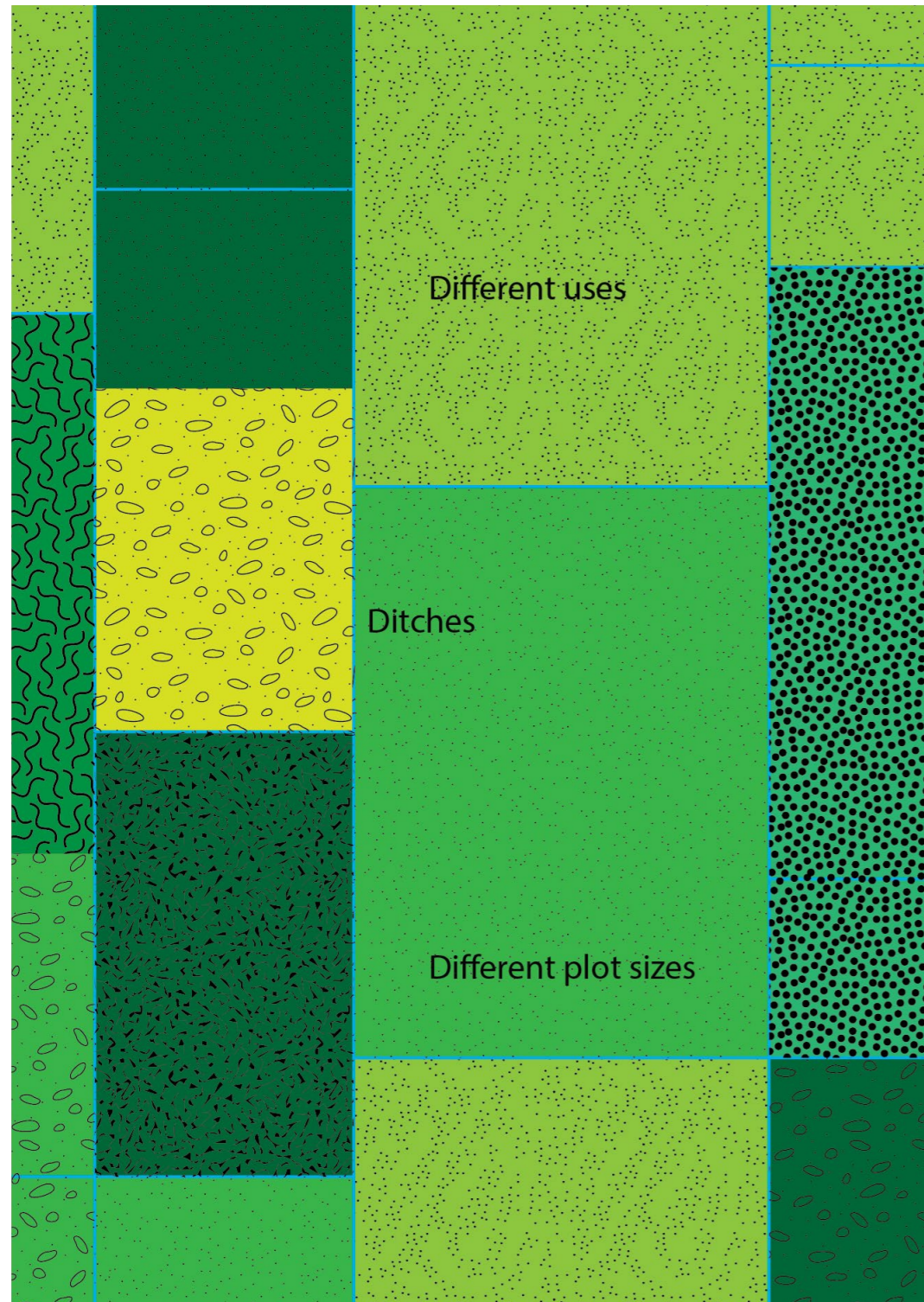


The large dike (4 meters high) is the main connector of the Merwevierhaven area with its surroundings. It is connected to the Dakpark and walk through the area with a good view over the wetlands and agricultural lands. The dike will bring the visitors to the head of the area where the area is connected with the rest of Rotterdam via a water taxi.

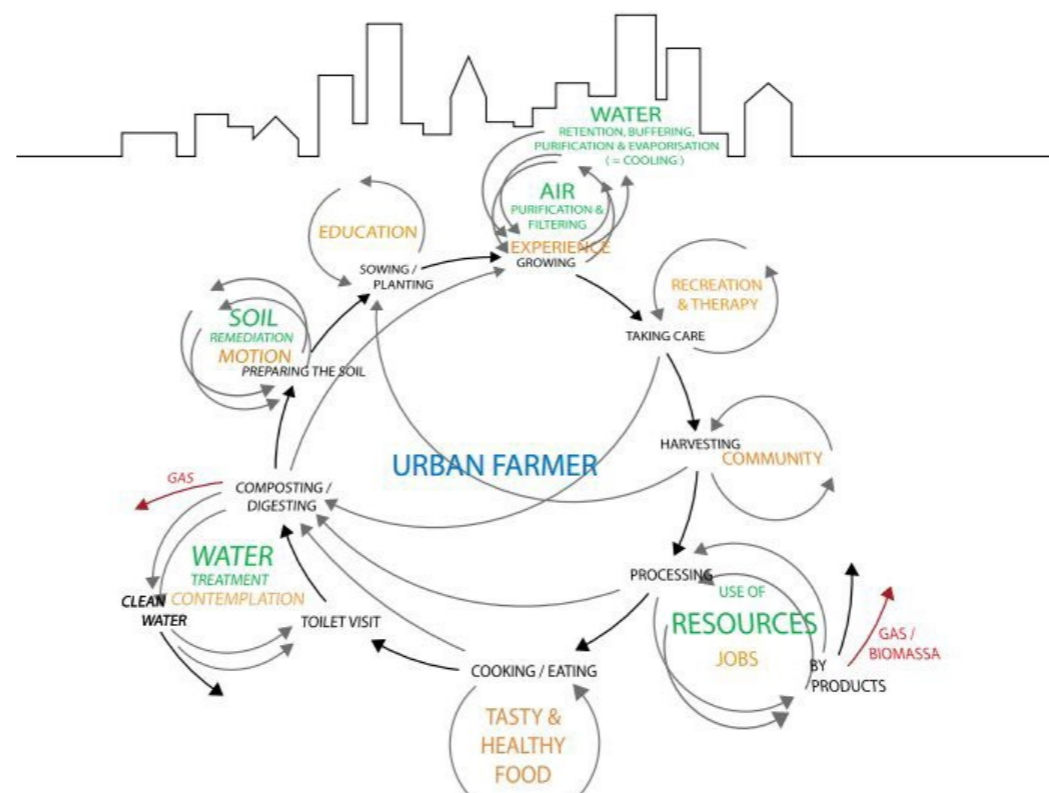
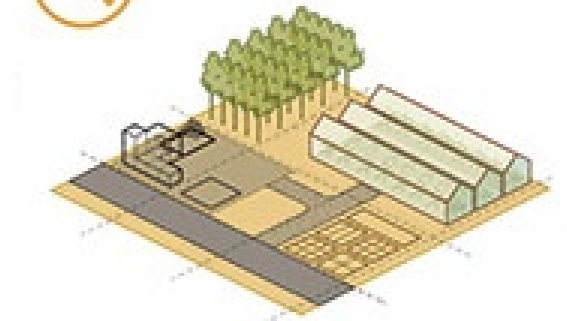




## Urban Agriculture



Both sides of the dike will work together. For example, the sludge of the wetlands can be used for farming. The local treatment makes people more aware. it renders palpable to them that their effluents do matter (cradle to cradle). This area will be very important for the whole city. Locals can contribute in producing a big variation of products.



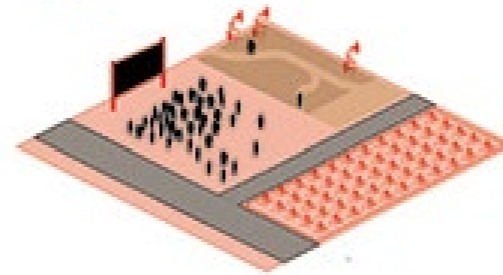
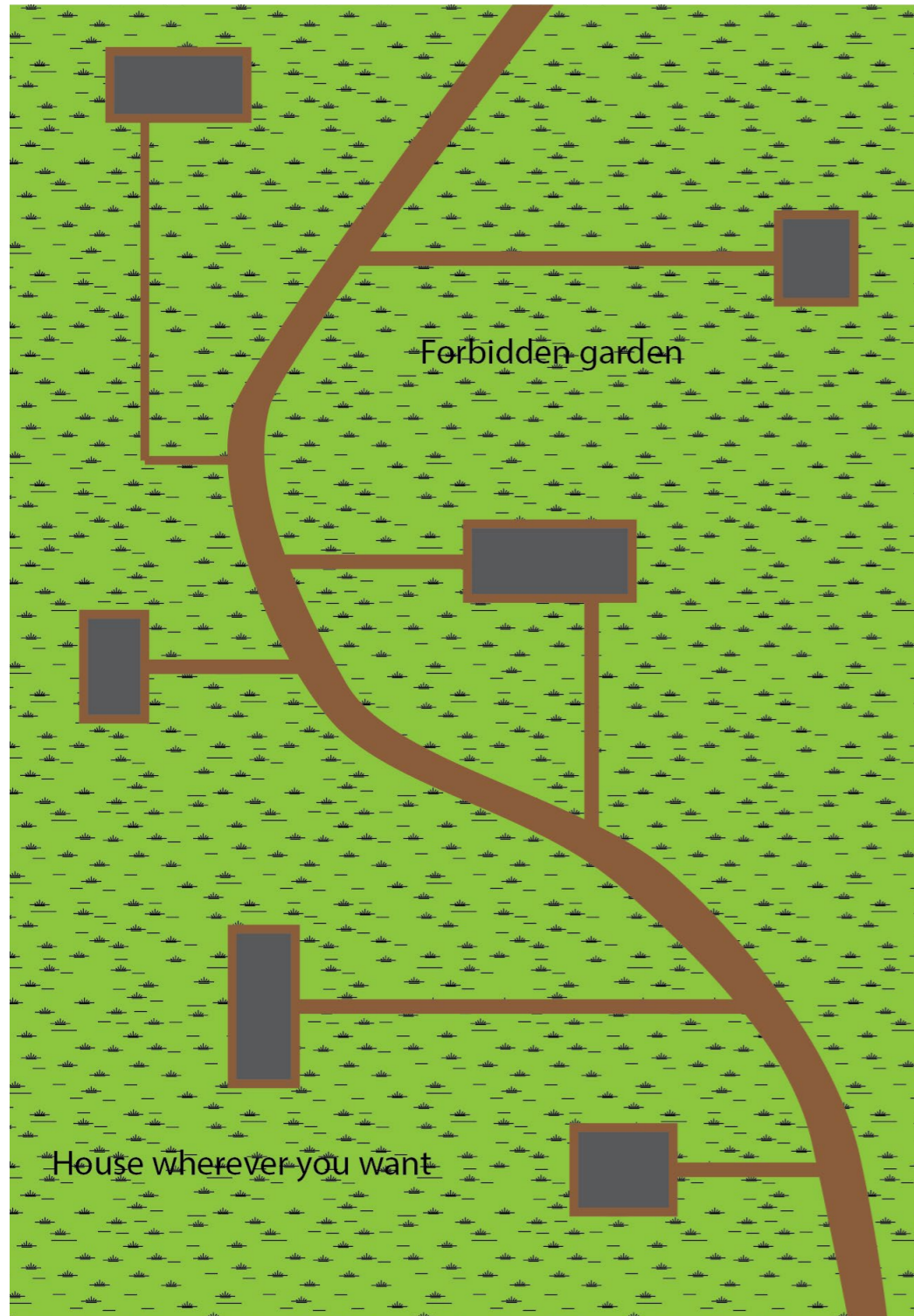
Source: De Graaf, P., RUIJME voor STADSLANDBOUW in ROTTERDAM, 2011.

### WORKING+ PRODUCTIVE LANDSCAPES

LANDSCAPES THAT GENERATE NEW KNOWLEDGE, GROW ENERGY AND FOOD, AND CREATE NEW URBAN EXPERIENCES

- RESEARCH LANDSCAPE
- URBAN FARM
- AQUACULTURE AND HYDROPONICS
- ALGAE-CULTURE
- ENERGY FIELD OR FOREST
- HOMESTEADS
- CAMPGROUNDS

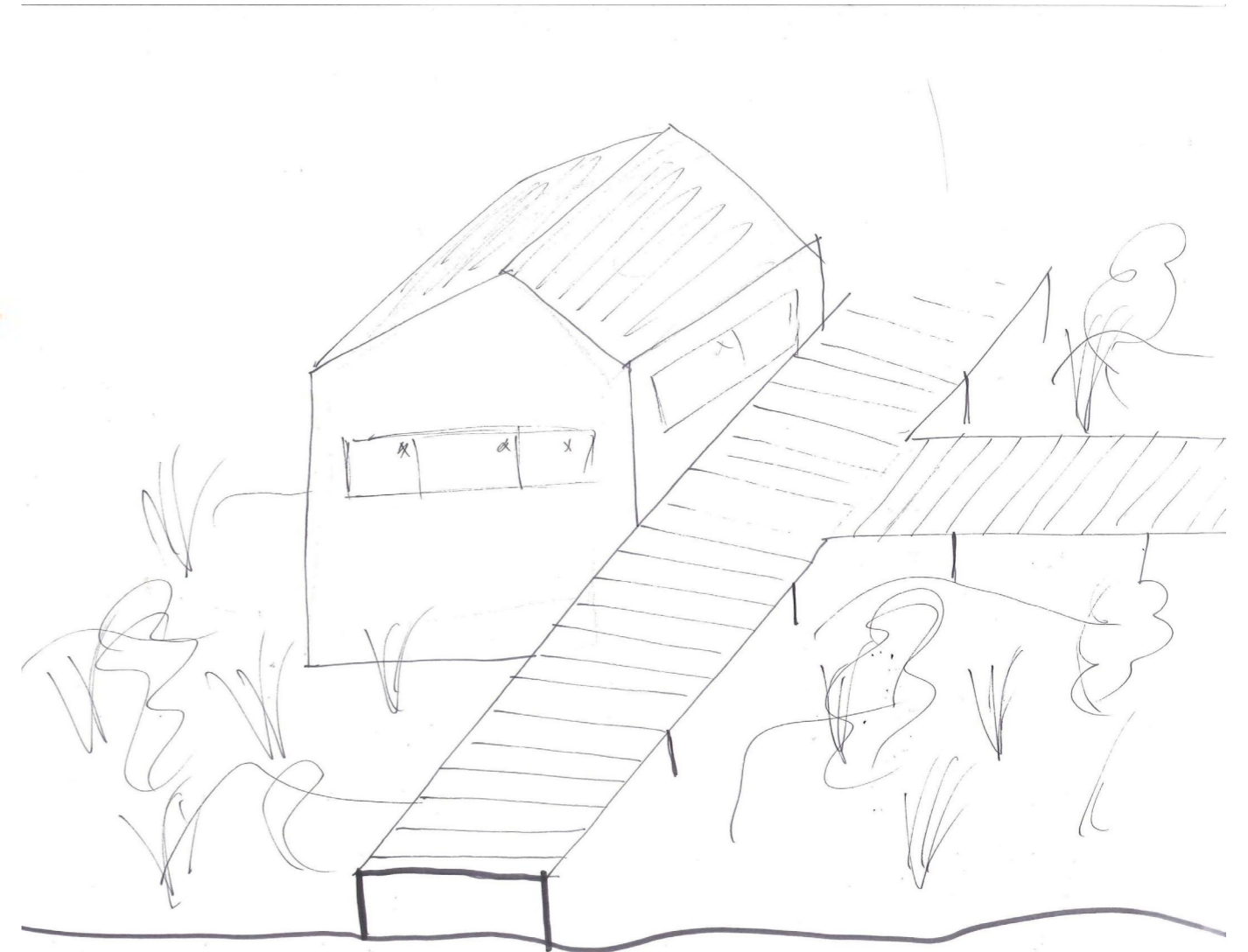
## Artificial Wetlands



### TRANSITIONAL LANDSCAPES

TEMPORARY LANDSCAPES THAT CLEAN SOIL AND ENABLE NEW FORMS OF SOCIAL LIFE AND CREATIVE DISPLAYS

EVENT LANDSCAPES  
REMEDATION FIELDS OR FORESTS  
ART-SCAPES  
URBAN MEADOWS



The main aim of this wetland will be making remediation visible and in this way be a temporary and changing landscape. Wetland areas provide vital centers for breeding, nutrient cycling, and water absorption and purification (cradle to cradle). Thereby bogs are better at soaking carbon dioxide than fully grown forests (rijnenburg Utrecht). Storm water and waste water are channeled through a series of connected wetlands that clean them, in process lightning the load on the river (cradle to cradle). In the 'forbidden garden' small routes will be made to small, sustainable and temporary houses providing spaces for business, information centres and community projects.

