A spatial study on the values of obsolete mobility infrastructure

INFRASTRUCTURE IN TRANSFORMATION

Carl Jarneving
Chalmers University of Technology
Architecture and Urban design
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READING INSTRUCTIONS

This thesis is a speculative study on the values of obsolete mobility infrastructure in a future public space based city. It investigates our current stock of infrastructure and performs different transformations on these systems based on a parametric model. These transformations are thereafter applied on a local representative context in Gothenburg. The booklet starts with a background and brief mapping of Gothenburg. The transformation method is then introduced, followed by research about infrastructure in transformation, mobility and future cities. The gained knowledge is applied as a series of design iterations, and ultimately a suggestive design scenario. Each chapter is introduced by a narrative text on its content, supported by the keywords bellow.

infrastructure
mobility
typology
hybrid
speculative
public space
catalyzer
obsolete
urbanization
transformation

INFRASTRUCTURE IN TRANSFORMATION

A SPATIAL STUDY ON THE VALUES OF OBSOLETE MOBILITY INFRASTRUCTURE

Chalmers University of Technology
MPARC: Architecture and Urban design
Year of graduation: 2020

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TU Delft	2018 - 2019	Rstudio	2016 - 2017

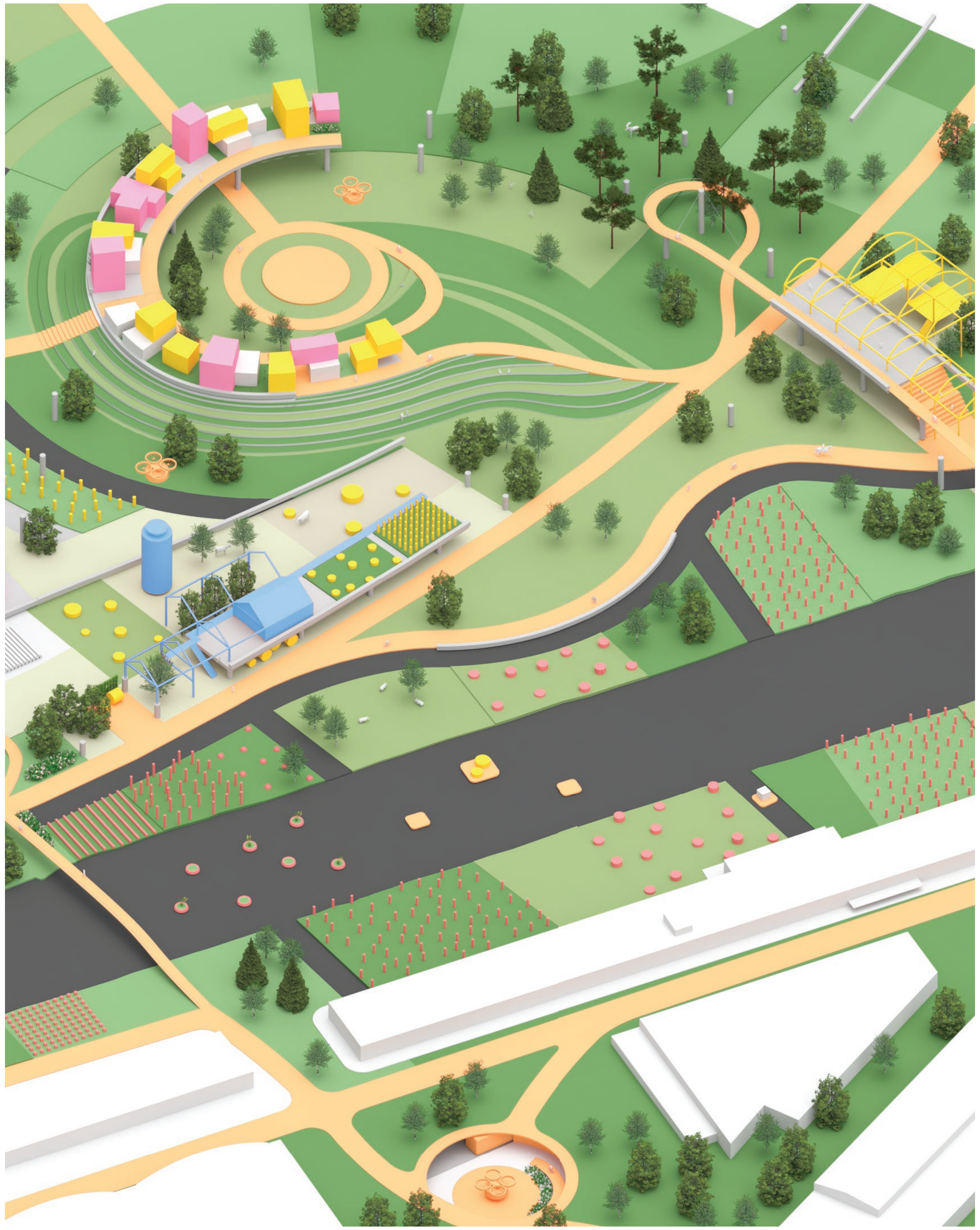
ABSTRACT

Our cities are complex systems in perpetual motion. They are the very reflection of our current and past societies. They are the physical manifestation of layers of time. Where past civilizations stood with their temples and other religious structures as embodiments of their time, we stand with our skyscrapers, airports, highways and other infrastructural elements as monuments of our age.

In an ever globalizing and transitioning world, systems and its supportive structures change over time. On a path to a sustainable future, the mobility sector and notion of private ownership is likely to go through considerable transformations.

Modern cities are centralized around the car, with streets, avenues and highways pulsing through the city's most central locations. They represent a network of barriers and potentials. In a shift to a public space city, these structures would undergo transformation. Some would be considered obsolete remnants of history whereas some would be readapted for a new purpose. This thesis aims to, in a speculative manner, investigate and visualize the potential of such transformation. The research is conducted through a series of spatial experiments with both general and site specific approaches. It investigates what inherent value these structures might hold when gradually transformed and how they can be imagined as catalyzers for new hybrid typologies and urban synergies.

The methodology used is a parametric generalized model of an infrastructure system with Gothenburg as a test site. Given the standardized nature of these systems, they are categorized into typologies and with the help of a parametric model the thesis proposes a system applicable to multiple infrastructural scenarios. The outcome is a suggestive design scenario visualizing, for a selected and representative site, how an area could use a specific selection of obsolete infrastructure elements to create a new hybrid typology: a responsive compilation of functions adding value, restoring local ecology and visualizing how deconstruction and upcycling can be used as a initiator of change.



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BACKGROUND

Our cities are complex systems in perpetual motion. They are the very reflection of our current and past societies. They are the physical manifestation of layers of time. Where past civilizations stood with their temples and other religious structures as embodifications of their time, we stand with our skyscrapers, airports, highways and other infrastructural elements as monuments of our age.

A world in transition

This is a thesis speculating on future scenarios and how our current stock of infrastructure could transition within the city of tomorrow. Our cities are complex systems in constant change, they are tangible and intangible, they span across disciplines and borders, and as we get more and more connected, complexity is ever increasing. Architects, designers and urbanists together with other disciplines in an perpetually increasing cross disciplinary field are tasked with mastering this equation.

The art of designing cities drastically changed in the middle of the 20 th century. The notion of “Over-determination” is introduced by sociologist professor Richard Sennett in his writings about the Open City. It discusses the paradoxical state of which today’s urban planners are equipped with a highly technological and profound urban tool-set, yet master plans and urban visions of the past century would more often than not result in over-zoned and frozen cities, were both social and physical functions lack the spontaneous dynamic of our past societies and urban fabrics (Sennett, 2019). This proves especially evident when it comes to infrastructure. Since the 1950’s the car has been the prevailing factor in urban planning. Cities have sprawled immensely, resulting in spatial and social reconfigurations of what previously was conceived as a city. It allowed a network of logistical possibilities, but also a network of barriers and borders. The possible implications of such planning was touched upon already in the 60’s by Jane Jacobs, “Erosion of cities or attrition of automobiles” (Jacobs, 1961, p.354). Automobile infrastructure and its supportive functions: gas stations, parking lots and garages and drive ins are described as elements of city destruction. It should be considered these writings are mainly seen from an American point of view, from cities that possibly holds the most predominate examples of car based planning. These planning patterns are however evident in most post war modern urban areas with over-zoning and heavy regulations, differentiation of functions, and ultimately people. These developments considered necessary to support our modern society and economical prosperity. One might be allowed to speculate on other ways though, ways in which alternative economical models can co-exist with a thriving and resilient public space based city.

The cities we’re left with are representations of our time, and likewise they evolve with it. Infrastructure based on a 20th century notion of transport and ownership will likely transform in line with the sustainable city. Architects and urbanists have always been speculating on and imagining future cities. Whether it might be to envision new utopias or contemplating on our current state, it potentially acts as a tool for better understanding our current cities and the mechanisms driving and controlling it. One of our greatest challenges of today is climate change. Our society needs to profoundly change in many areas, mobility and the infrastructure to support it is one of the most urgent topics. This thesis argues our current infrastructure stock as a transformable urban resource, a capacity and potential to support sustainable and resilient urban developments.

Figure 1. Highway intersection (Lockwoord, n.d.) CC0.

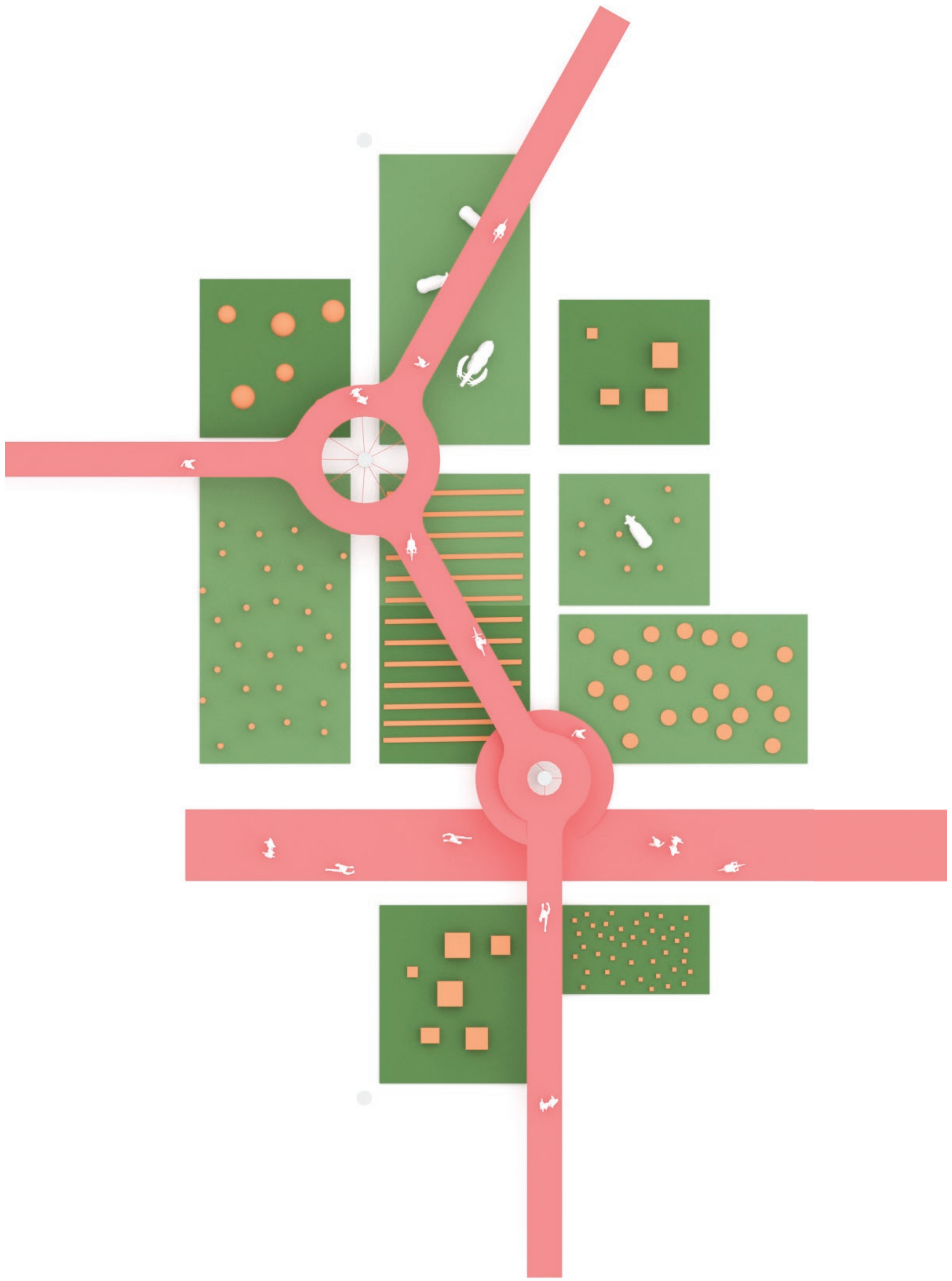
About
During my time at MVRDV and TU Delft I've been working on big urban projects and typologies all addressing urgent topics , namely sustainability and urbanization. I've been working in numerous scales and with different parametric systems, exploring designs to various visionary degree. I've developed a deep interest to explore projects that stretches across scales and disciplines, projects that are open-ended and responsive to dynamic contexts. To bring this knowledge and approach to a, by me familiar context, is a great opportunity to explore these topics with an added layer of depth and sensibility.

Purpose
The reason for pursuing this thesis is to elaborate on and explore my interest in future urban developments. The inherent complexity of urban growth, especially in times of rapid societal change is a rich ground for investigation and research, and likewise a great forum for imagination. The purpose of this thesis is to produce a visionary and speculative set of design iterations based on urban future predictions. It dives into a imaginary domain of design, not necessarily constrained by regulations nor deep present specific physical context.

Subject
The field of research is urbanism/architecture with special attention to infrastructure in transformation. As any urbanistic challenge it does however require a diverse and transdisciplinary approach, which is why this thesis addresses several fields of research. The following topics are specifically addressed and used as a research base for the various design iterations

- Infrastructure/Mobility
- Transformation/Recycling
- Predicted urban development

Relevance
In a typical Swedish city as much as 1/3 of the area is devoted to infrastructure systems (Naturvardsverket, 2019). Furthermore, the transport sector constitutes about 30% of Sweden's total greenhouse gas emissions (Trafikverket, 2019). Our infrastructure network is a system of mobility potential, but likewise a system of restrictive barriers and borders. How our infrastructure system will evolve in the city of tomorrow is both a spatial and sustainability challenge. This thesis aims to investigate and explore what values and capacities these systems holds when transformed, and how they might be used as catalyzers for change.



THESIS

this thesis is a speculative study on a series of what ifs. It envisions a scenario were future cities are green, built upon sustainable mobility solutions and centralized around public space, as opposed to our decentralized, linear, over-zoned car based cities.....

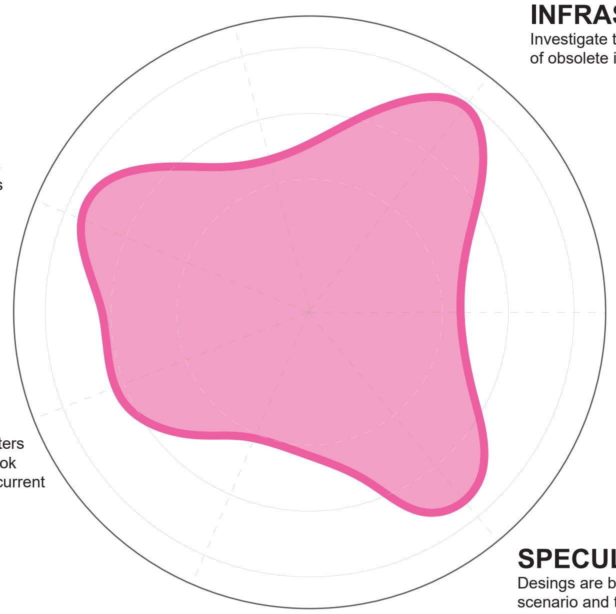
Thesis question

In the transition to a sustainable future, infrastructure based on a 20th century notion of transport will likely come to a different use. Bridges, highways and major boulevards are all subject to reprogramming. The scope of focus is to investigate what potential value our current stock of infrastructure holds and through a series of spatial experiments what kind of new hybrid typologies that could derive from these obsolete mobility artifacts and how they can be used to restore areas where infrastructure was once imposed.

Infrastructure in transformation
A spatial study on the values of obsolete mobility infrastructure

Focus / Delimitations

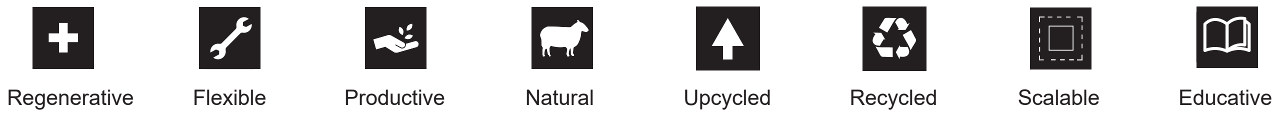
This thesis aims to, on a systematic level, investigate the capacities of our current stock of infrastructure. This thesis makes the assumption that in a future public space based city, the notion of private ownership linked to mobility will change, and as a result entire or parts of our current infrastructure system can transform and be allocated to alternative use. It's suggestive and speculative and makes no claim in grasping the complexity of future urban growth. Neither has it any intention to deeply research any physical context. It aims to, based on typical and generalized infrastructure typologies, make sample design iterations within a limited and representative area of Gothenburg. The designs will react to local conditions of the area, paying attention to future possible developments and environmental parameters related to infrastructure. The aim with the systematic approach is to suggest a catalog of solutions that could be widely imagined throughout the city and beyond, as the vast majority of our infrastructure is indistinguishable from one another.



From obsolete infrastructure to urban resource

Program

Rather than specific and rigid programmatic functions, the designs are classified and characterized by their features. The features are specifically chosen to promote a resilient development for the new typology.



Context

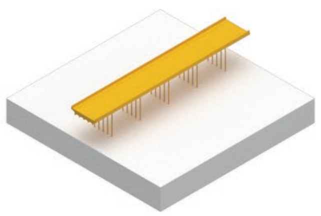
Our infrastructure network is a large top down system. It's coherent and standardized to foster efficient flows and rapid expansion within and outside our cities. It has by default similar materials and dimensions. When we imagine an infrastructure system in transformation, we can consider the city as a whole and we may therefore envision the designs to be applicable in several scenarios as generalized typologies.

Sample site

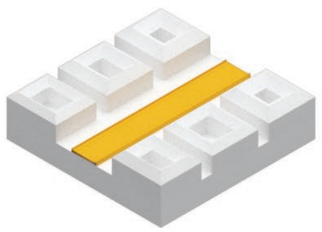
To concretize and anchor the designs in a relatable context, this thesis is operating on a sample site. The sample site contains the typical and representative elements of how infrastructure is planned and conducted in Gothenburg.

Example typologies

To narrow down and simplify the research, this thesis looks mainly at three generalized typologies/scenarios of infrastructure. These are frequently apparent situations in our infrastructure network. They represent different spatial situations in how they interact with their specific context.



Bridge/Elevated highway



Intersecting highway

Highway ramp

Characteristic infrastructure

Characteristic infrastructure


Tingstadstunneln

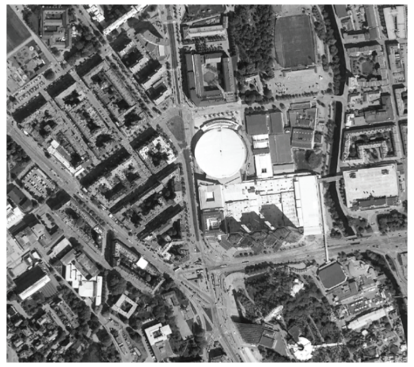
Sample site


Partihallsförbindelsen

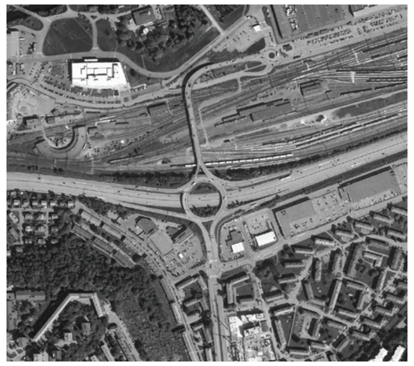

Gamlestaden


Brunnsbo


Älvsborgsbron


Södra Vägen


Nya Allen


Sävenäs


Masthuggskajen


Hissingsleden


Götaälvbron


Riksväg 40


Kviberg


Backa


Bräcke


Älvsborgsbron


Sandarna


Västra Frölunda


Delsjömotet


Annedalsmotet


Lärjemotet


Tuvevägen


Frihamnsmotet


Flatåtsmotet

Sample site

The mixed use area of Gamlestaden has a wide variety of programmatic zonings. These are supported by structurally dominant and imposed infrastructure. The infrastructure and its surrounding areas creates a series of spatial potentials and barriers. These spaces are for instance: Voids, elevated surfaces, covered spaces and undulating landscapes.

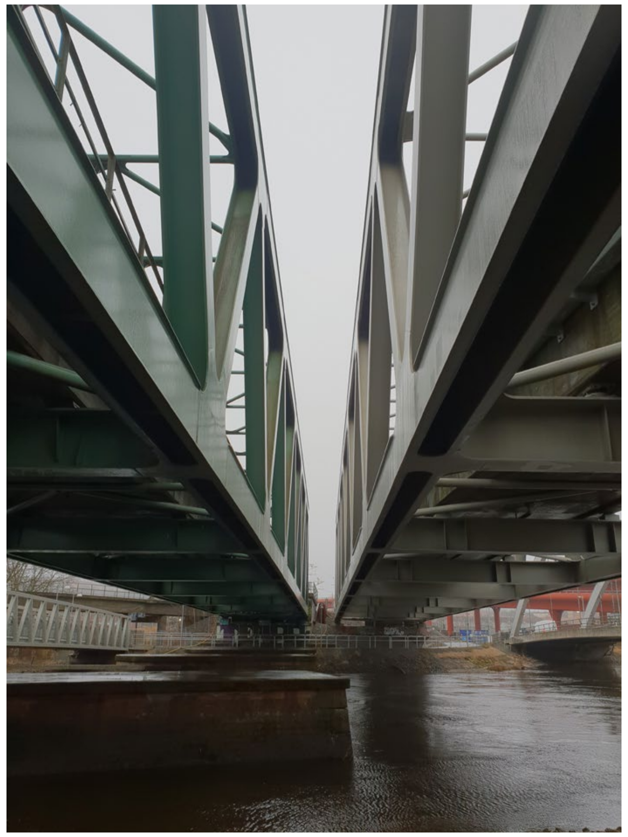


Figure 2, 3 and 4. Gamlestaden infrastructure (own photos).

METHOD

to imagine how our over-zoned and fragmented cities could be transformed to public space based cities I created a script that would gradually reduce and dissolve the previously observed infrastructure typologies...

Approach

The methodology conducted in this thesis bear strong resemblance to what is applied in the The Why Factory at TU Delft, in which I have studied. The Why Factory is an urban think tank initiated by MVRDV and it's main objective is to produce and elaborate on future visions for our cities. It's a data and theory based research by design process, with the ultimate goal of creating open-ended and speculative reflective design iterations.

This thesis applies similar methodologies and knowledge in a local context of Gothenburg. Given the speculative nature of the assumed transformation of infrastructure, the research is by intention kept open and parametric to not go deep into unpredictable territories.

Step 1 - Design input

The input is a set of known or intentionally generated values. This research operates on specifically chosen fragments of infrastructure that we here will refer to as paths. The input of the parametric model, besides the guiding path, is a set of values/dimensions to best represent a real piece of infrastructure. Relevant conditions of the local site are also taken into consideration.

Step 2 - Design transformations/values/capacities

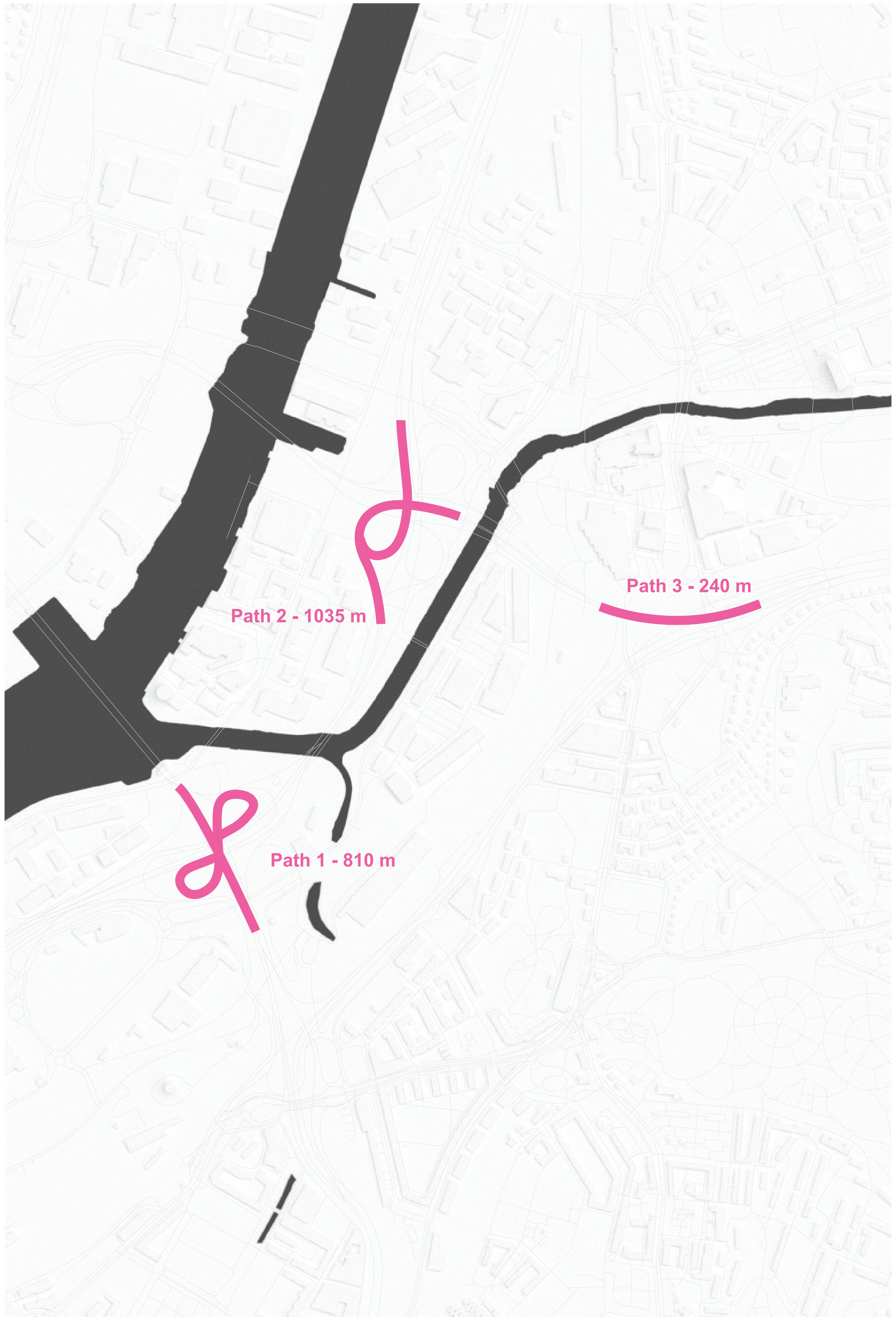
The observed infrastructure systems are here transformed with a reductive script. The reduction process is observed to investigate what values and capacities the infrastructure elements holds when transformed. The transformed systems are thereafter classified as design transformations to be further used as a toolset of design.

Step 3 - Design iteration

The design transformations are at this stage applied on a local site responding to local conditions. They propose how certain elements of the transformed infrastructure systems can be used to interact with a local context. They are still kept open ended and suggestive to a certain degree.

Step 4 - Design observation

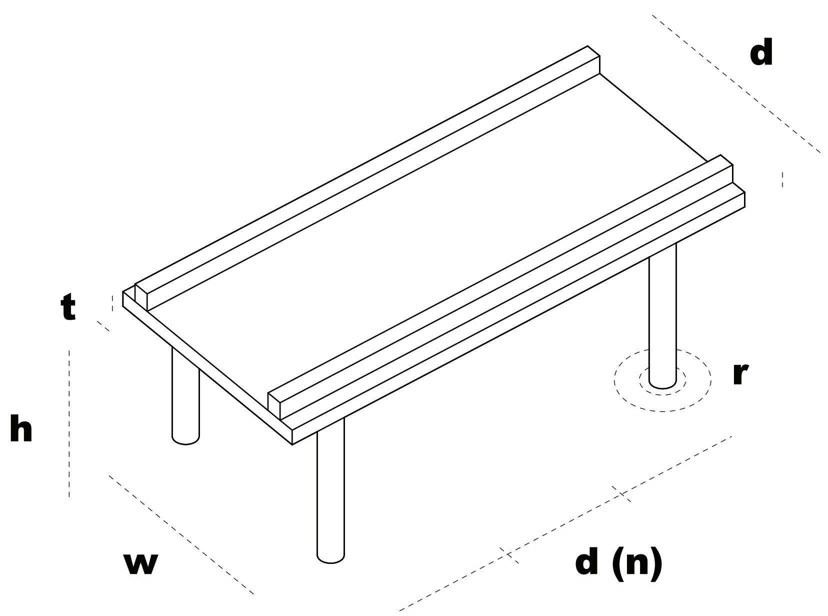
The design proposals evaluated and discussed according to their ability to utilize the obsolete infrastructure to transform and add new value to the area, and be part of a resilient transformation strategy.



Possible example paths

Input

To facilitate a parametric process, the design iterations uses a generalized model of a road. This is done to create quantifiable and transformable design iterations with a higher output and on a more systematic scale, as opposed to carefully mapped and bespoke representations of specific roads. The parametric generalized model consists of different elements, with different dynamic properties to best represent different scenarios and contexts.



Dynamic parameters of the generalized test model

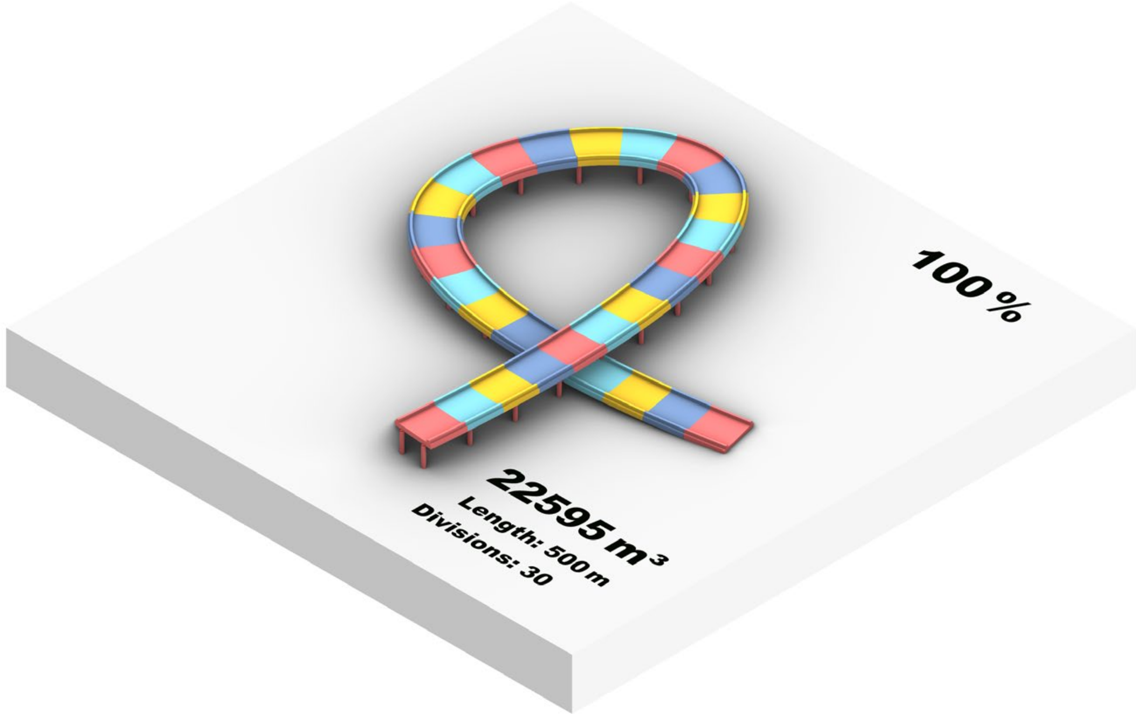
Parametric variations

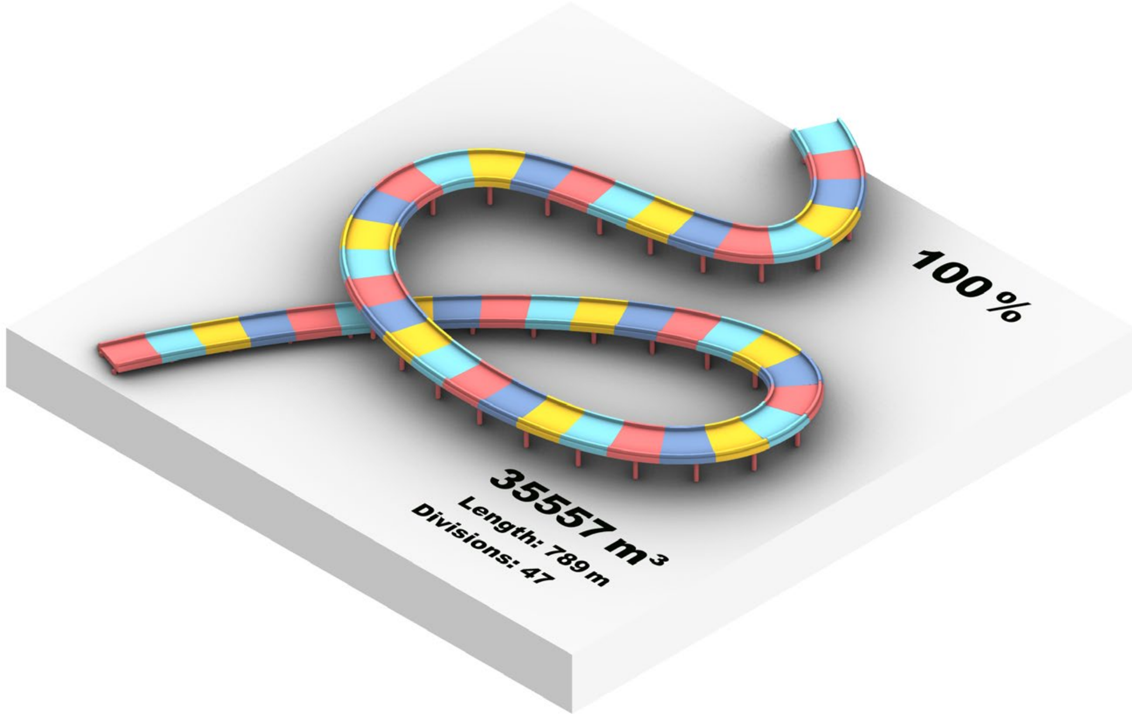
The script allows the model to represent different roads in terms of material type and thickness, width, height, radius, column spacing and frequency.

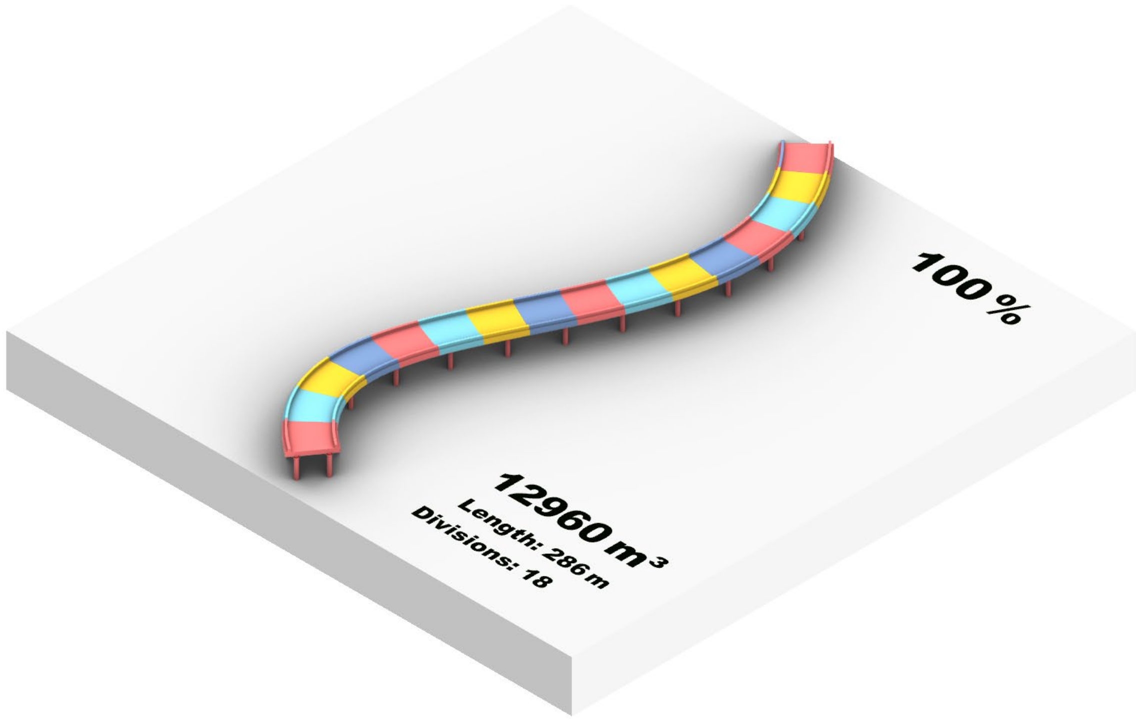
Parametric variations

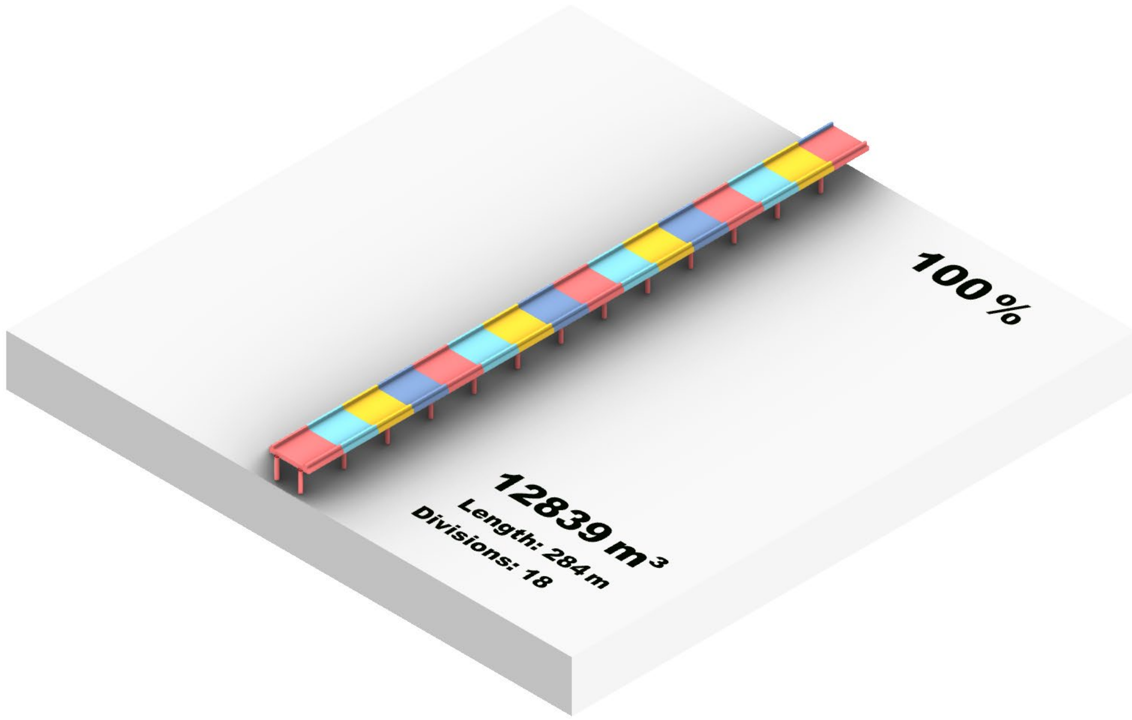
Flexible input path

The script can generate a test model of various input paths to resemble different contexts.









Script / Reduction

The script aims to, in a reductive way, transform any chosen piece/system of infrastructure. By reducing a system of infrastructure, new spatial relations emerges, both internally and in connection to other elements. As a starting point, this script is a detached system without external parameters, it therefore works with a random reduction pattern.

Seed

The main benefit of using a parametric model is the ability to easily construct various models and conduct multiple iterations. This would, if done manually, be a time consuming and repetitive task, and by leaving this task to an algorithmic agent, we can possibly discover unexpected results and patterns.

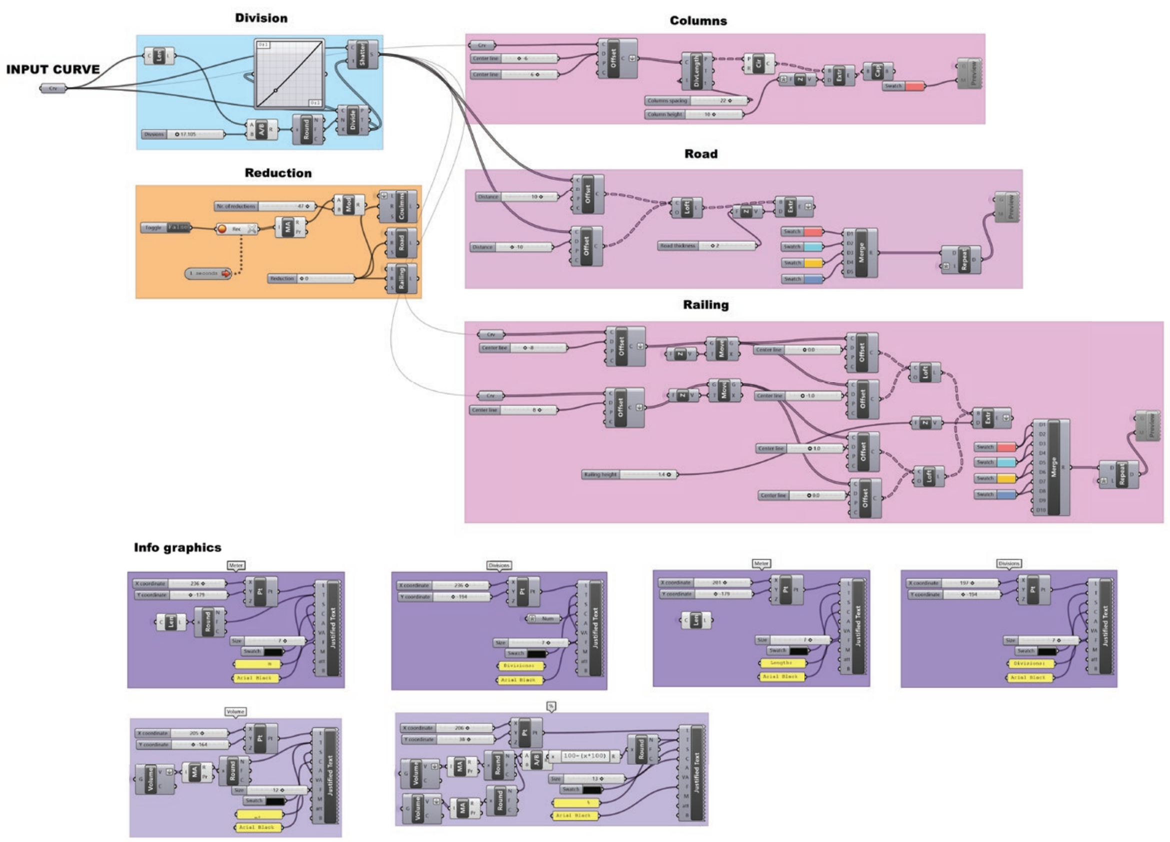
“The seed is a starting point for a sequence of pseudorandom numbers. If you start from the same seed, you get the very same sequence. This can be quite useful for debugging.” (Yourbasics, n.d)

Simulation

In order to grasp and analyze the simulations, the results are recorded to facilitate observation and communication.

Data output

For comparability reasons every stage of the simulation is measured. These data helps to grasp the scale of each iteration, and gives quantifiable information in terms of material usage/recyclability.



Observations

The system is observed at certain moments of interest - reduction precentage.

33%
Reduced

Divisions : 30
Length : 500 m
Volume : 15 210 m³

DESIGN THEORY/THEORY

to give depth to the speculative iterations both current and probable urbanization and mobility patterns, theories were researched and analyzed to be used as design input...

What if...

To anchor my research and iterations within a theoretical albeit speculative framework, I've looked at research and theories from leading thinkers and scientists within the field of future urban developments. I've studied typical methods of speculation to make credible iterations and decisions.

Architecture has a long and rich history of radical and speculative design explorations. Dating back to the 60s and 70s prominent design studios such as Archizoom, Archigram and Superstudio gave us a range of provocative and thoughtful projects on these matters. Speculative design offers as Anthony Dunne describes in his book on speculative design: A repository of dreams and desires. They can be the driver of change, and are ultimately a medium in which we can imagine alternative realities. Whether the design aspects and outcomes of such projects might prove provokingly interesting and appealing, the real gain is the ability to highlight weaknesses in what is consider normal at present (Dunne and Raby, 2014, pp 6-35).

Architecture and urban design practice MVRDV and their academic think tank The Why Factory, both in which I've worked and studied, are at the forefront of future urban development. In their designs and writings, which sometimes are close to indistinguishable to one another, they highlight and discuss future urban concepts. Many of my design ideas and concepts are offspring's and elaborations on these ideas. These concept are presented next:

Urban Capacities

Within a world of ever increasing density: space and resources are at the top of the agenda. How we imagine and drive the exploration for new spatial urban capacities is crucial for how our built environment is materialized. Exploration of such hypotheses can be labeled "What ifs", and would be a tool for understanding and revealing blind spots and possibilities within current mechanisms (KM3, 2005).

Porocity

Porocity is an urban concept that argues our cities being introvert and enclosed, not utilizing urban life and ecological possibility. It aims to blur strict urban boundaries by dissolving and reconfiguring our built environment, this could result in a more informal and dynamic city. A porous city also challenges the way we consider flows, were flows of today is tightly confined by the rigidity of infrastructure and buildings. A porous building typology could reconfigure and enhance these flows (Poroctiy, 2018).

Hybrid typologies

The Porocity concept challenges the way we see solidity and functionality. It considers our current typologies of shopping malls and office towers as containers of monofunctionality. To address this it suggest a built environment that is less dense, but more intense. It celebrates the mixed functionality as a synergy for social interaction and exchange of ideas (Porocity, 2018)

Infrastructure

Urbanist and Architect Pierre Berlanger, Hardvard GSD, is a researcher in the fields of landscape and infrastructure and known for his elaborate views on synergies between mentioned systems. In one of his recent writings "Landscape as infrastructure", a collection of manifestos reimagining the utilitarian linear way of seeing urbanization and infrastructure he presents different ways in which to rethink these topics. Ecology is to be seen as the new engineering. Infrastructure is often associated with age and decay, landscape is namely associated with cultivation. To landscape is to enhance and improve, to harness potential as opposed to imposing structures. He suggests a model were we go beyond the purely economic evaluation of production and land use. The typical zoning of land (industrial, commercial, residential and public) can be reorganized and profoundly designed to foster ecological systems with greater adaptability, interconnections, synergies, overlaps and productive zones. Pierre means rethinking these systems should be a careful interplay between mobility, food production, water management, waste flows and energy production (Bérlanger, 2017). Pierre introduces a series of concepts on these topics described bellow.

Ecological Engineering

Ecological engineering stands in contrast to static and monofunctional ways of engineering, and questioning civil engineering as the prevailing discipline of our era. These systems may be designed/reorganized as circular operations with autonomous and versatile capacities in mind (Bérlanger, 2017, pp 148).

Unplanning

Unplanning is to be seen as a response to infrastructural decay and Pierre means it's a way to highlight the weakness of federal zoning. The concept of unplanning means to rezone and redevelop through ecological layers, ultimately reclaiming and purifying contaminated land and preserving and promoting social and ecological resilience (Bérlanger, 2017, pp 148).

Waste ecologies

Understanding and mastering the complex urban process of recycling and remediation could result in productive synergies at both urban and local scale according to Pierre. It involves mapping and utilizing the flows (water coolants, energy, material input, emissions, effluents, waste fluids and gases) of multiple actors in parallel with local biological and geographical conditions. (Bérlanger, 2017, pp 212).

Landscape metabolism

Previously mentioned concepts might be summarized under the domain of Landscape metabolism. This neo-industrial approach to planning stresses the importance and potential of post-industrial/infrastructure sites and their possibility of serving as productive/regenerative multi-purposed landscapes. When done right, they can foster circular and resilient urban economies and developments (Bérlanger, 2017, pp 236-245).

Mobility

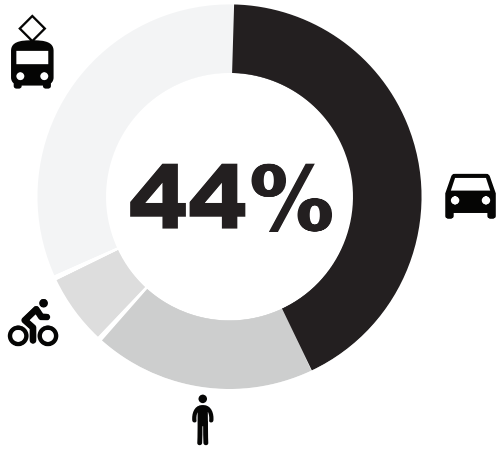
Transporting people, goods/waste and information (read: flows) is the engine of our modern society, and that will likely remain as instrumental for any future society. However, as our cities get denser and more complex, a transition to a more efficient and sustainable way of achieving this seems necessary. In a completely car dependent society, our post-war cities have been allowed an immense urban sprawl. This development causes, apart from socially secluded cities, a high degree of congestions, and ultimately pollutions. As much as 30% of the surface area in a typical Swedish city is reserved for infrastructure related to mobility (Naturvardsverket, 2019). This creates a network of restrictive borders and barriers.

Future mobility

Due to population growth and urbanization. traffic in our cities are expected to increase, as much as 33% to 2035 in Gothenburg (Göteborgs stad, 2016). Whereas it's hard to speculate on future mobility patterns, analysts and researchers all have their predictions on potential developments. In a report about future mobility scenarios by analyst company McKinsey it's suggested that the future of mobility is an interplay between factors such as autonomy, shared mobility, integration of energy systems and innovations in public transport. Different scenarios are imagined for cities of varying size and economy, but they all implicate an increase of autonomous vehicles, cleaner and more efficient public transport, regulations to private vehicles and new platforms of shared mobility and on demand solutions, also refereed to as seamless mobility (McKinsey, 2016). The introduction of these solutions and systems will prove to have profound spatial implications in our built environment. Possible outcomes and effects of an autonomous and seamless driving fleet:

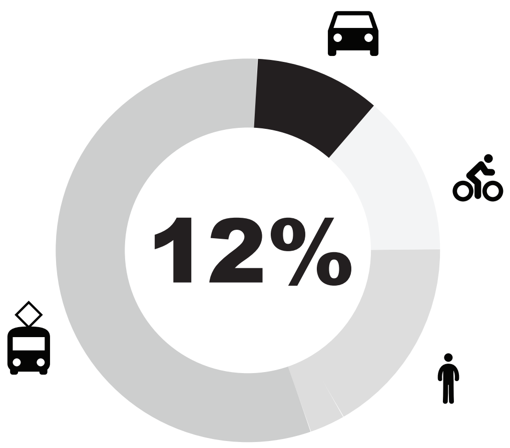
- The total number of vehicles on our roads would decrease and ultimately the total m² of parking space.
- Autonomous vehicles require less space. With decreased driving lanes a large amount of space could be reprogrammed for other purposes.
- Air quality would increase and cities would have low-emission zones.
- Acoustic pollution would decrease.
- A system driven by algorithms is less likely to face congestions and less prone to accidents.

2018

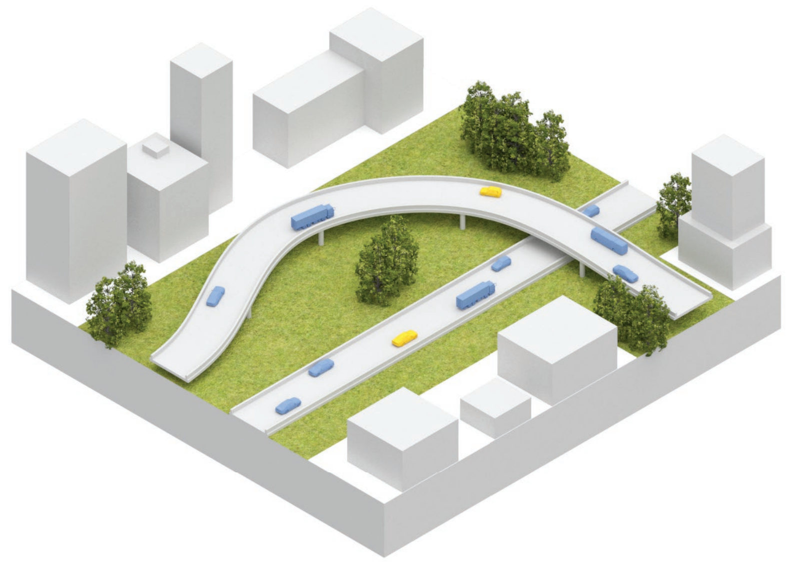


Division of means of transportation in Gothenburg 2018. Travels by car is the dominant part by 44%

2035

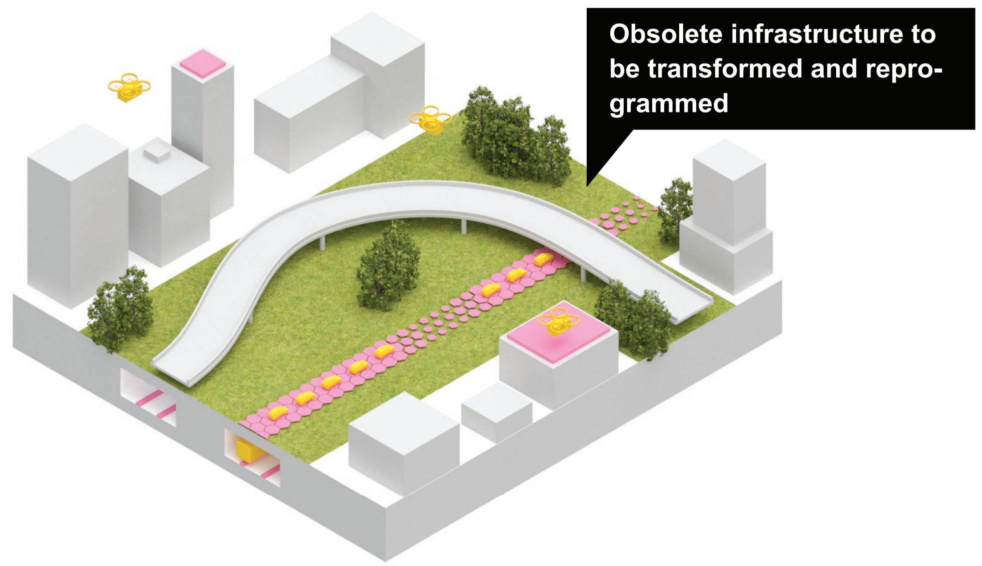


Expected division of means of transportation in Gothenburg 2035. Travels by car has decreased to 12% (Göteborgs stad, n.d)



Scenario 2035

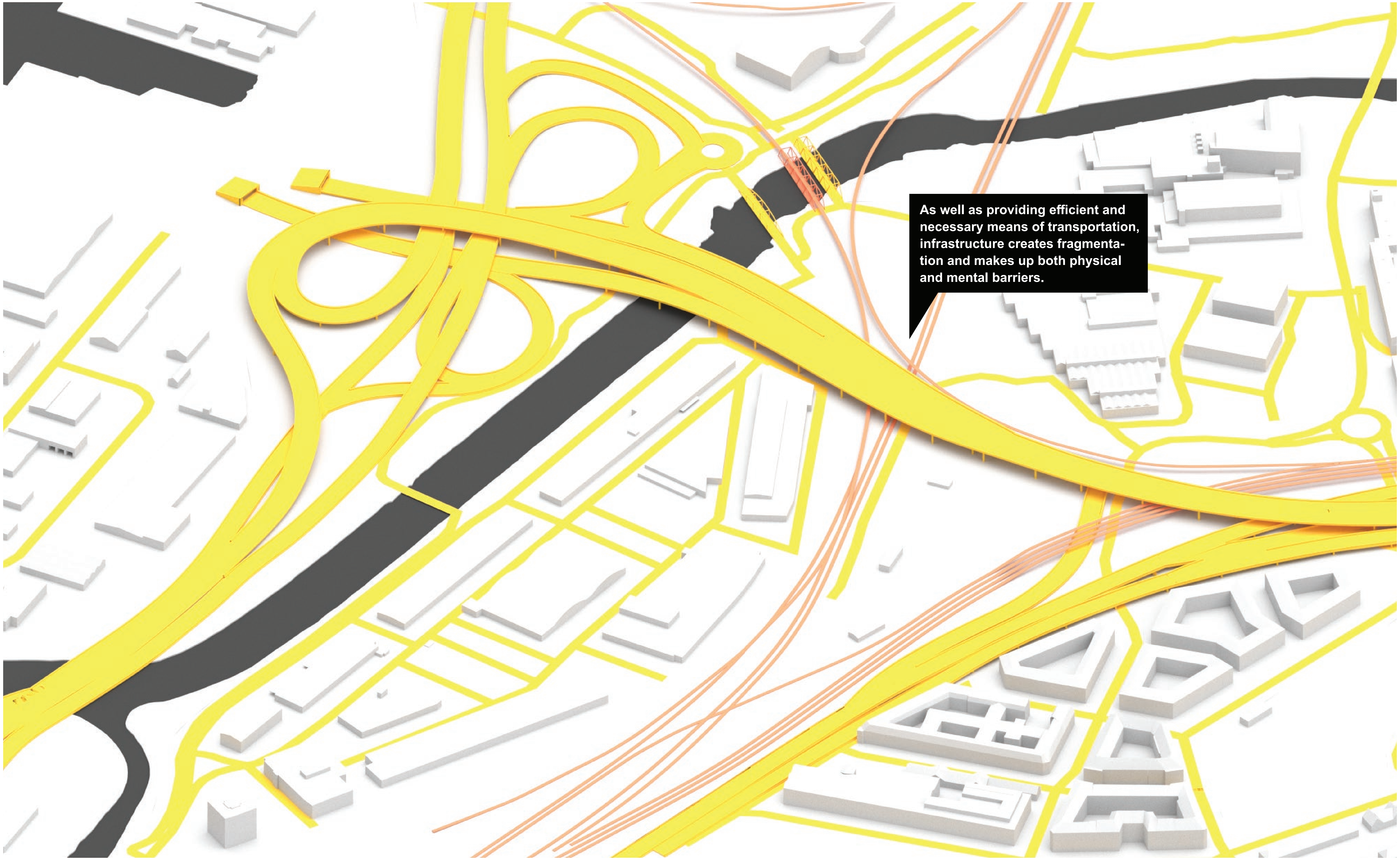
Traffic will increase and a certain percentage of the vehicles are likely to be autonomous.



Scenario 20XX

Mobility is now a seamless integrated autonomous system. Parts of previous infrastructure will become obsolete.

Mapping: Infrastructure



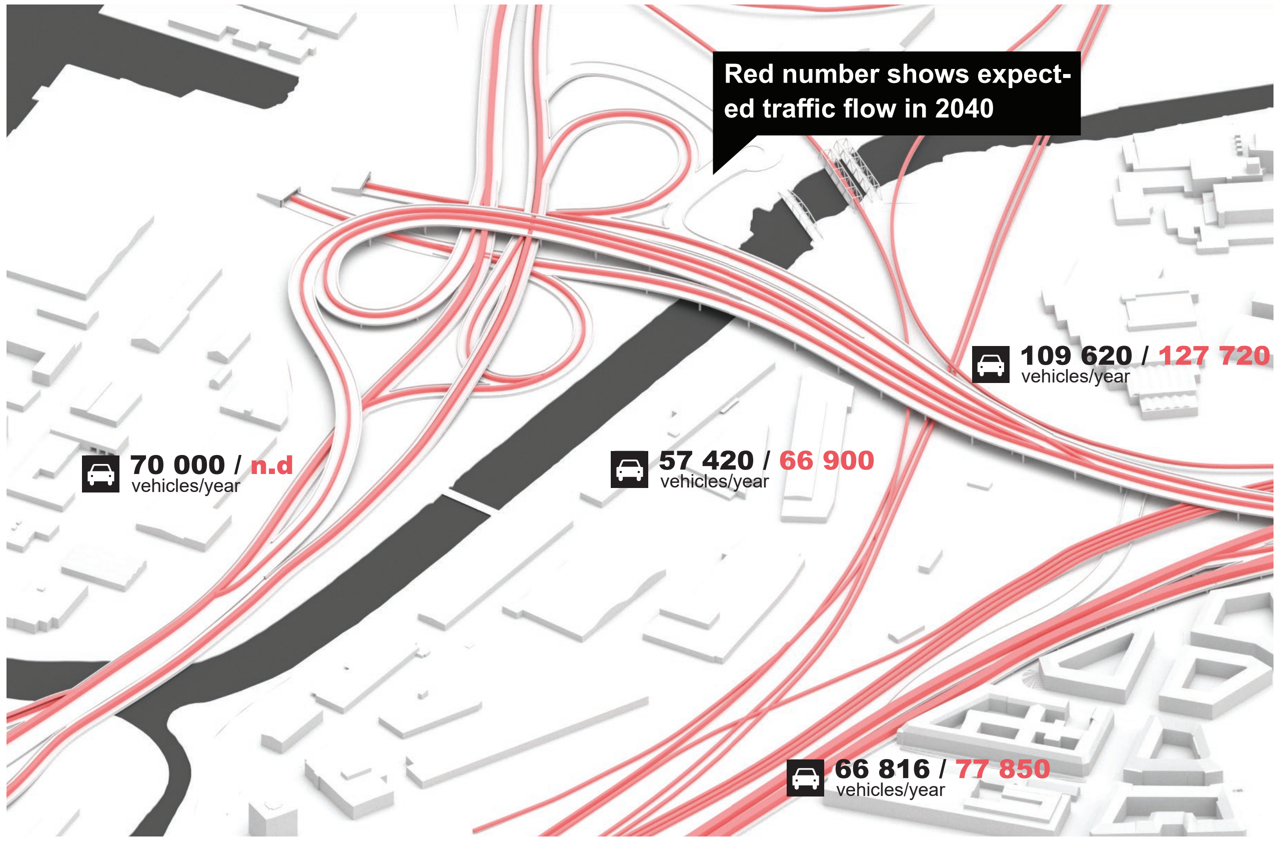
Infrastructure
The main infrastructure network within the sample site. This analysis excludes internal streets on properties. Train tracks represent both goods and passenger traffic.

Road length : 12 993 m*
Road volume : 139 200 m³

Street/highways
Trains tracks

* Numbers might have a slight deviation from reality because of the generalized parametric model

Mapping

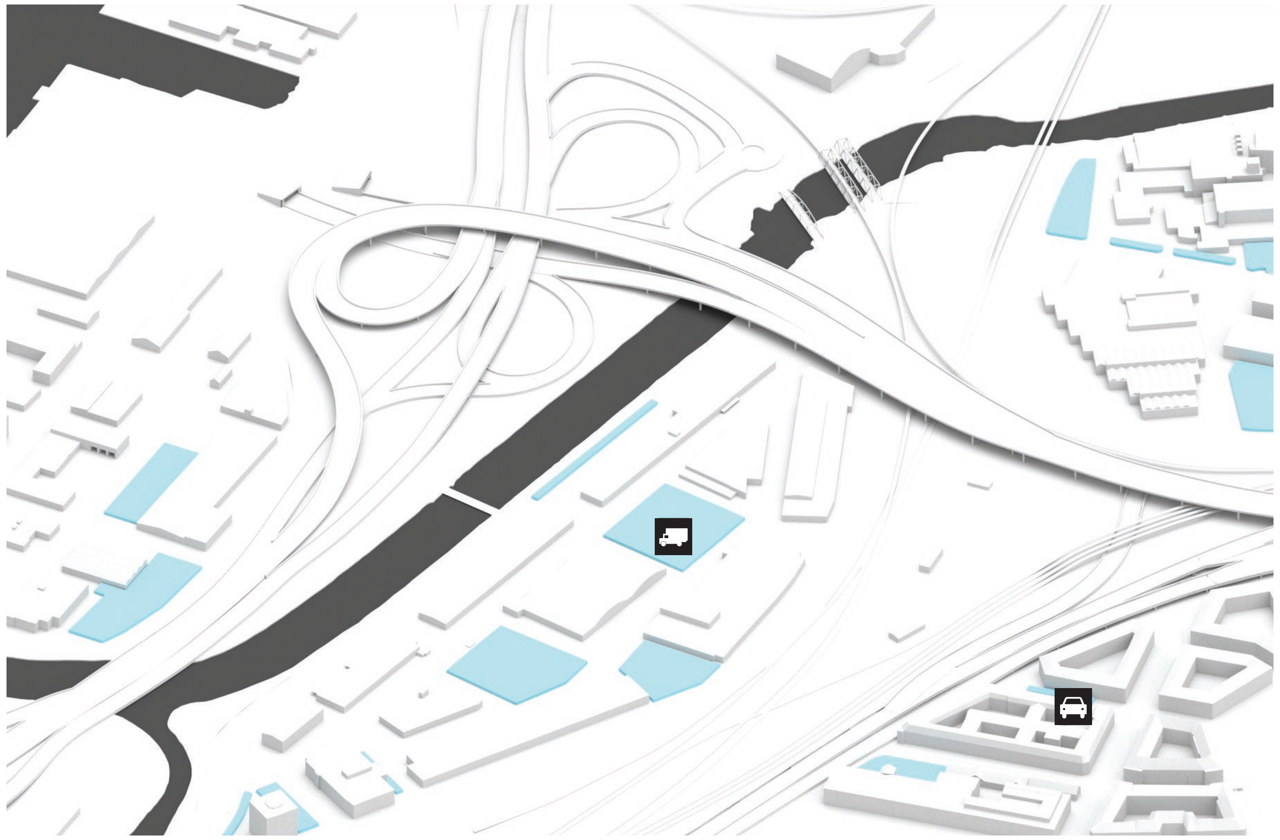


Flows The magnitude of flows has big impact on how the infrastructure effects the area, and the flows are expected to grow. This thesis is based on a scenario in which the mobility situation is radically reimagined*.

Flora and Fauna Säveån is a rich ecological area protected by national interest*. Green space : 305 500 m²

Fishes: Säveålaxen, Nothern Lamprey, Sea trout, Chub, Burbot

Birds/Insects: Kingfisher, Bats, Bee, Bumblebee, Beetle and Butterfly



Parking space Current parking spots designated for private/commercial vehicles. Parking space : 61 830 m²

Pollutions Contamination caused by road traffic and industrial activity over time*.

Pollutants: PBDE, PAH, Sodium, Copper, Mercury, Zinc, Oil, and ground level ozone.

* Read appendix mapping section for additional information

DESIGN ITERATIONS

the goal of the design iterations were to investigate what inherent value the future obsolete infrastructure system holds, and through transformation how this could be used to host and catalyze new urban hybrid typologies...

Prototype model

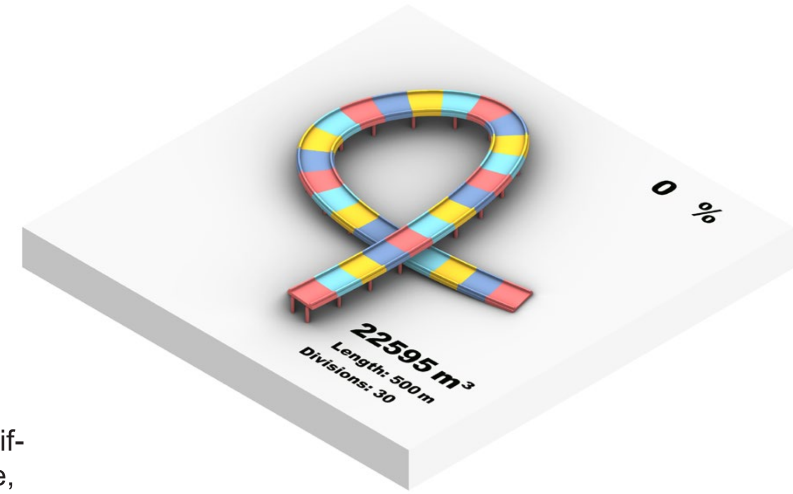
Randomly reducing a percentage of a generic structure to investigate what values that might be found within these structures when transformed.

00%
Reduced

Divisions : 30
Length : 500 m
Volume : 22 595 m³

Observations

Infrastructure still intact. Status quo. The zones might however acquire different properties. Weight, traffic type, productivity, transparency, surface, restrictions etc.



33%
Reduced

Divisions : 30
Length : 500 m
Volume : 15 210 m³

Observations

The system is still perceived as an infrastructure entity. The perforations might emerge as a consequence of proximity to other functions, line of sights or sense of orientation.

62%
Reduced

Divisions : 30
Length : 500 m
Volume : 8 567 m³

Observations

The system is shattered and can now be considered loose entities. This system could potentially accommodate separate functions.

92%
Reduced

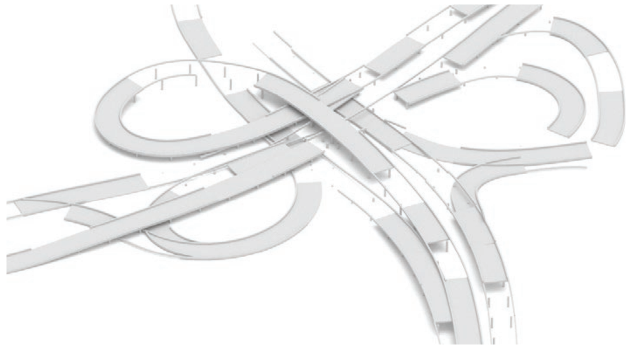
Divisions : 30
Length : 500 m
Volume : 1 916 m³

Observations

At 92% the system is nearly dissolved, and might not be considered a barrier. The remaining elements might be integrated in a new function or nature.

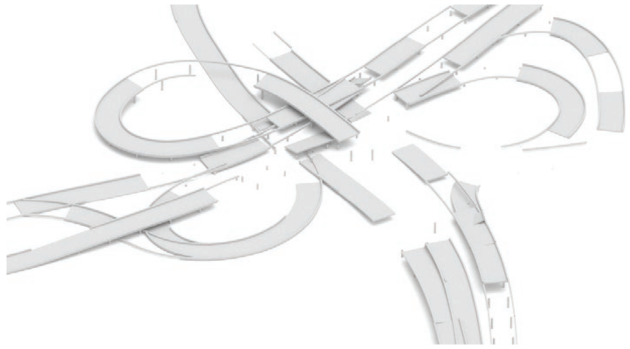
Prototype model / Seeds

The deconstruction process is here applied on a more complex set of infrastructure paths. During the deconstruction process different interesting spatial relations emerges. The parametric model facilitates the exploration process and many options (seeds) can easily be analyzed.



Seed 1
Reduced: 35 %
54 508 m³

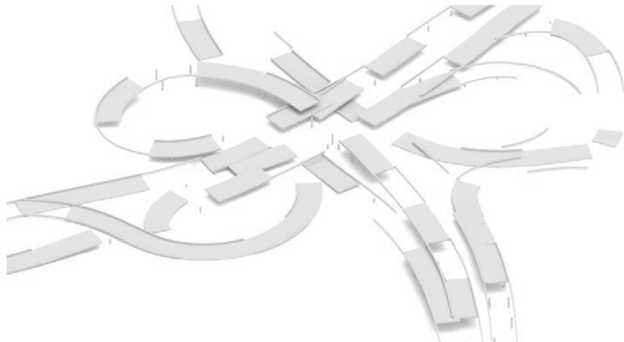
Seed 2
Reduced: 35 %
53 627 m³



Seed 3
Reduced: 35 %
54 306 m³

Seed 4
Reduced: 35 %
52 525 m³

Seed 5
Reduced: 35 %
55 206 m³



Seed 6
Reduced: 35 %
54 974 m³

Prototype model / Observations and Classification

The spatial situations observed during the reduction process. To investigate and classify these values, we must not only observe them as sole entities and elements, but also in their relation to one another.

Single solitary column

Rectangular composition

Reduced column arcade

Curved and stepped columns

Curved semi open slab

Slanted semi open slab

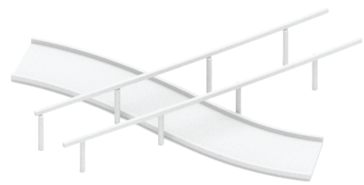
Elevated semi open slab

Elevated centered open slab

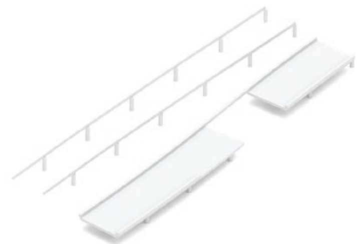
Intersecting open slab

Elevated reduced slab

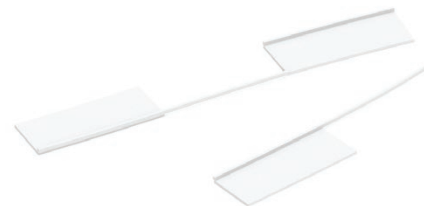
Reduced circular slab



Curved slab with intersecting arcade



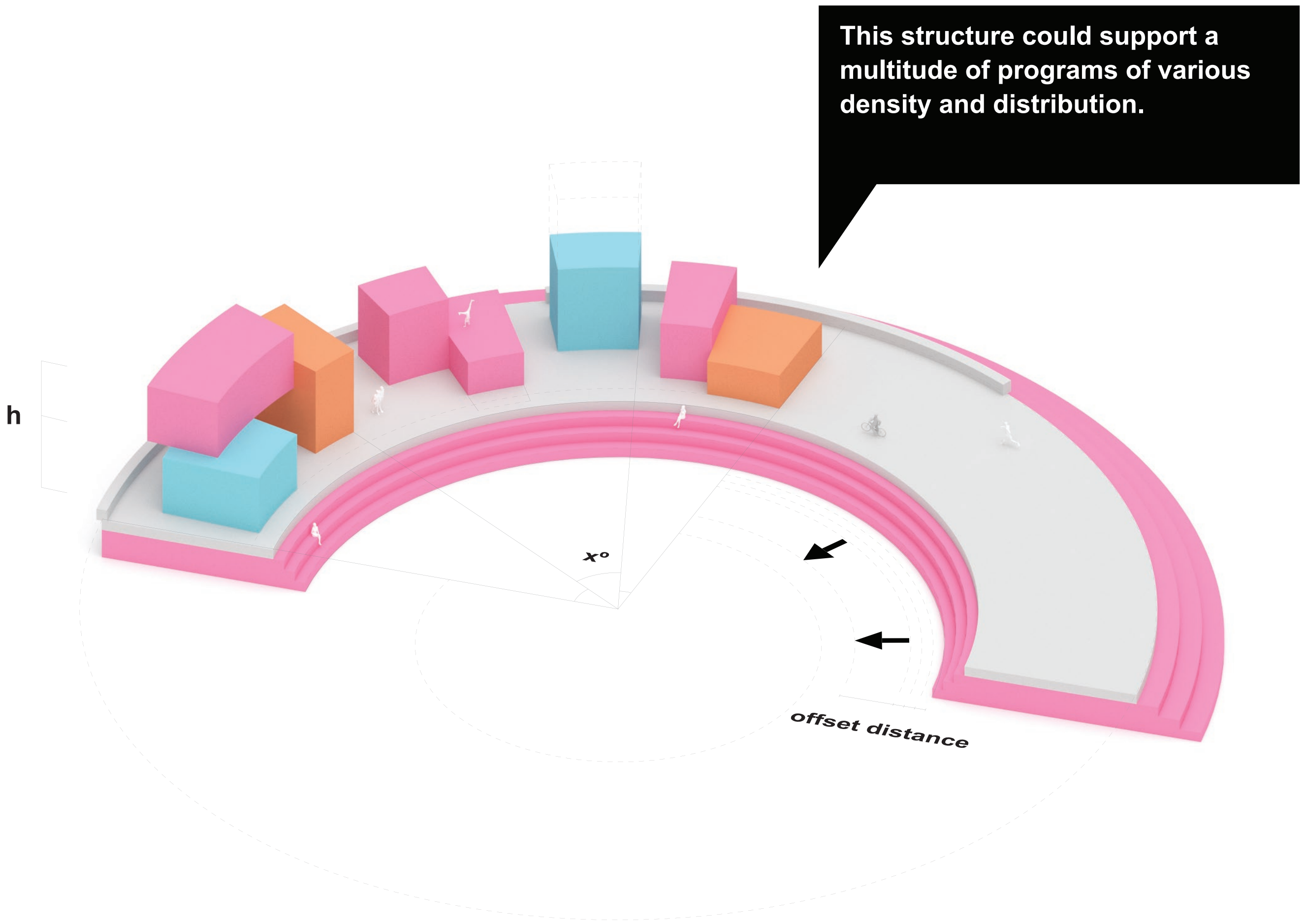
Semi open slab parallel to arcade



Parallel slabs with railing

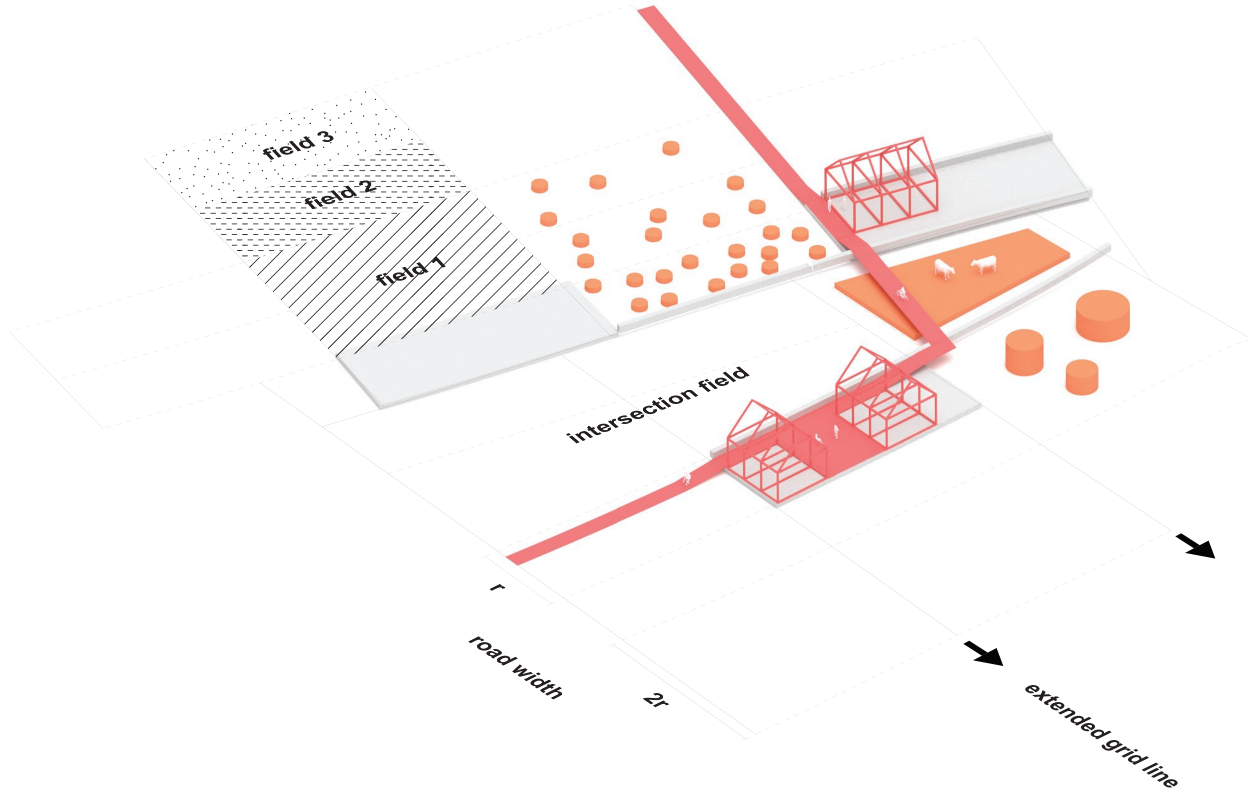
Prototype model / Transformations, values and capacities

Potential transformations of the previously observed situations and their suggested use



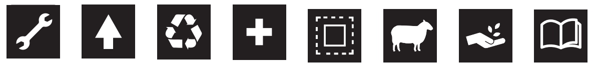
Circular Node

By emphasizing and enhancing the existing shape of the elevated ramp, the central space is reactivated and might be used for different purposes. Tribunes are introduced to ease accessibility locally but also to dissolve the barrier the infrastructure system once constituted. The new structure can support various programs, suggestively a mixed used program if the infrastructure is in a central location.



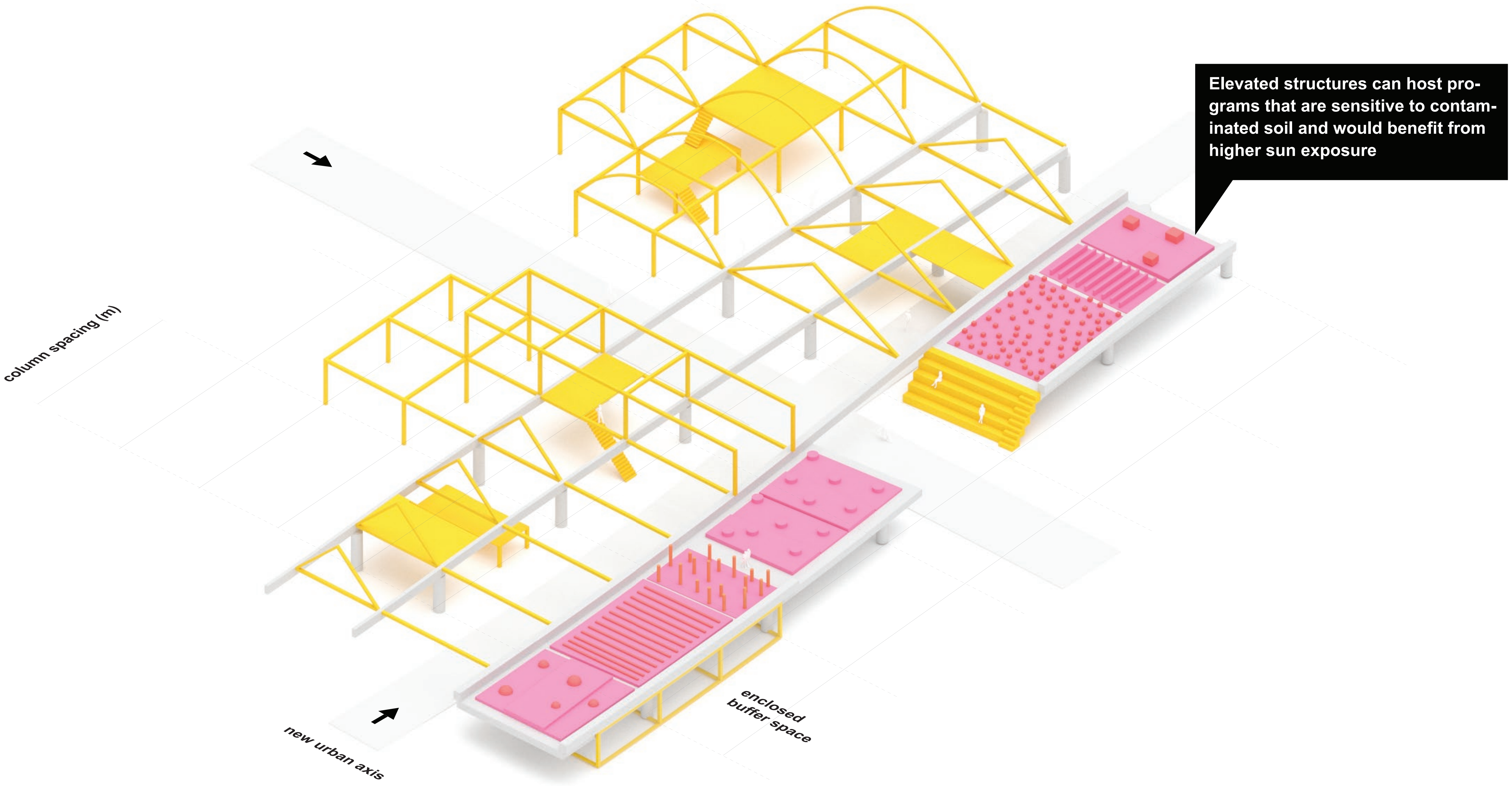
Resourceful landscapes

The voids and adjacent areas of the infrastructure could be used as resourceful landscapes, and act as a tool for transition. They might be productive, regenerative or buffer zones, or combinations of the above mentioned. The existing dimensions are used to facilitate planning, modularity and construction.



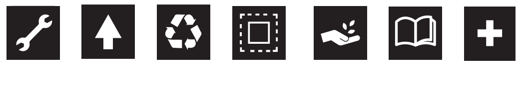
Prototype model / Transformations, values and capacities

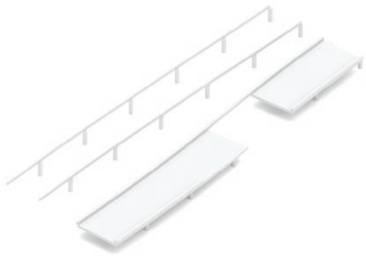
Potential transformations of the previously observed situations and their suggested use



Mixed used program hub

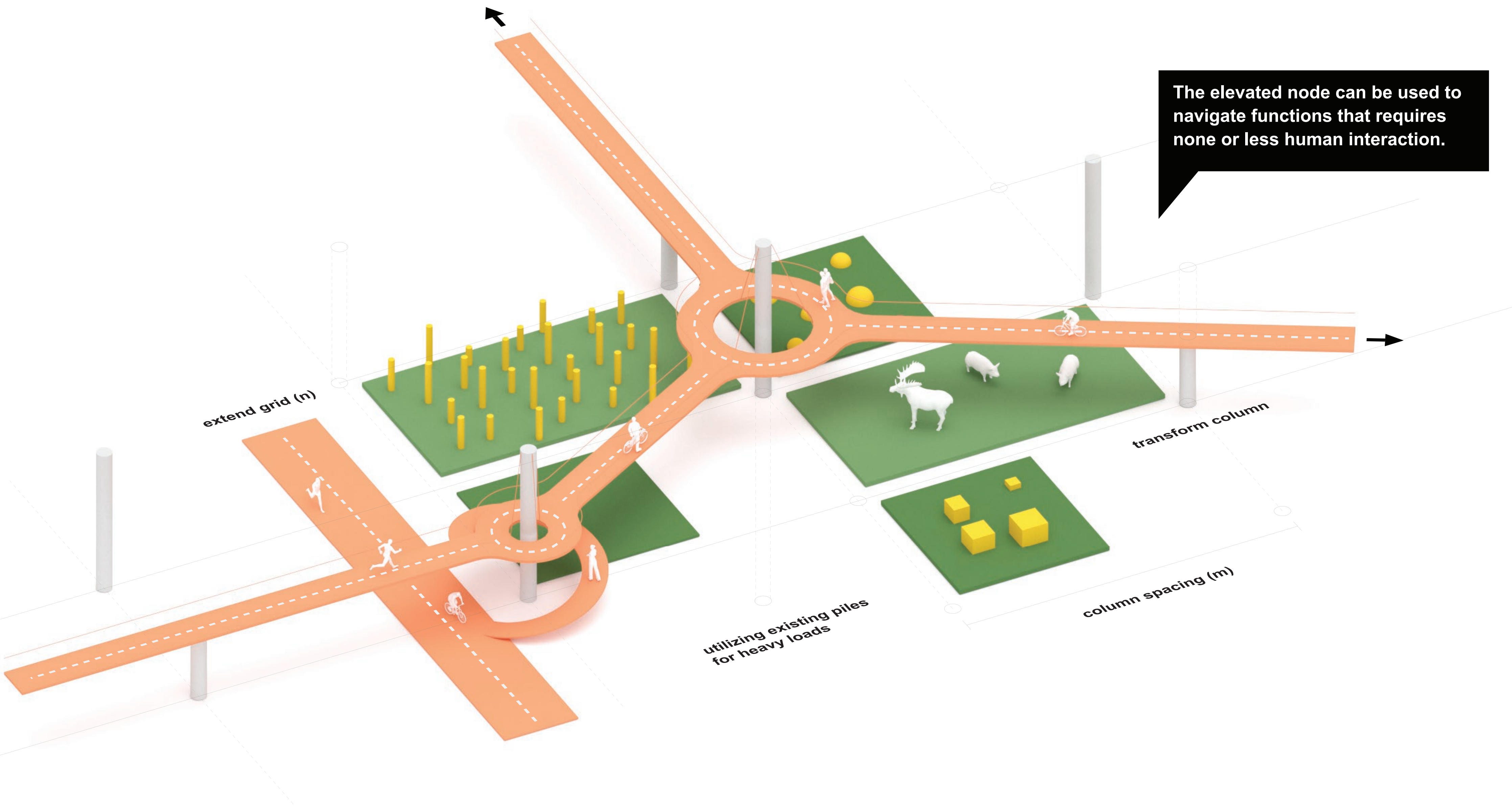
Parallel elevated highways serves as a great expandable framework for a mixed use program hub. The existing structure could be partially reused and extended. The variations in closed/enclosed space together with the porous existing grid creates a variety of spatial qualities. These connections can foster new developments and urban connections.





Prototype model / Transformations, values and capacities

Potential transformations of the previously observed situations and their suggested use

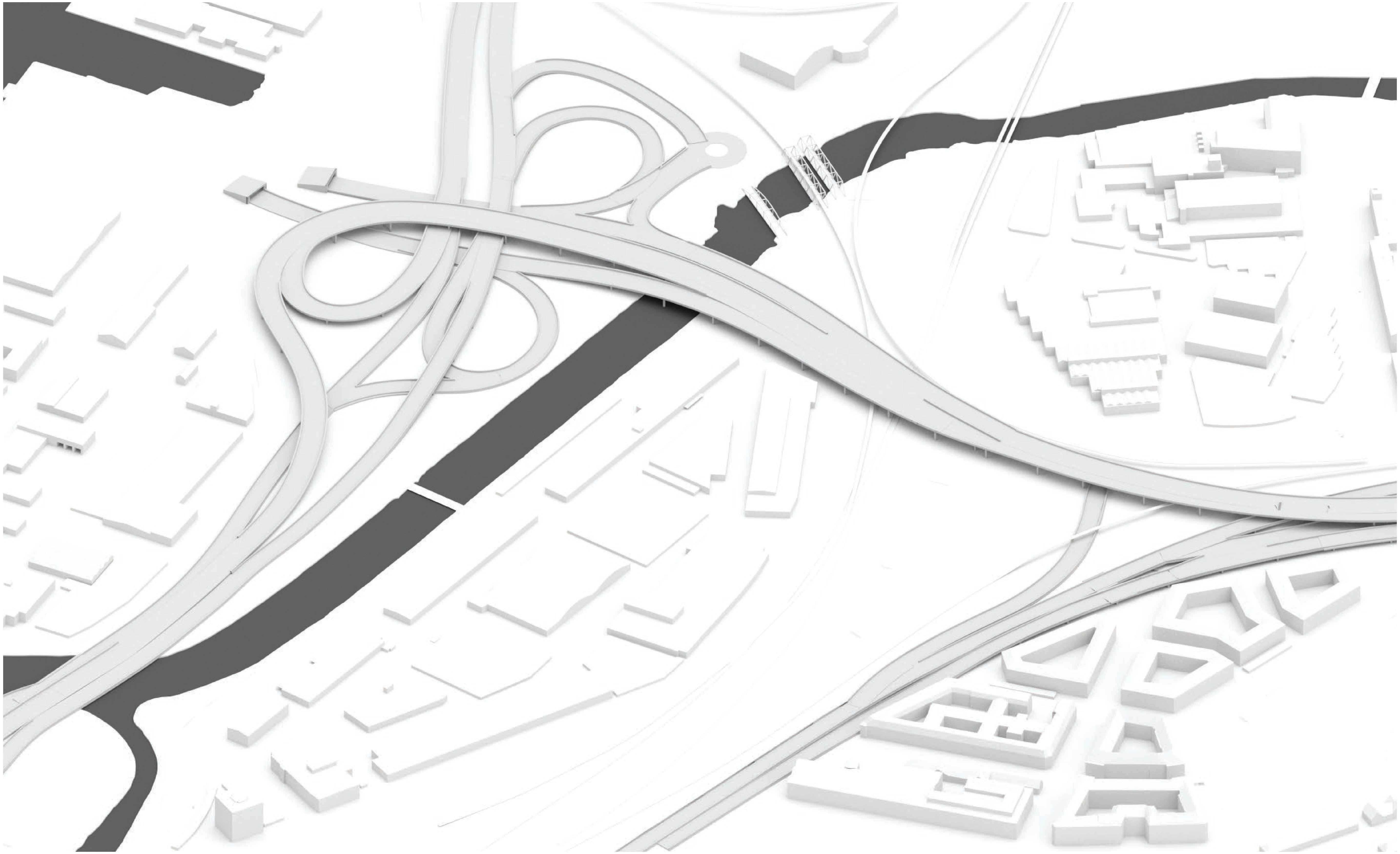


Transversal communication node

By adding lightweight structures and utilizing the existing columns, we can create transversal communication nodes to navigate the new hybrid landscape, without reintroducing the barrier once constituted by the infrastructure at site. These flexible nodes are to deal with a new reality of traveling and to cater the new typology in a multi-functional way.

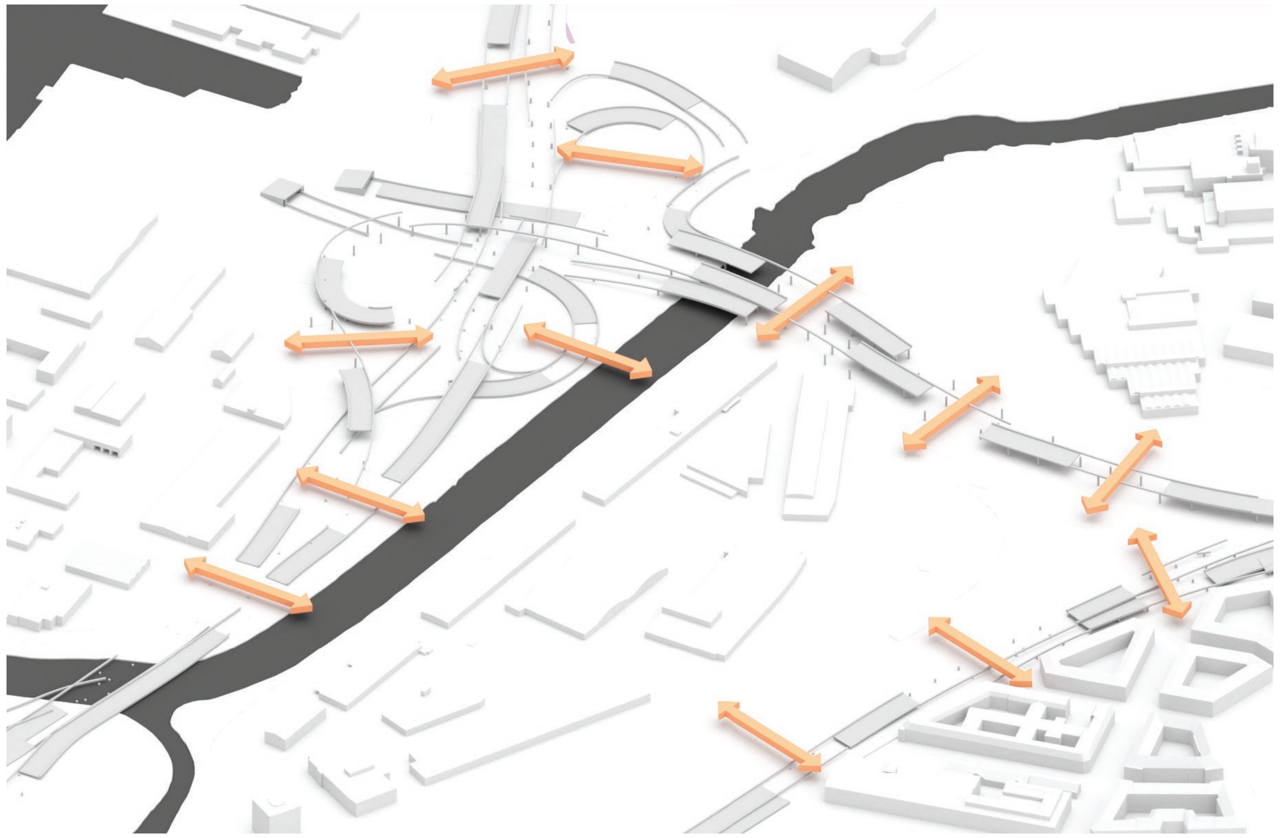
Urban situation

The infrastructure makes up a clear and disruptive barrier fragmenting the urban fabric

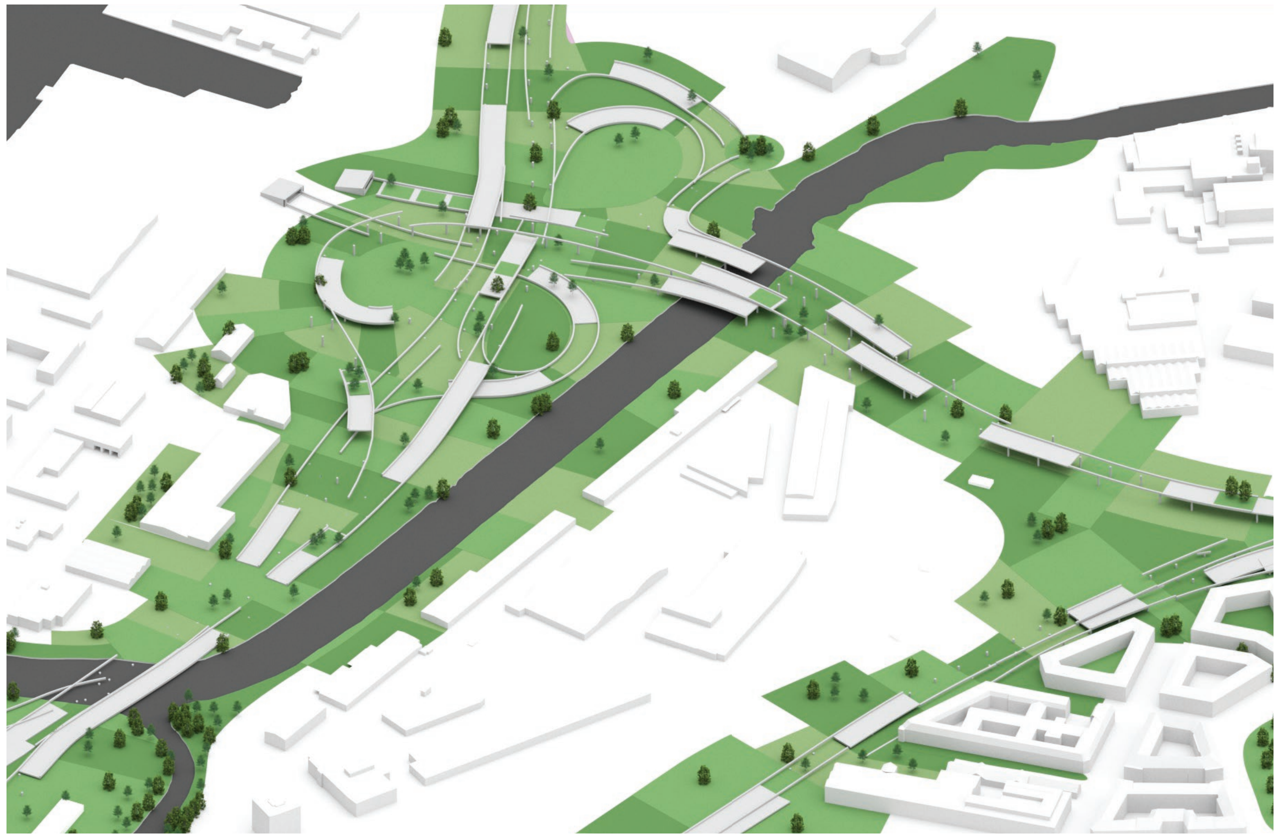


Urban concept

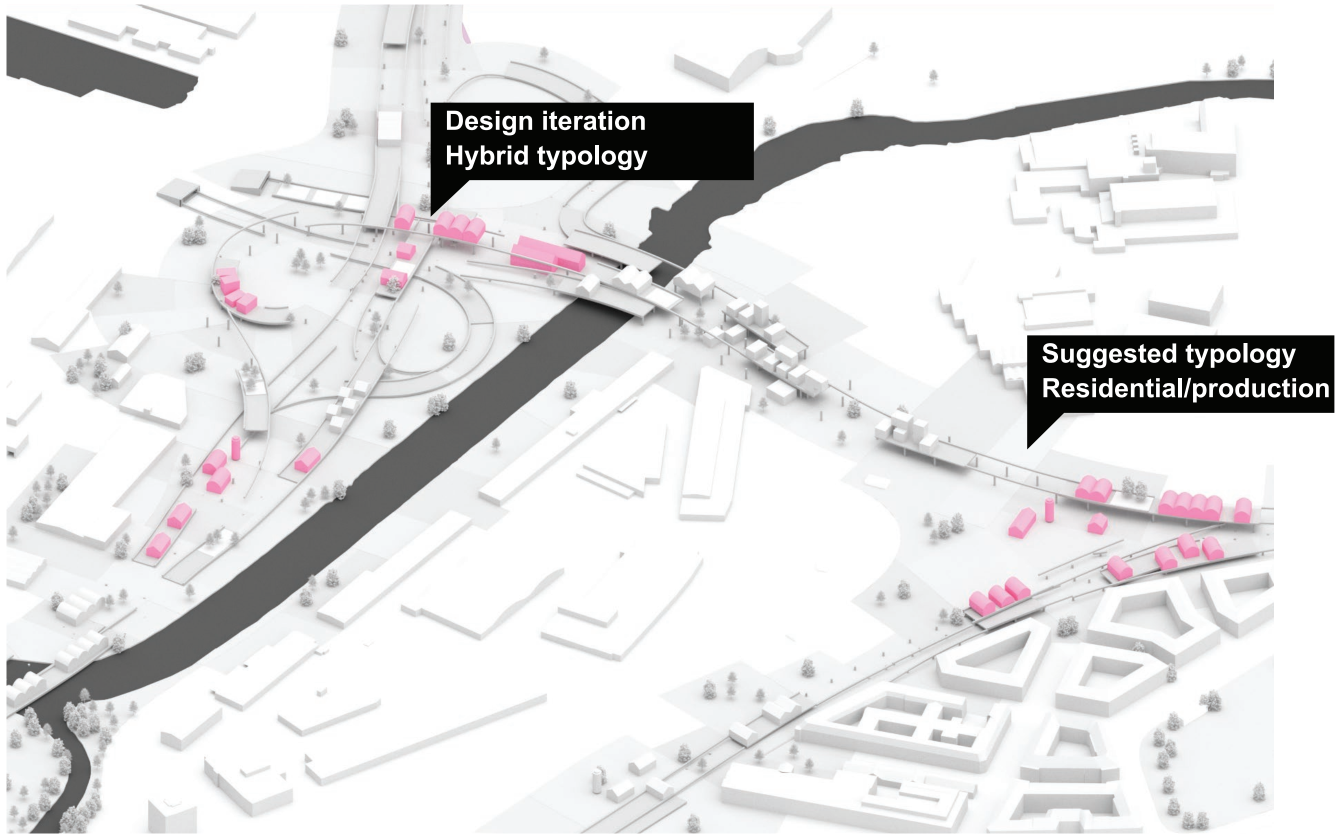
General urban concept for transforming the greater area



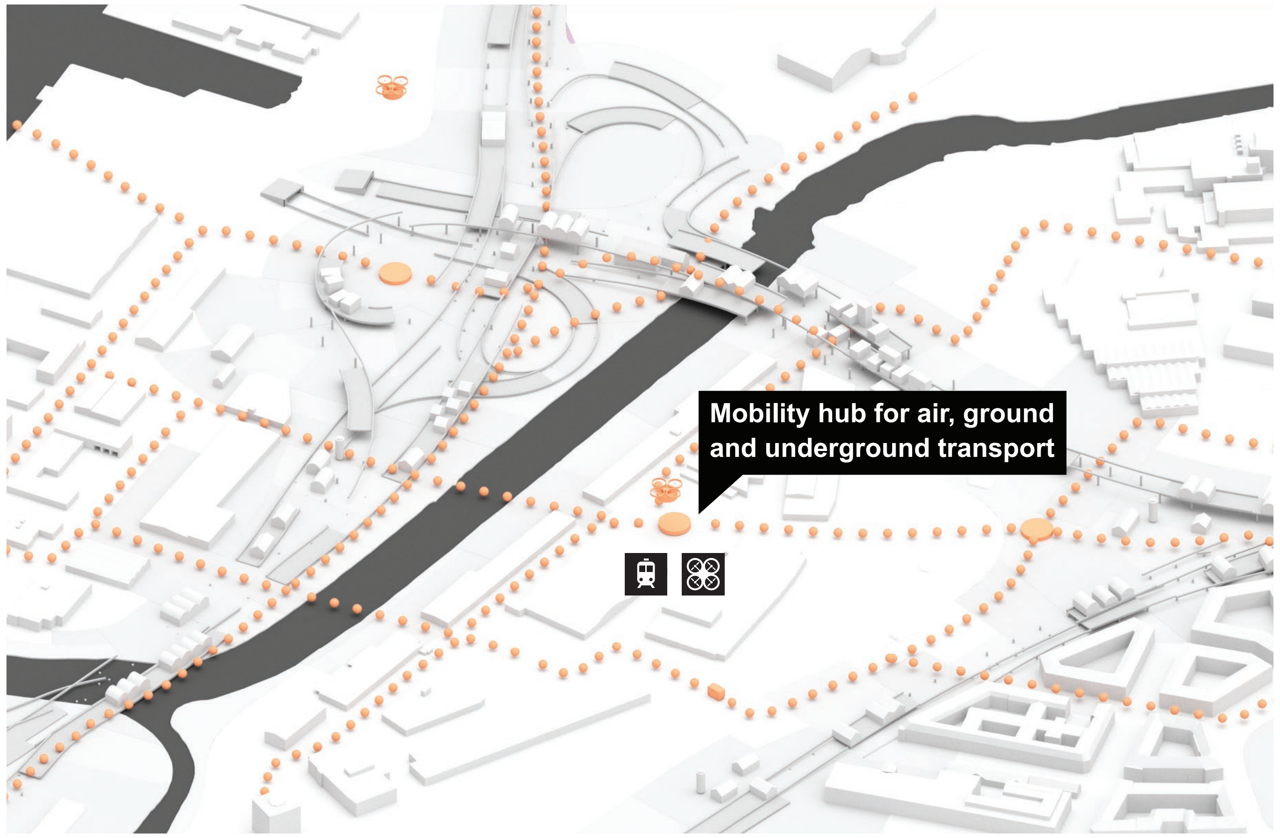
Dissolving the barriers. Reconnecting and mixing the urban fabric allows for programmatic synergies between the zones and healing the area once fragmented by infrastructure.



Reclaiming and expanding green space. Taking back the green space once claimed by infrastructure. The expansion is powered by a resilient transformation strategy to address local conditions, adding sustainable and regenerative functions while ensuring and restoring local flora and fauna.



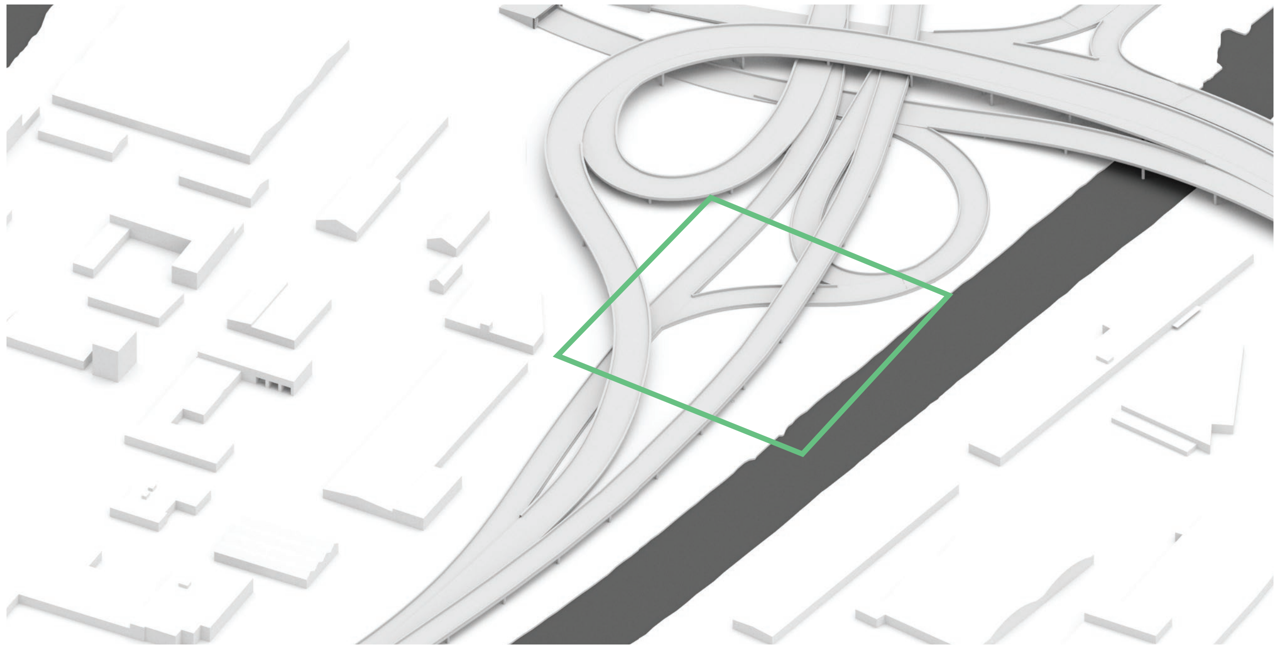
Catalyzing nodes / Hybrid typologies.The newly established porous transition zone is a catalyzer for a new range of hybrid typologies adding public space, new connections and restoring to the area.



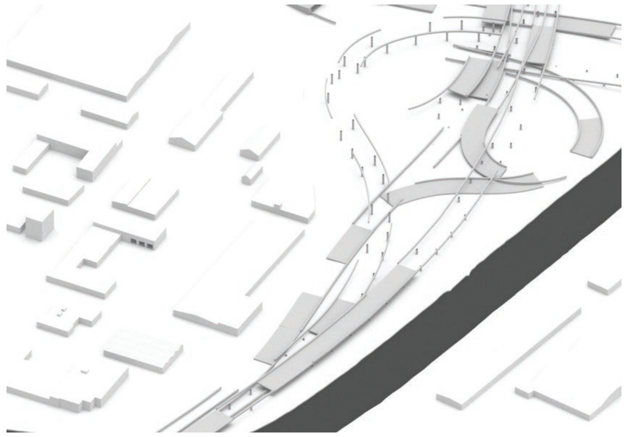
Decentralizing / Seamless mobility. As opposed to previous linear and horizontal infrastructure, the future city is supported by a seamless mobility system. This is a dynamic on-demand solution made out of a public autonomous vehicle fleet only in use when needed and operating on shared communication routes.

Hybrid typlogy / Approach

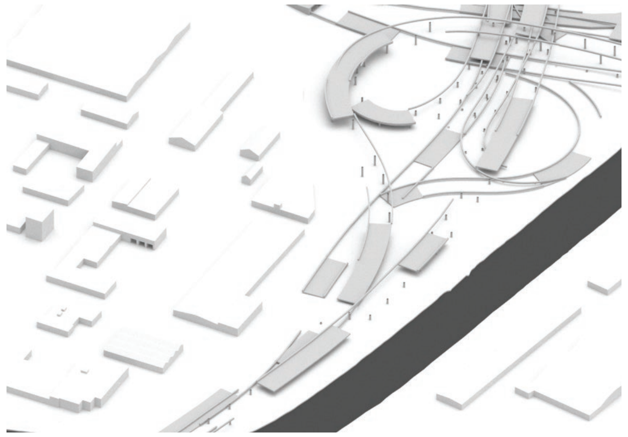
An area of the sample site is transformed in a series of reductions (seeds) to investigate a high output of spatial options. In the following step a certain set of pieces are selected based on various parameters, explained on page 66-67. The diagram to the right shows the step by step process performed on a fraction of the site in a comprehensive diagram.



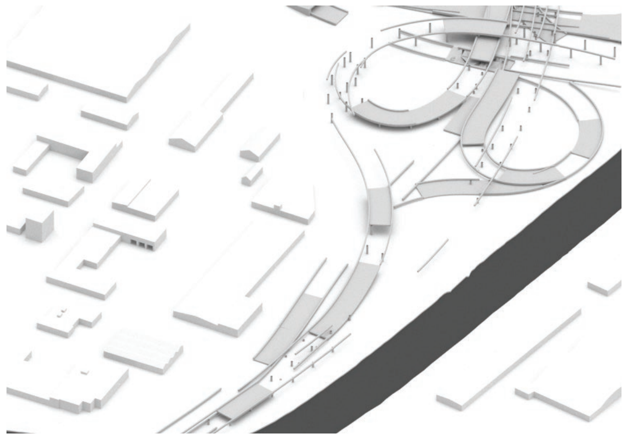
Seed 1



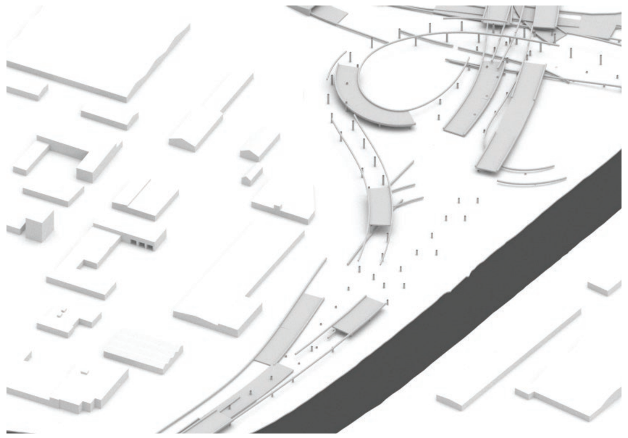
Seed 2



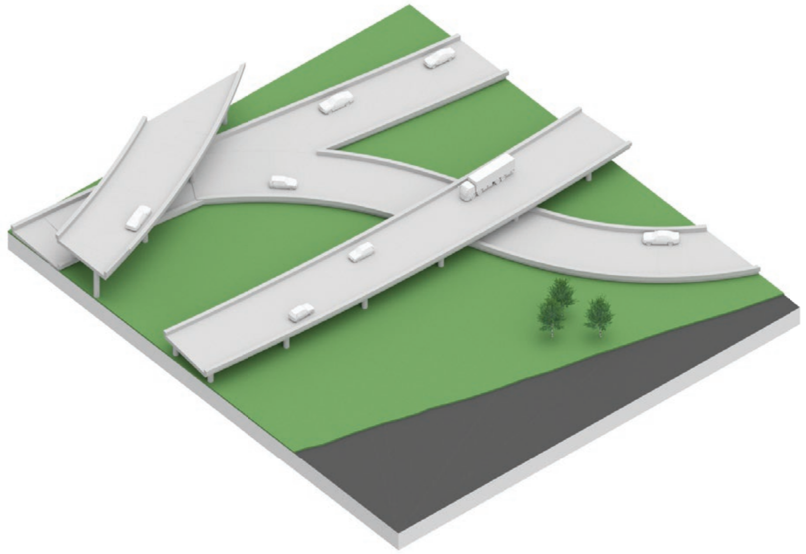
Seed 3



Seed 4



Step1. Design input
Infrastructure of today. Consuming horizontal space and making barriers



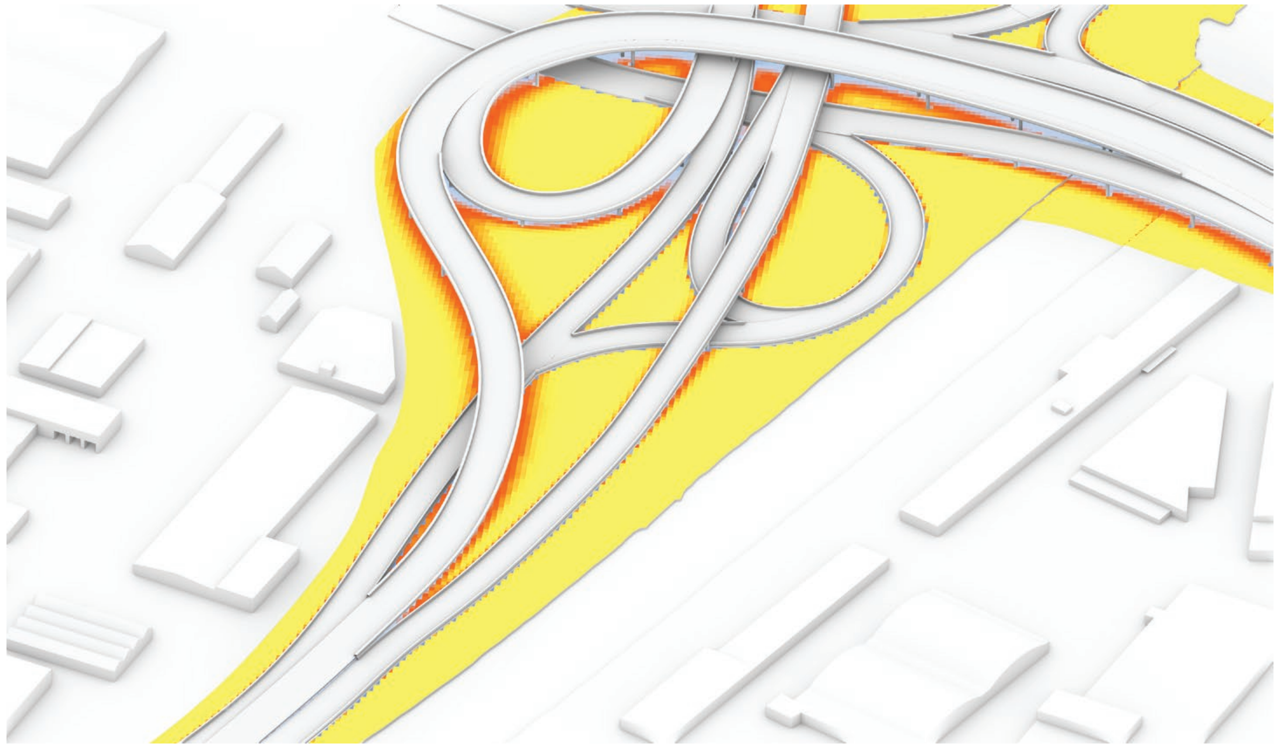
Step 2. Design Transformation
Transformation strategy based on local conditions and spatial capacities

Step 3. Design iteration
Responsive design solutions

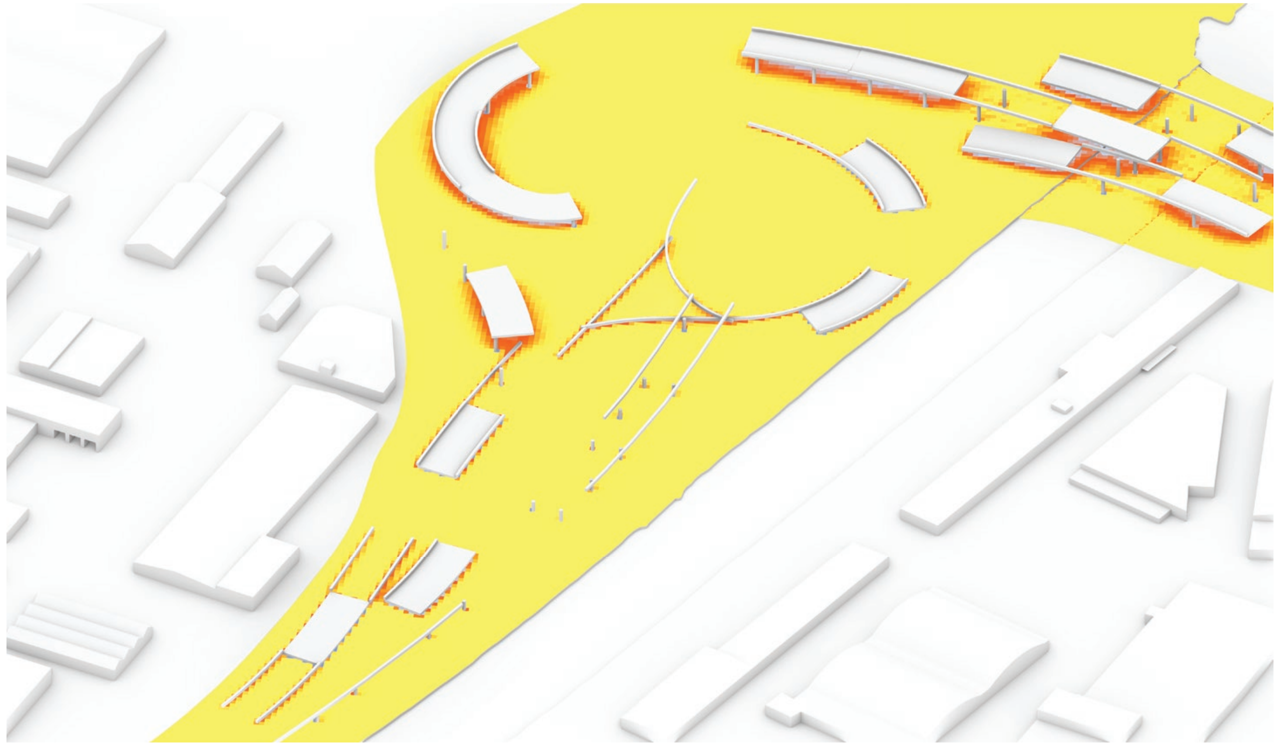
Solar analysis

An immediate effect of the dissolved infrastructure system is the regained access to sunlight. The increased sun hours makes the area suitable for more programmatic functions, especially productive/regenerative functions such as energy production, cultivation and remediation.

Annual solar radiation exposure



Infrastructure current state

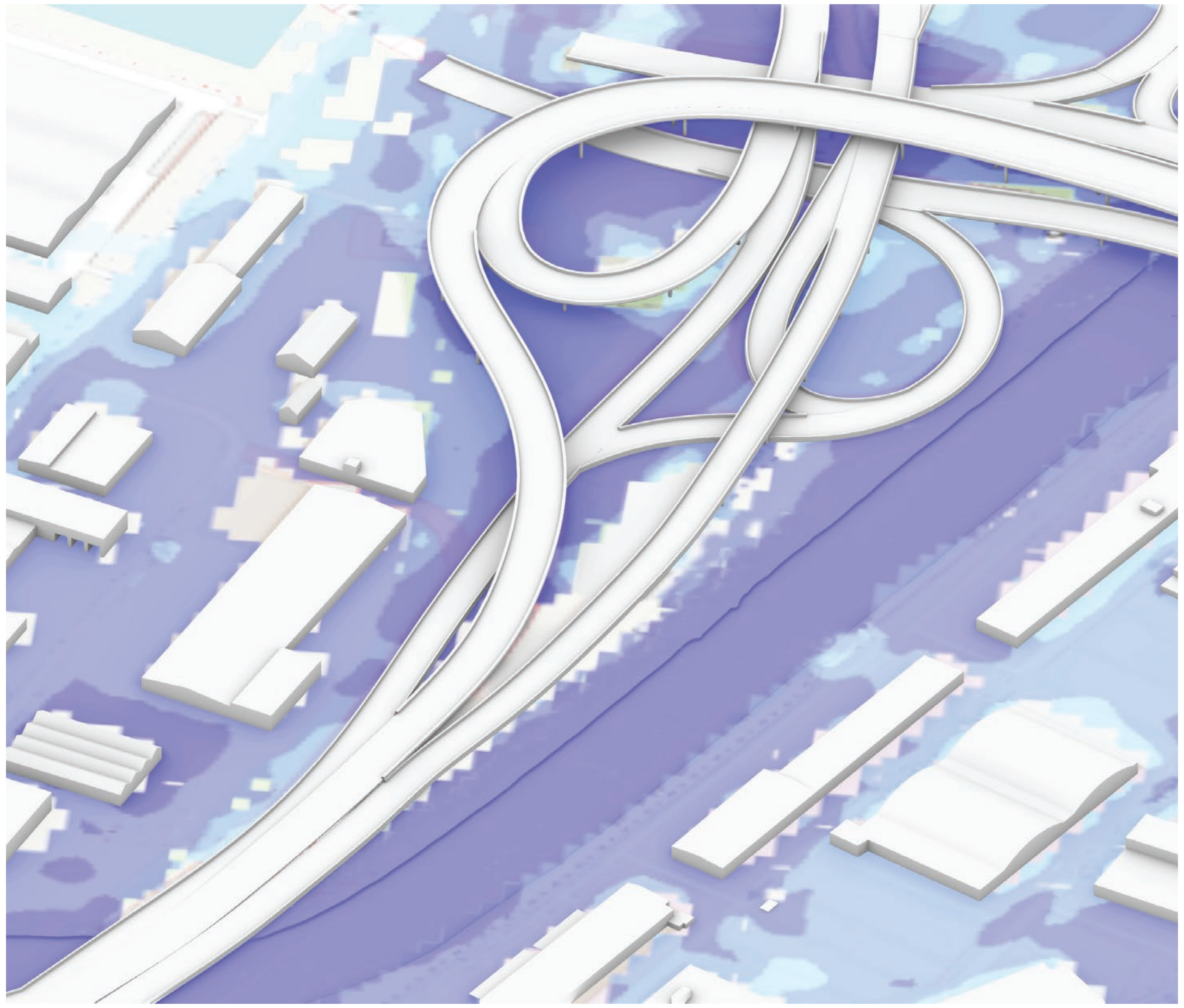


Disolved infrastructure

Flooding analysis

Säveån is prone to flooding due to climate change. A predicted sea water level rise of 2.3 m would have major implications for the entire site. Embankments connected to infrastructure could be used to further enforce or controls future flows of water (Vattenigoteborg, n.d).

Flood tide 2070 / + 2.30 m



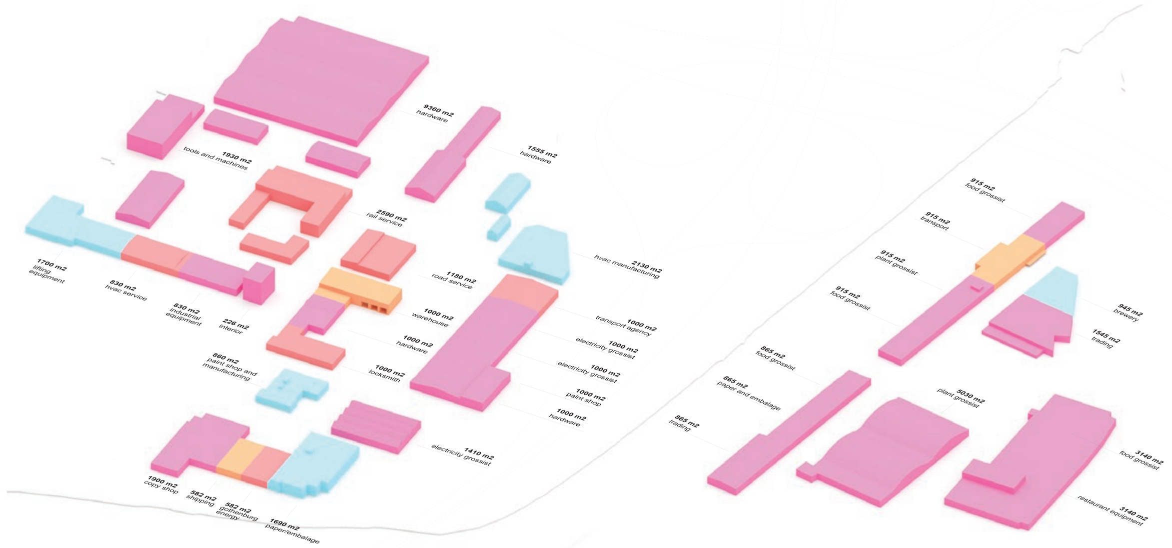
> 1.0 m   0.5 - 1.0 m   0.3 - 0.5 m   0.1 - 0.3 m

Program characteristics

The programmatic functions are here arbitrary divided into categories. The categories possesses certain characteristics here presented as inputs and outputs. These data are used as responsive and evaluating parameters for the new development. The parameters can suggest what treatment , processing or buffer functions it may require in its material/business cycle. It may also suggest possible synergies between functions, in other words metabolic systems.

Metabolic systems

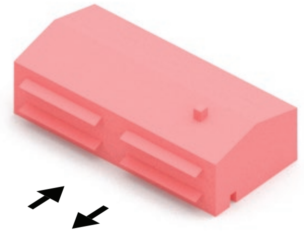
A metabolic system strives for synergies and circular loops of energy/material. This might materi-alize in shape of manufacturing/disassembly services, recycled material markets, shared material stocks, local waste treatment plants and local energy and goods production all contributing to a resilient local industrial ecology.



Service

Municipal or private service provider.

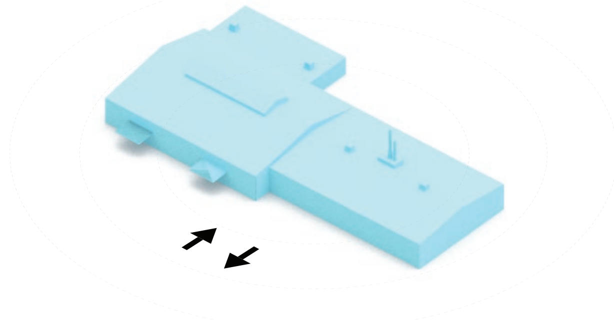
Input	Output
customers	digital/physical service
data	data



Manufacturing

Refining and processing of materials to generate products.

Input	Output
raw material	physical product
goods	waste
energy	gases
	water coolants
	emissions/effluents



Commercial

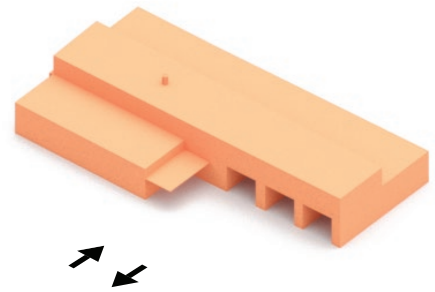
Retail and wholesale. Stores with large stocks. Some of which require specific climatic conditions

Input	Output
customers	physical product
space	waste product
goods	water coolants
energy	

Logistics

Storing and distributing goods on do-mestic/international scale.

Input	Output
goods	goods
space	service

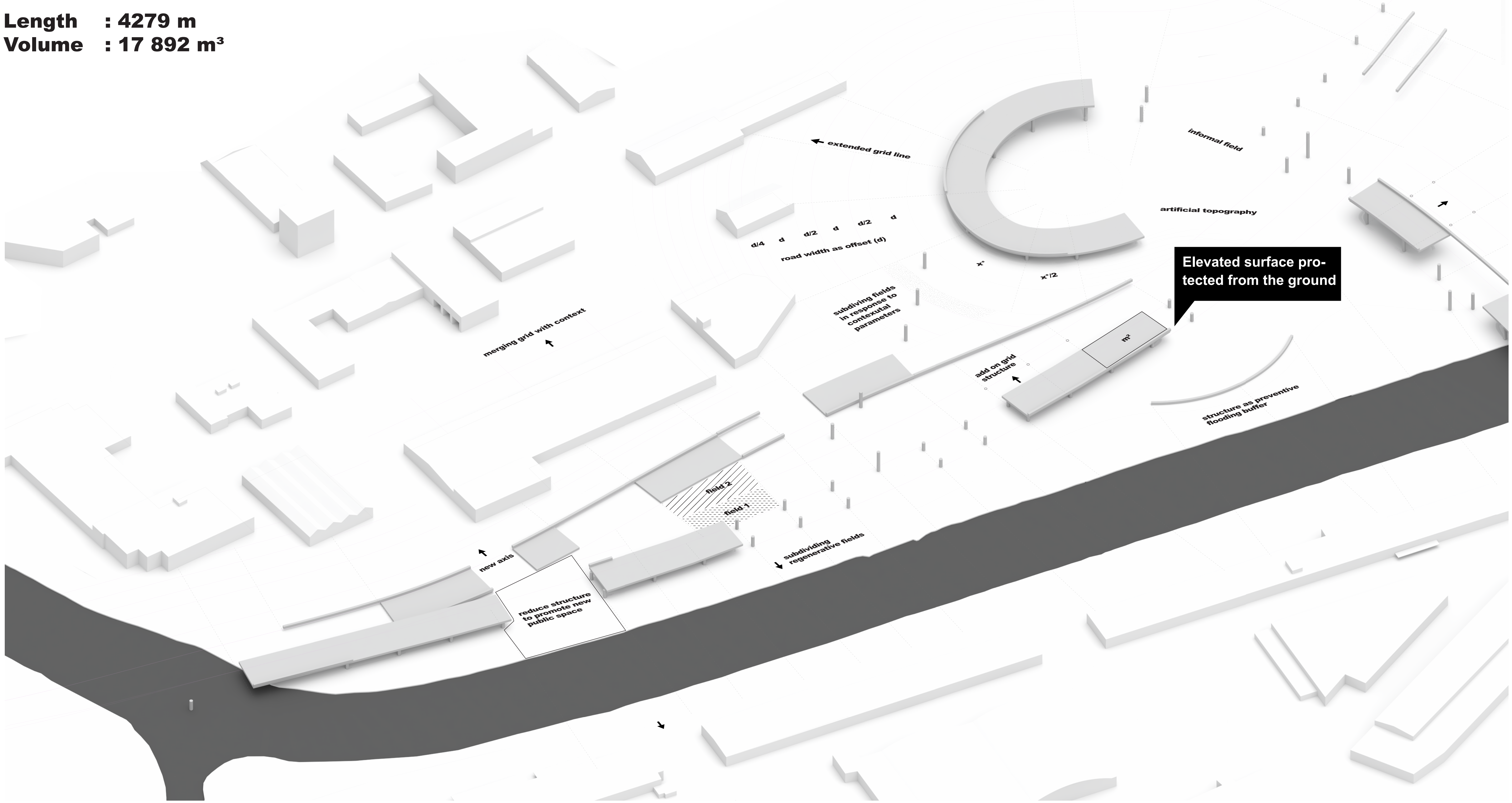


Obsolete infrastructure

A set of obsolete infrastructural pieces were carefully selected according to their ability to support new hybrid functions, interact with its context and degree of urban perforation. The grid/guidelines highlights their spatial capacities, characteristics and shows how the new functions can expand and interact with its surroundings. The data shows how much of the initial structure that were reduced and the amount of material (volume) that were upcycled.

73%
Reduced

Length : 4279 m
Volume : 17 892 m³



Program strategy

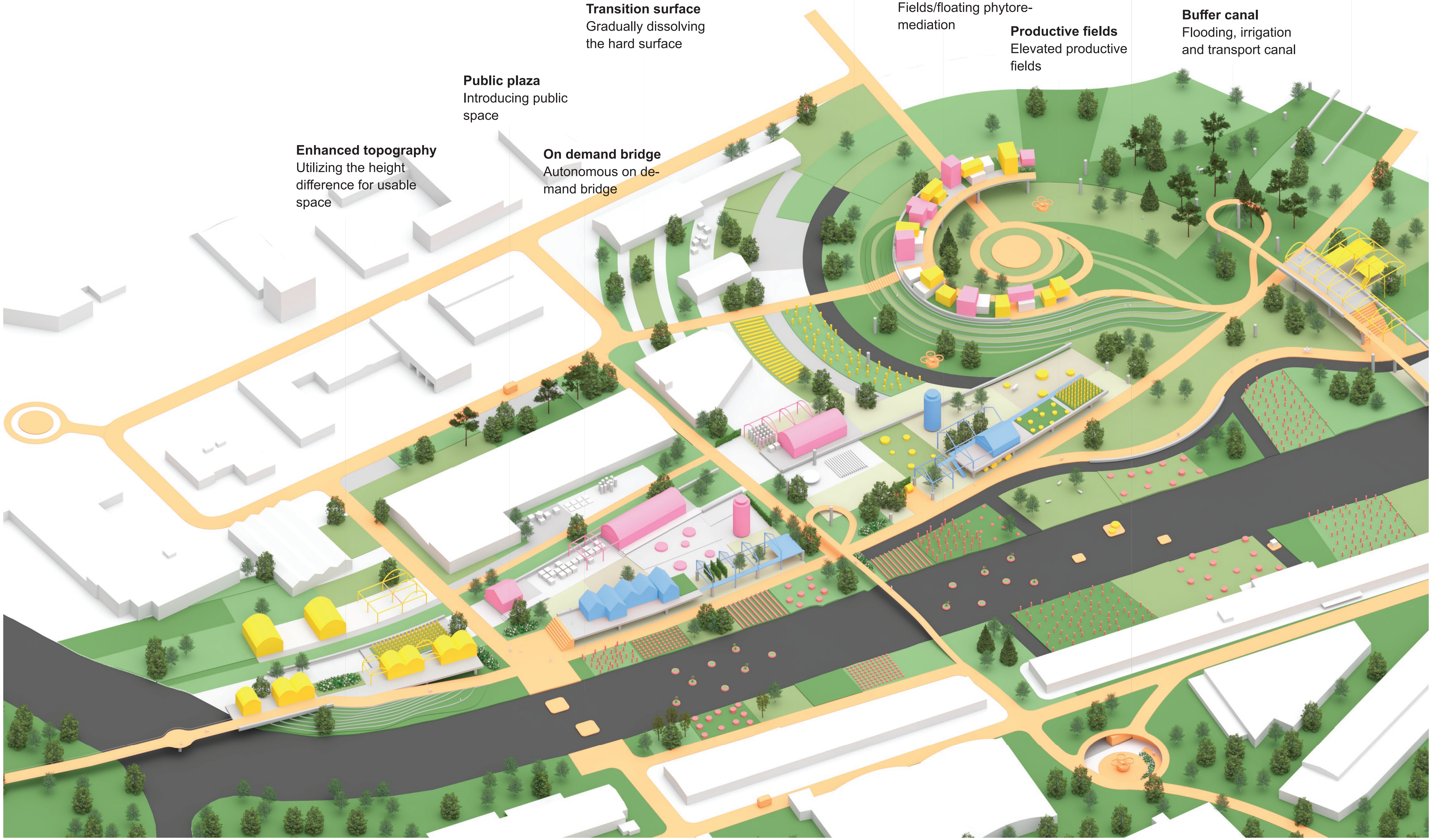
A programmatic selection of functions created to add a diverse mix of features. The functions are created as a coherent unity, were the functions complement each other and interact with the surroundings in a symbiosis to activate, restore and add value to the area once claimed by infrastructure. The functions and their respective actions form a local circular industrial/landscape metabolism, ultimately contributing to a resilient regenerative urban densification.

Mobility

A new layer of seamless mobility is intertwined with the remaining infrastructure to promote a new communication, namely inclined towards pedestrian and green mobility solutions, in contrast to the linear disruptive mobility flows of today. The new system is multi directional and on-demand based, meaning increased spatial efficiency and unconstrained travel.

Hybrid typology

The hybrid typology is a compilation of functions acting in synergy to add value and restore ecology in the area. It's a series of flexible, productive and regenerative functions supported by the obsolete infrastructure remnants and their tool set of expansion. The main features of the new typology are highlighted on the map.

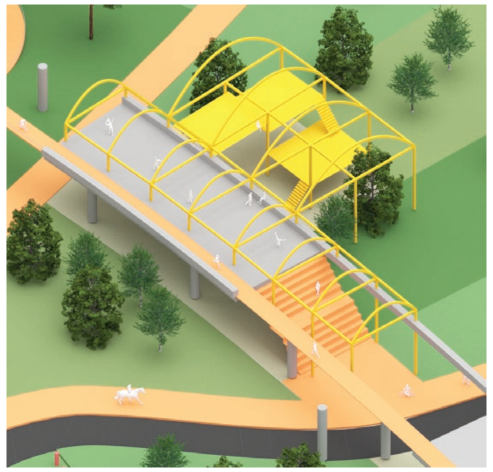


DESIGN RESULTS

the observations and evaluations of the designs shows different ways in which the spatial value of the obsolete infrastructure could be used to catalyze new functions

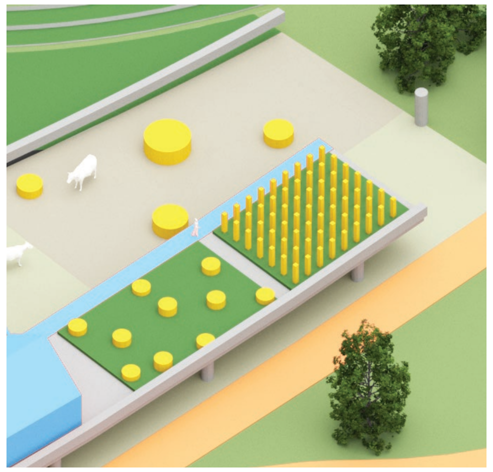
Public plaza
Cutting through the infrastructure to break the horizontal and linear flow made up by the infrastructure in favor of a multi directional crossing enables new public space. The cut perpendicular edges make up a new public plaza and can support new urban axises to reconnect urban fabric. The height differences are utilized as a tribune to activate the plaza and provide further connectivity to the elevated functions.

Public bridge buffer
By taking advantage of the inherent connectivity and exposure of the bridge, the transformed version is an excellent place to host public programs and events of bigger size. The previously spatially dominant structure is dissolved and connected with the ground in various ways. When parallel bridges are dissolved, the remaining structures can be combined to create even wider structures. They can therefore become a mixed programmatic hub, enhancing the connective feature of the bridge beyond mere communication.

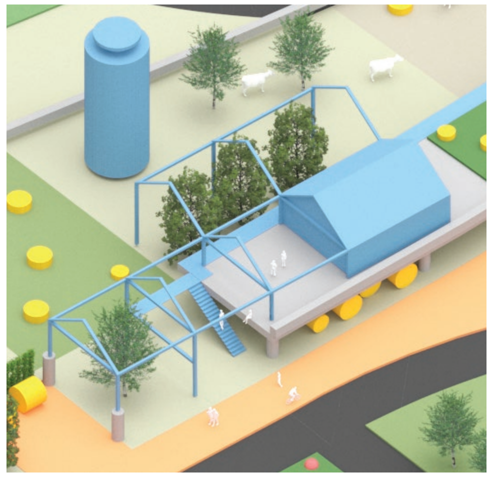


Enhancing shape
Using and enhancing the spatial characteristics (turning radius and height difference) of the circulation space by connecting and densifying. This creates a naturally enclosed space with a range of spatial qualities. It may host both private and public functions. The central part is here used as a mobility hub, whereas the outer edges are merging with the existing landscape to artificially dissolve the harsh border made by the infrastructure whilst adding an outdoor public space/tribune.

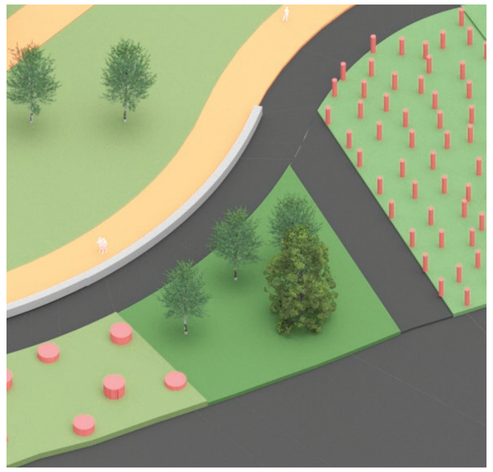
Productive fields
Utilizing the extensive horizontal surface of the elevated highway to host productive fields. The structural capacity of these systems makes them great to support weight intensive additions, such as farming. The inherent linearity also provides a framework for phase requiring processes. The elevated surface has a naturally high solar exposure, beneficial for productive functions and is furthermore suitable to host functions that are sensitive to contaminated soil as opposed to placing them on the ground.



Productive structure
The elevated road is here transformed to host a productive hub. By using the existing structural grid it can be extended with modular elements. Making use of the height difference, it may also host spatially requiring functions such as indoor farming. The dissolved structure creates connectivity with the public path and canal.



Purification fields, buffer and irrigation canal
As a response to future flooding risks of Säveån due to climate change, a buffer canal is carved out. It uses the remaining structures of the infrastructure as extra barriers. The canal also functions as irrigation and transportation for the productive and regenerative fields. The fields uses phytoremediation to purify the contaminated embankments and sediments of the river and contributes to restoring the ecology in the river itself.



THE NEW HYBRID

The disruptive mobility flows ceased, the perpetual motion of the city remained, redistributed and reinvented, articulated in a new hybrid typology. Hosted on the obsolete remnants of infrastructure, this time with regeneration and diversity on the agenda. A literal act of using deconstruction and decay as a catalyzer of change.

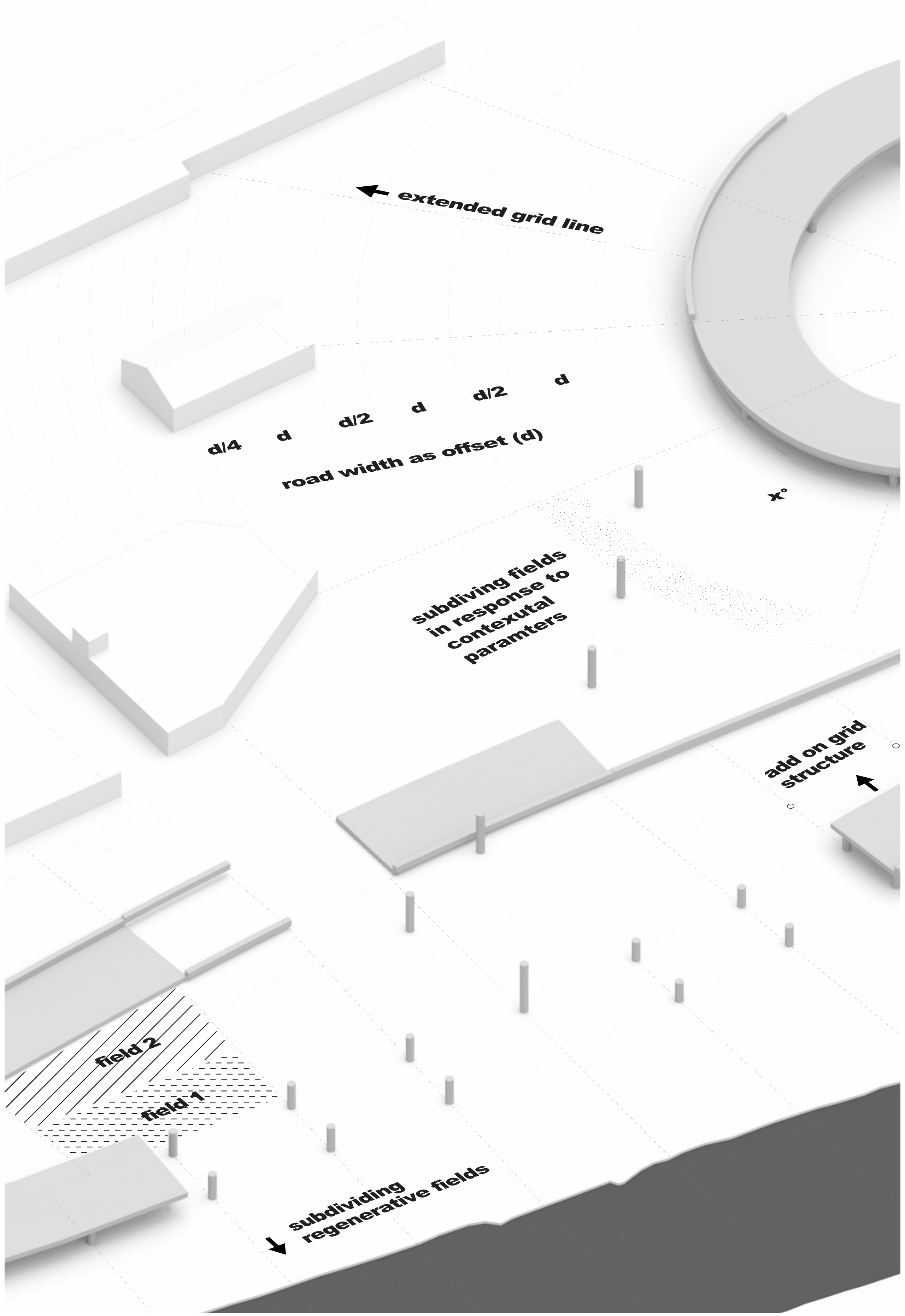
CONCLUSION

This thesis set out to investigate the values of potentially obsolete mobility infrastructure in a speculative future public space based city. More importantly how these artifacts could be used to catalyze new urban hybrid typologies and restore areas were infrastructure were once relentlessly imposed. It's an investigation on how deconstruction and decay could be used as an initiator of restoration and change. It aims to contribute to the sustainability discourse from an upcycling and regeneration perspective and to encourage thoughtfulness in the planning process to avoid repeating old mistakes.

The thesis performed a set of transformations on a generalized model of infrastructure, both in a fictive context and on a sample site in Gothenburg, to research and reveal the potential values of these structures. By using both the horizontality and verticality of the infrastructure remains we could release a range of multidimensional spatial potentials already present in our cities, more often than not in central and relevant locations. The spatial qualities and capacities can be further enhanced and developed to support a multitude of new programmatic functions, and ways to reinteract with its context. These transformation would challenge and reimagine the linear and monofunctional purpose of infrastructure of today. Furthermore they would dissolve the heavy barriers constituted by today's infrastructure responsible for dividing urban fabric, and ultimately people.

The methodology used was a parametric generalized model of an infrastructure system to facilitate the creation of a series of non specific but context aware design iterations, widely applicable to many infrastructural settings and contexts. It does not provide the specificity of a complete design, but rather a flexible design principle with the ability to respond to contextual parameters. This was intentionally done to cope with the inherent uncertainty of speculating on future scenarios, and to keep an open-ended and suggestive process. The parametric model is also a way to interact with the standardized nature of infrastructure. By adapting to existing preconditions, we can easily imagine expansion with repeating and modular elements.

This thesis is meant as a suggestive and optimistic story on how letting what once conquered an area be the primary force of societal and ecological regeneration. It aims to be instructive, educative and a ground for further interesting discussion about future urban development and regeneration.



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Reference projects

The following projects contain or resembles elements of what this thesis has been investigating.

Transformations

Project: The Weaves, MVRDV, 2019.
Location: Seoul, South Korea.
Program/Size: Public / 630 000 m^2
Reuse and reclaming of infrastructure and nature.
https://www.mvrdv.nl/projects/411/the-weaves

Project: Seoullo 7070 Skygarden, MVRDV, 2017.
Location: Seoul, South Korea.
Program/Size: Public / 9 961 m^2
Reuse of infrastructure
https://www.mvrdv.nl/projects/208/seoullo-7017-skygarden

Project: The Hauge Canals, MVRDV, 2019.
Location: The Hauge, The Netherlands
Program/Size: Public / n.d
Reuse of infrastructure
https://www.mvrdv.nl/projects/407/the-hague-canals

Project: Madrid Rio Park, West 8, 2011.
Location: Madrid, Spain
Program/Size: Public, Commercial / 1 210 881 m^2
Reuse of infrastructure, revitalziation of river
http://www.west8.com/projects/madrid_rio/

Project: Westergasfabriek, Mecanoo, 2006.
Location: Amsterdam, The Netherlands
Program/Size: Public, Commercial / 135 000 m^2
Reuse of industrial heritage
https://www.mecanoo.nl/Projects/project/91/Westergasfabriek-Terrain?t=0

Tactical/Transformative urbanism

Project: Pink Balls, Claude Cormier + Associes, 2011
Location: Montreal, Canada
Program/Size: Public / 1 km street
Infrastructure as urban communicator/arena
https://www.claudecormier.com/en/projet/pink-balls/

Project: Portals to Places initiative , Project for public spaces, 2019
Location: n.d, n.d
Program/Size: Public/Mobility / n.d
Infrastructure as place making
https://www.pps.org/portals-to-places

Project: Metro Cable, Urban Think Tank, 2010
Location: Caracas, Venezuela
Program/Size: Public/Mobility / n.d
Infrastructure as social activator
http://u-tt.com/project/metro-cable/

Project: Weekly closing of highway, Sao Paolo municipality, n.d
Location: Sao Paolo, Brazil
Program/Size: Public / 22 km highway
Highway closed on Sundays as a gradual transition to public space
https://www.theguardian.com/cities/2017/dec/01/taming-worm-minhocao-elevated-high-way-sao-paulo

Parametric/Mobility/Visionary urbanism

Project: Toronto Smart City, SideWalklabs, future vision
Location: Toronto, Canada.
Program/Size: Mixed / 49 000 m^2
Smart city research development
https://www.sidewalklabs.com/

Project: Woven City, BIG, 2021
Location: Fuji, Japan.
Program/Size: Mixed / 70 000 m^2
Smart city and integration of autonomous vehicles
https://www.dezeen.com/2020/01/07/big-toyota-woven-city-future-mount-fuji-japan/

Project: round Around, MIT Media lab, 2019
Location: Amsterdam, The Netherlands
Program/Size: Mobility / n.d
Automus boat fleet, on-demand infrastructure
http://senseable.mit.edu/roundaround/

Project: EgoCity, The Why Factory, 2015
Location: n.d
Program/Size: Mixed / adaptive
Adaptive and responsive living space
https://thewhyfactory.com/output/ego-city/

Project: PoroCity, The Why Factory, 2018
Location: n.d
Program/Size: Mixed / adaptive
Adaptive building typology exploring urban density
http://thewhyfactory.com/project/porous-city/

Project: SkyCity The Why Factory, 2018
Location: n.d
Program/Size: Mixed / adaptive
Non constrained parametric on-demand urbanism
https://www.mvrdv.nl/news/2498/mvrdv-and-the-why-factorys-contributions-to-the-uabb-in-shen-zhen-

APPENDIX

Composition / process

Step story of the process

Obsolete infrastructure to urban resource

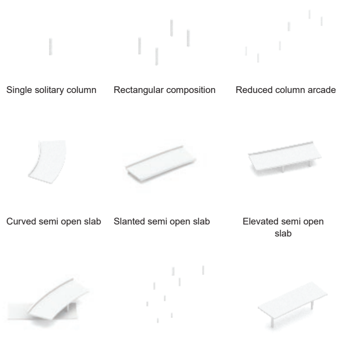
A descriptive story on how a selected fragment of mobility infrastructure can transform from obsolete artifact to urban resource.

Identify infrastructure
A certain portion of an infrastructural context is chosen to be investigated.

Parametric model
The dynamic parameters of the paramteric model is adjusted to best represent the physical appearances of the selected infrastructure system.

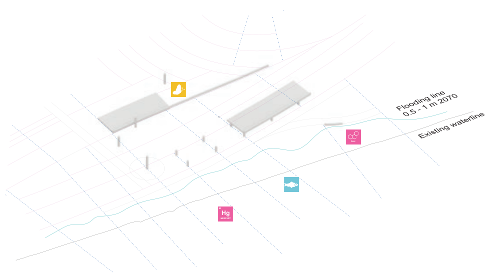
Local adaptaion
The model is quantified and locally adapted to represent the real scenario

Simulation/Seed
The reduction script is gradually transforming the system. Each step is observed to reveal the potential spatial value in the sole elements and in their newly emerged relation to one another.



Single solitary column
Rectangular composition
Reduced column arcade
Curved semi open slab
Slanted semi open slab
Elevated semi open slab
Intersecting open slab
Curved and stepped columns
Elevated centered open slab

Observations
Specific elements of interest are classified to be further used as design tools.

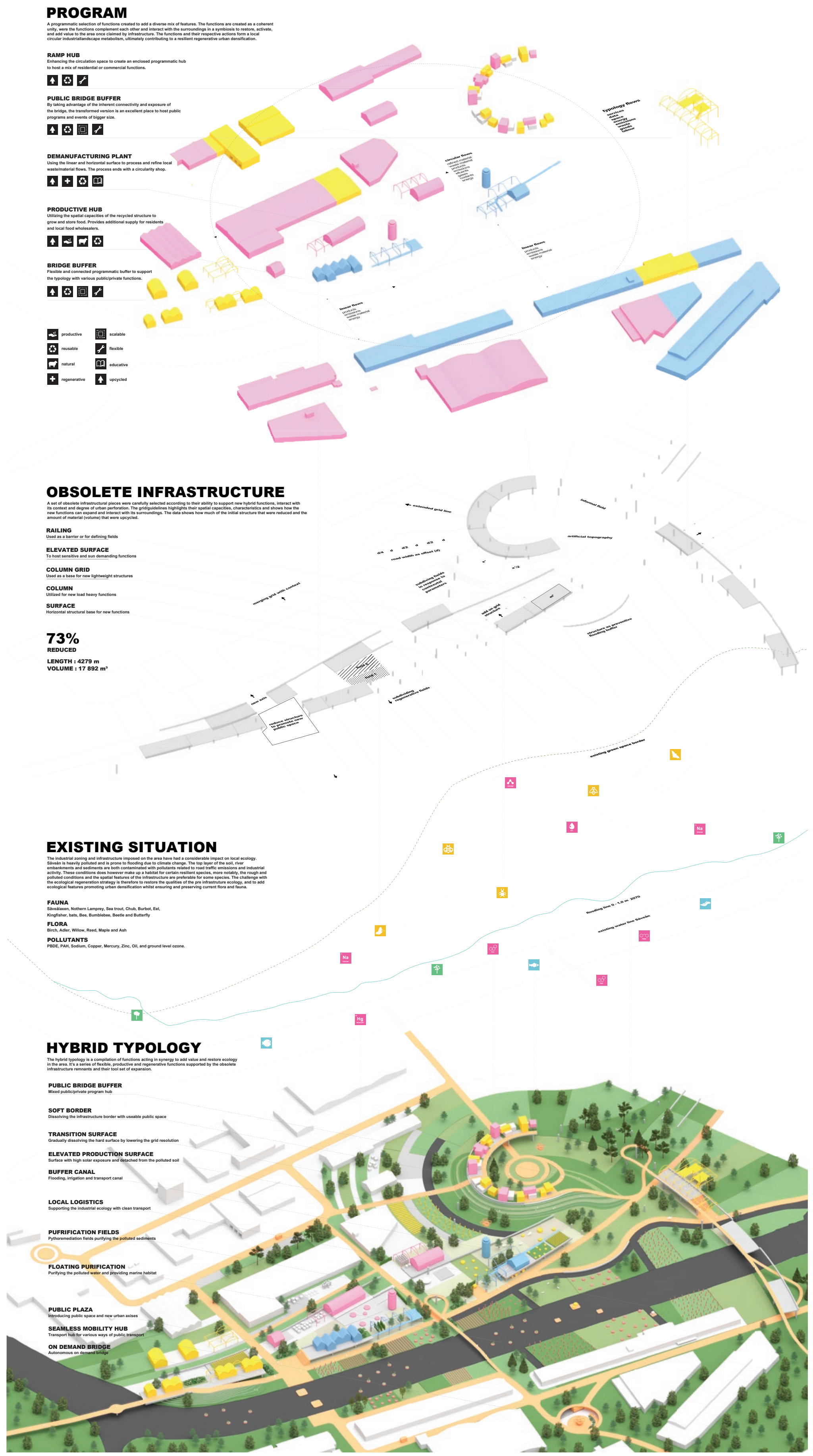


Transformation
Transformation strategy based on the specific spatial potentials of the previously observed elements combined with local conditions.

Design scenario
A set of responsive design solutions manifested in a hybrid typology with the aim of adding value and restoring ecology in the area.

Composition / exploded axonometric

Exploded axonometric of the major components of the design scenario



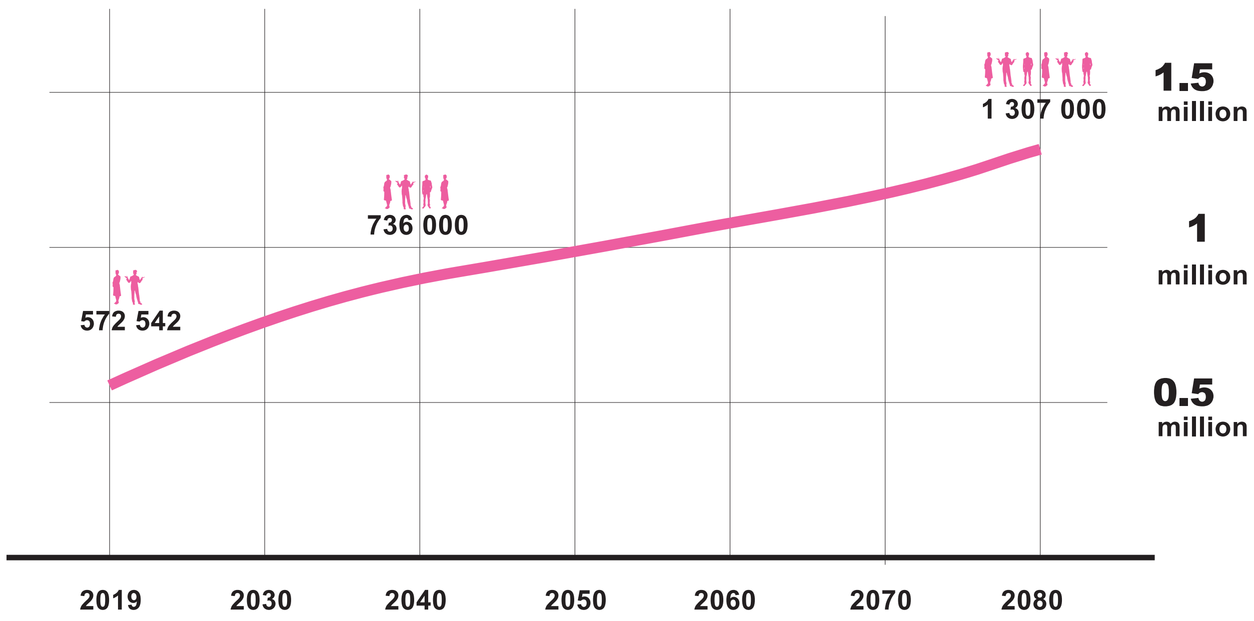
Urbanization (additional research)

Today we are facing unprecedented urban and societal challenges in terms of climate change, population growth and social disparity. The urbanization rate is ever increasing, which puts an immense pressure on our natural and artificial environment. The cities of tomorrow needs to be resilient and sustainable to a whole new degree to accommodate this rapid development. The people living in urban areas today are about 55% (4.2 billion people), a number that is expected to rise to about 68% by 2050 (9.7 billion people) (UN, 2018). To deal with these changes is an decisive challenge for any urban area, and it has profound impact beyond the mere physical densification. Food, energy and waste has to be produced and processed within a new urban fabric, a city planned with a holistic and non linear approach ready to face a different spatial and mental reality.

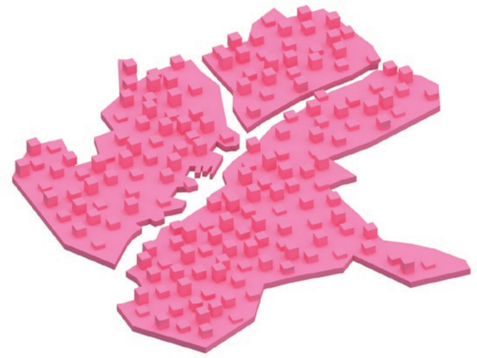
Density

Sweden is seeing similar patterns of urbanization were 85% of the people live in the urbanized areas, and more interestingly 85% of the people living on 1.3% of the total area, a number that is expected to rise even more (Boverket, 2019). This means our cities are growing, the already urbanized areas around Stockholm, Gothenburg and Malmö are experiencing the biggest growth. Gothenburg has a total population of 572 542 today (2019) and is expected to grow by the following numbers (Goteborg, 2019).

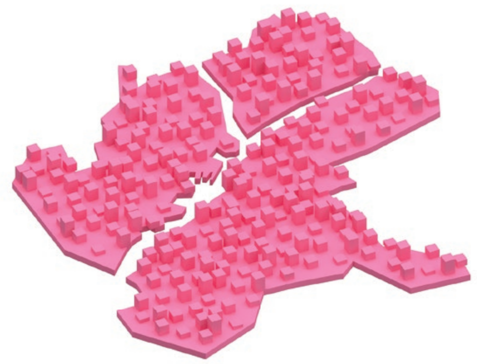
Gothenburg predicted population growth/year



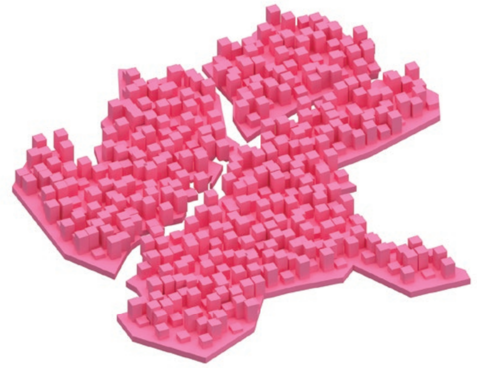
* Year 2080 is calculated by comparing Gothenburgs current share of the population to the national population projections (SCB, 2019).



1276
Persons / km²
in 2019 *



1639
Persons / km²
in 2040

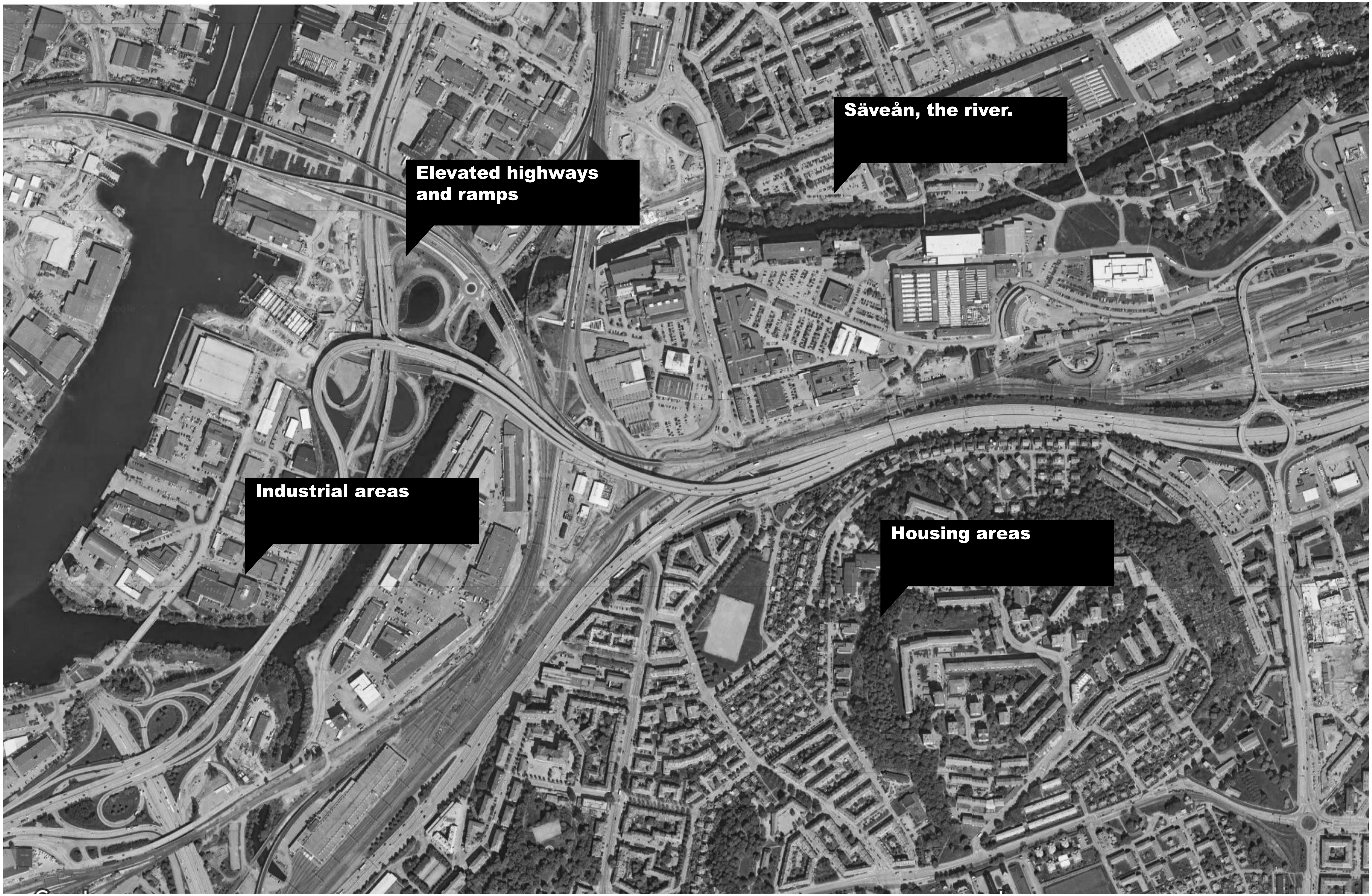


2913
Persons / km²
in 2080

These are speculative calculations based on the assumption that the municipal border doesn’t expand considerably and as a result the city is heavily densified.

* Year 2019 is measured data. Following numbers are proportional speculative calculations (Regionfakta, 2019).

Sample site (full map)

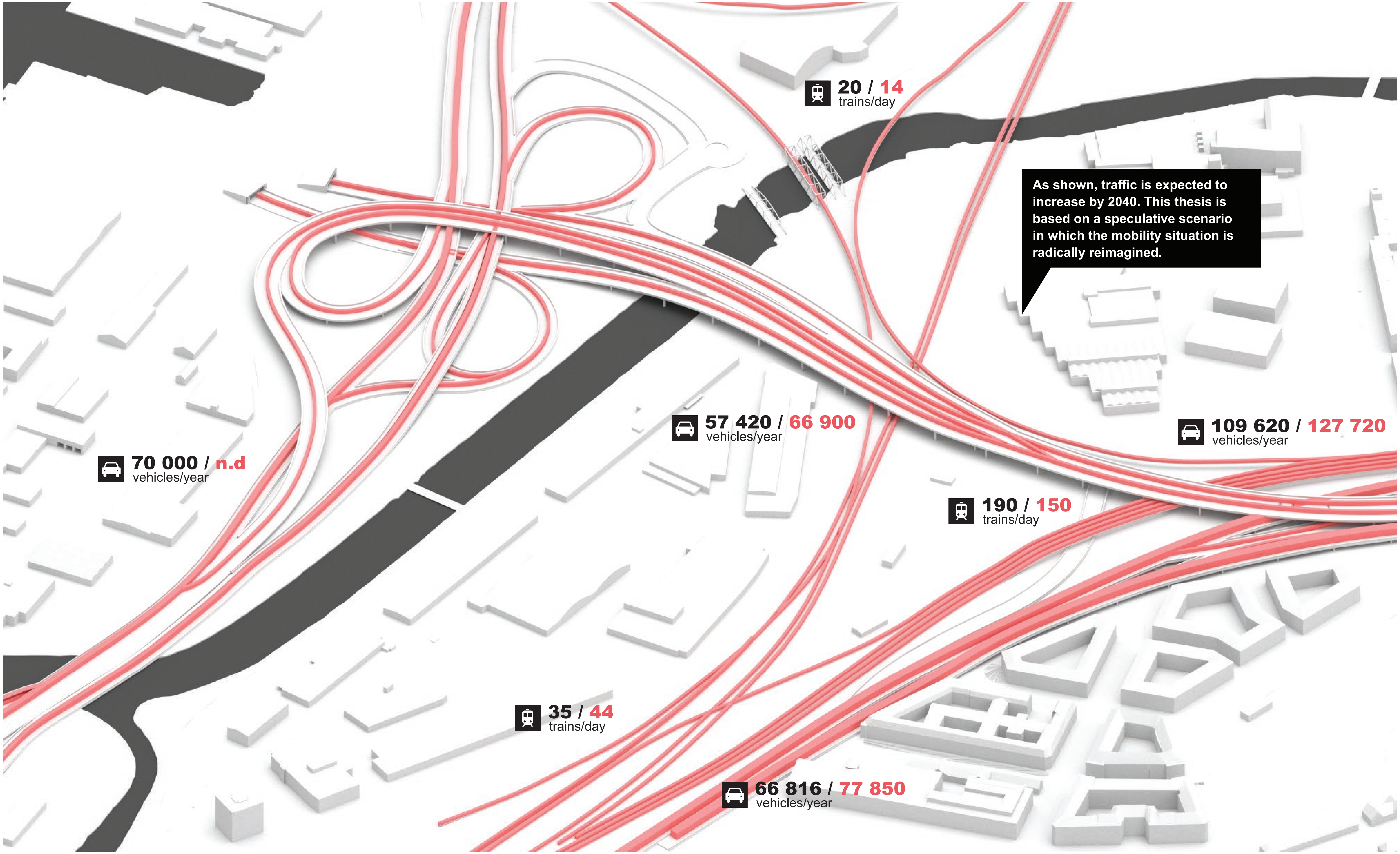


Representative sample site with typical Gothenburg elements showing the fragmentation of urban fabric

Historical map 1809

Figure 5. Historical map Gothenburg 1809 (Göteborgs stad, n.d.) Reprinted with permission.

Flows (full map)



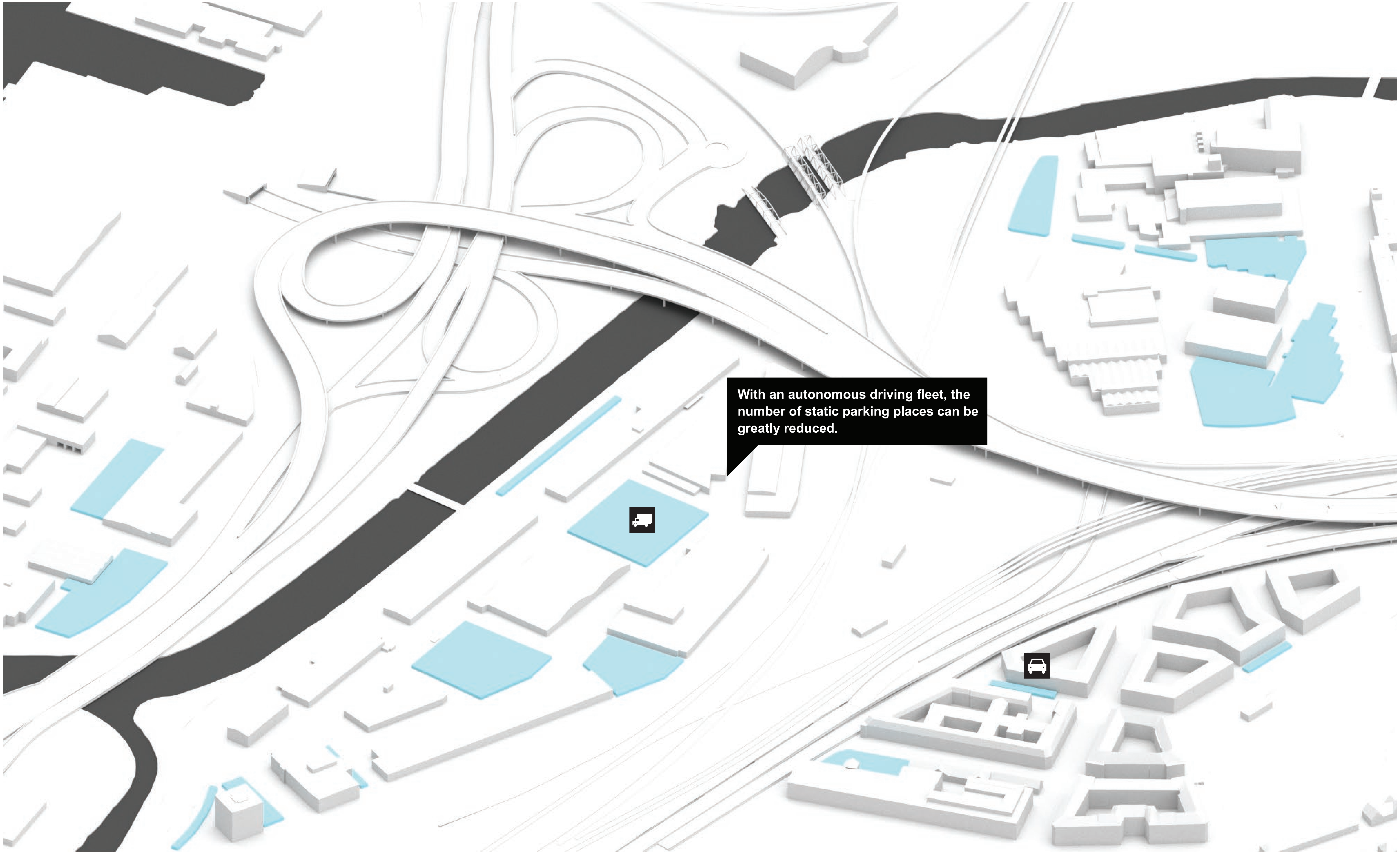
Mobility

The magnitude of traffic flows has considerable impact on how the infrastructure affects the surrounding area. Higher values results in higher levels of emissions but also light, visual and noise pollution.

* Data collected form the risk analysis of dangerous goods (COWI, 2017).

Traffic flow 2020
Expected flow 2040

Parking space (full map)



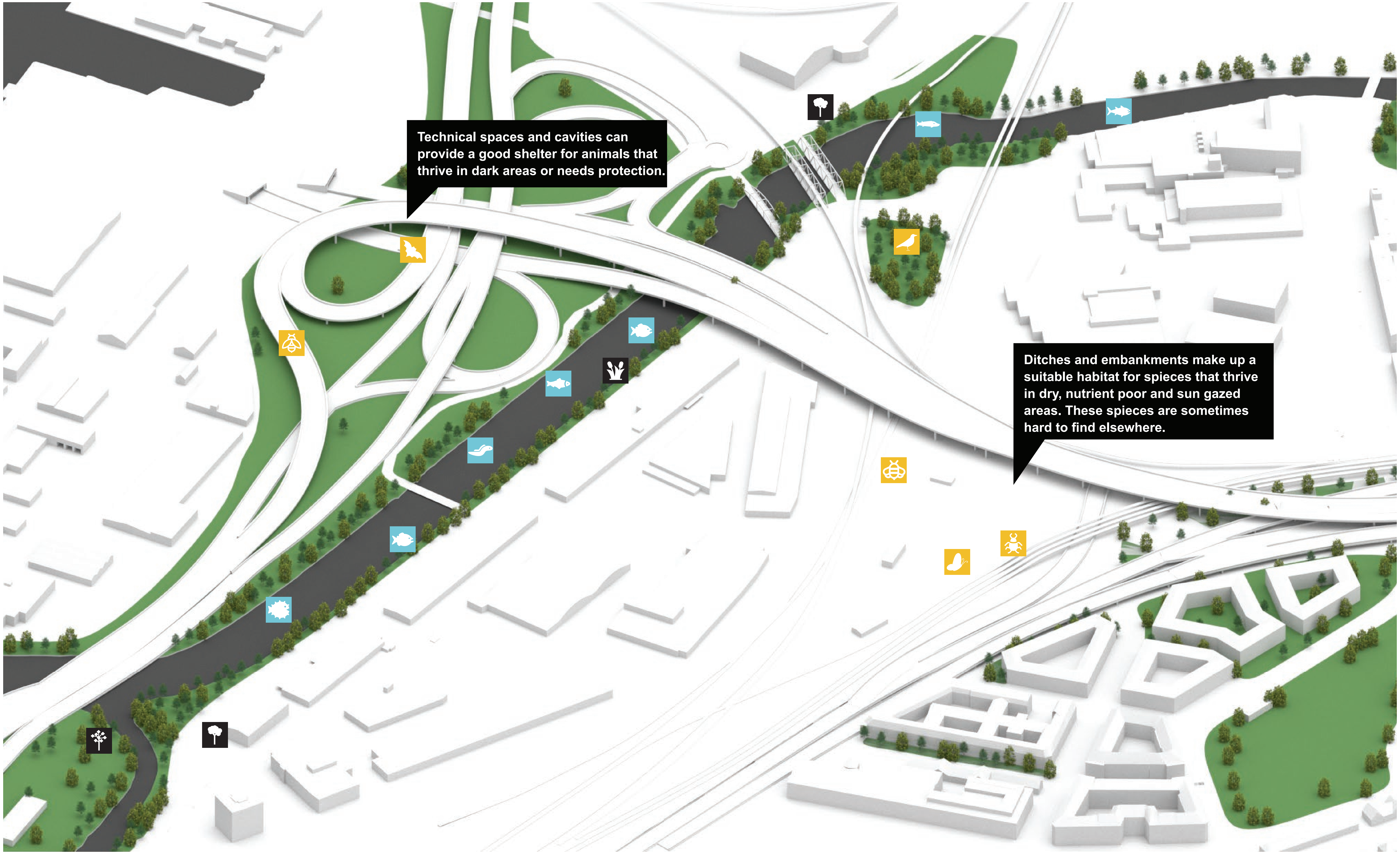
Parkings

Current parking spots. This map does not show internal parking spots on properties.

Parking surface : 61 830 m²

Parking

Flora and Fauna (full map)



Fauna

Säveån is a natural habitat for Säveålaxen and Kungsfiskaren. It also hosts numerous resilient species that can survive the contaminated waters. (Stadsbyggnadskontoret, 2004).

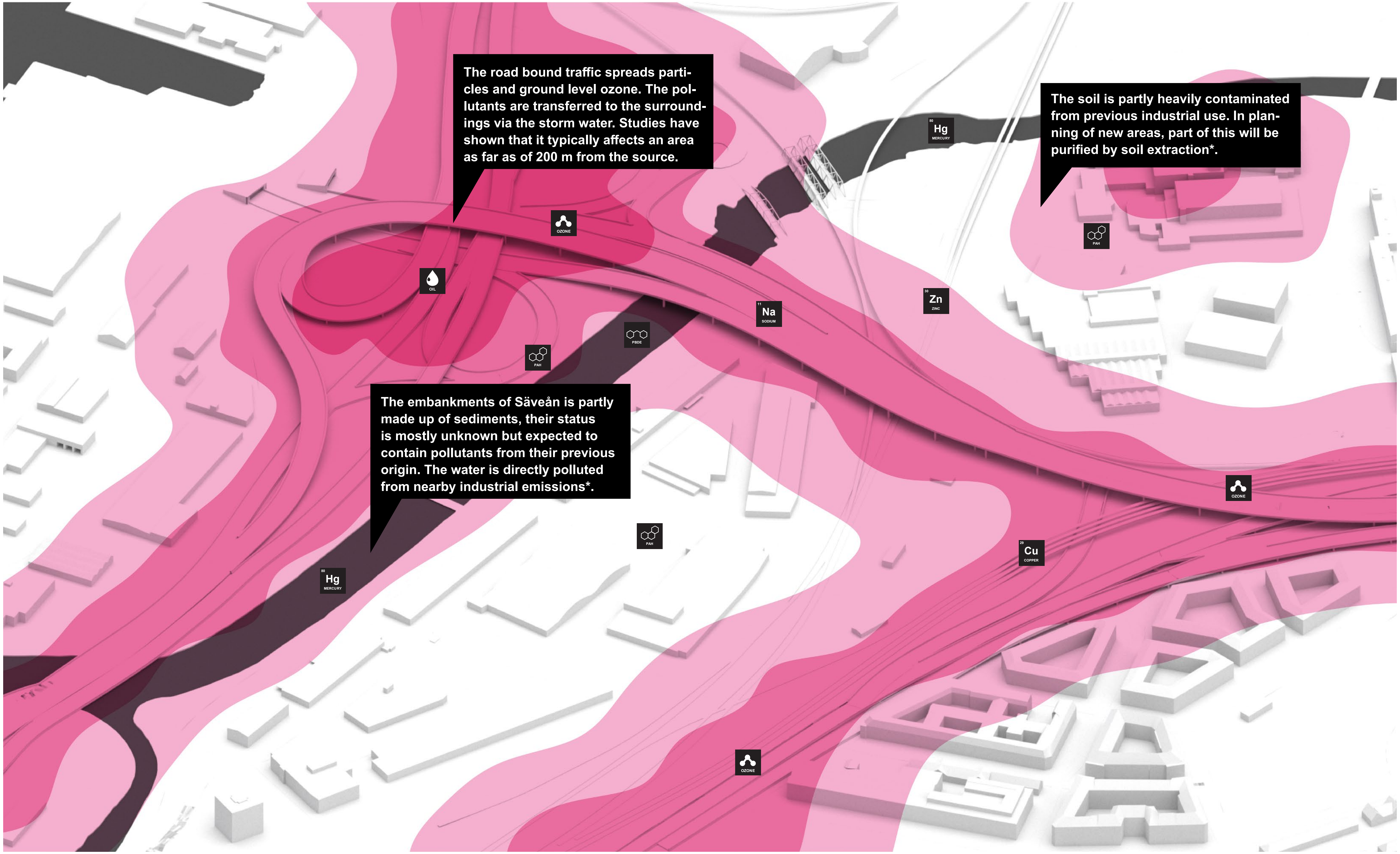
Green space : 305 500 m²

Fishes: Säveålaxen, Nothern Lamprey, Sea trout, Chub, Burbot

Birds/Insects: Kingfisher, bats, Bee, Bumblebee, Beetle and Butterfly

Trees and plants: Birch, Adler, Willow, Reed, Maple and Ash

Pollutions (full map)



Pollutions

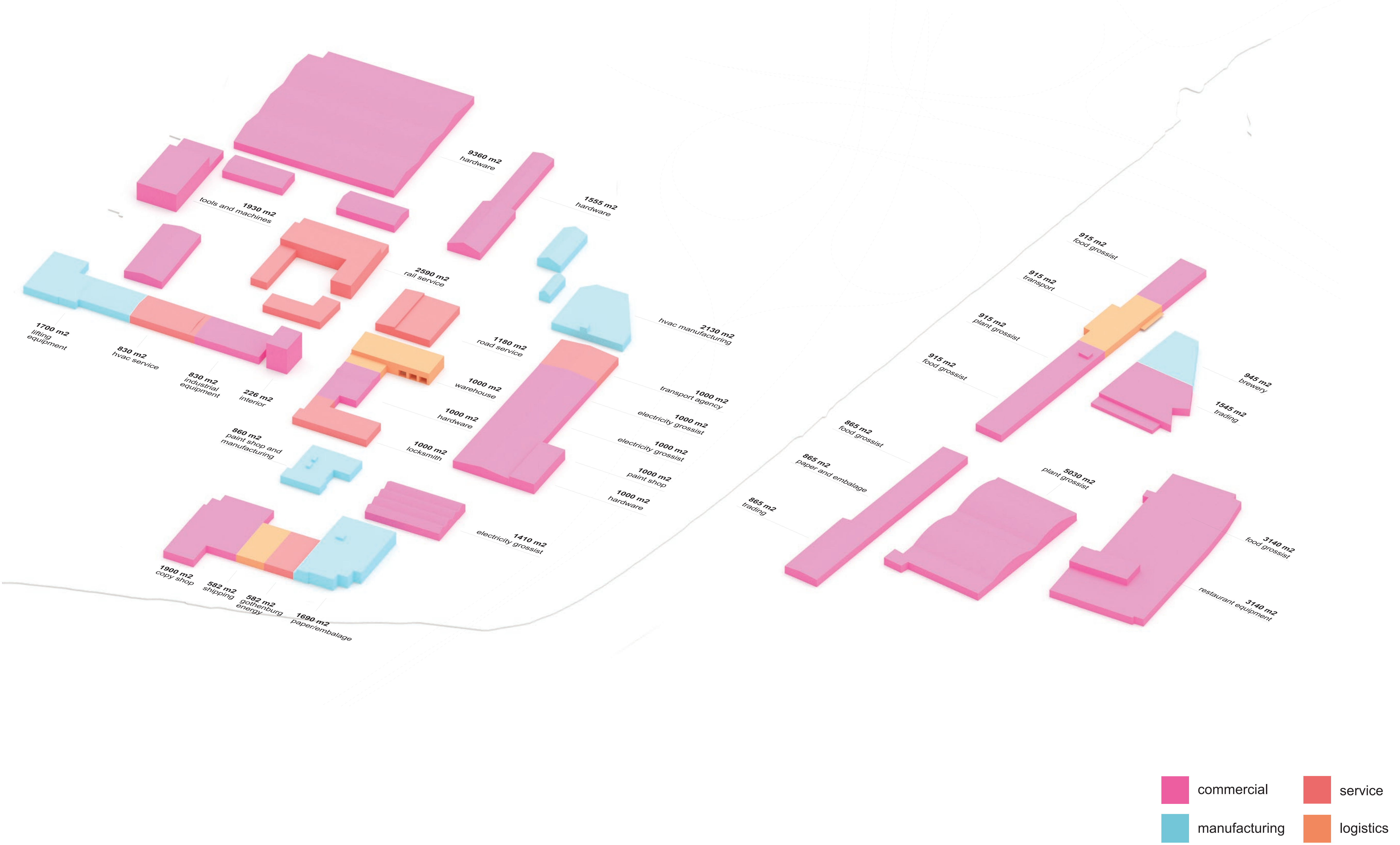
The area has various sources of pollution. The road traffic emits not only pollutants from combustion, but also particles due to frictional tear from the vehicle and road surface (Trafikverket, 2005).

Pollutants: PBDE, PAH, Sodium, Copper, Mercury, Zinc, Oil, and ground level ozone.

* Pollutions data retrieved from the environmental consequence analysis (Jakobi, 2019)

Program characteristics (full map)

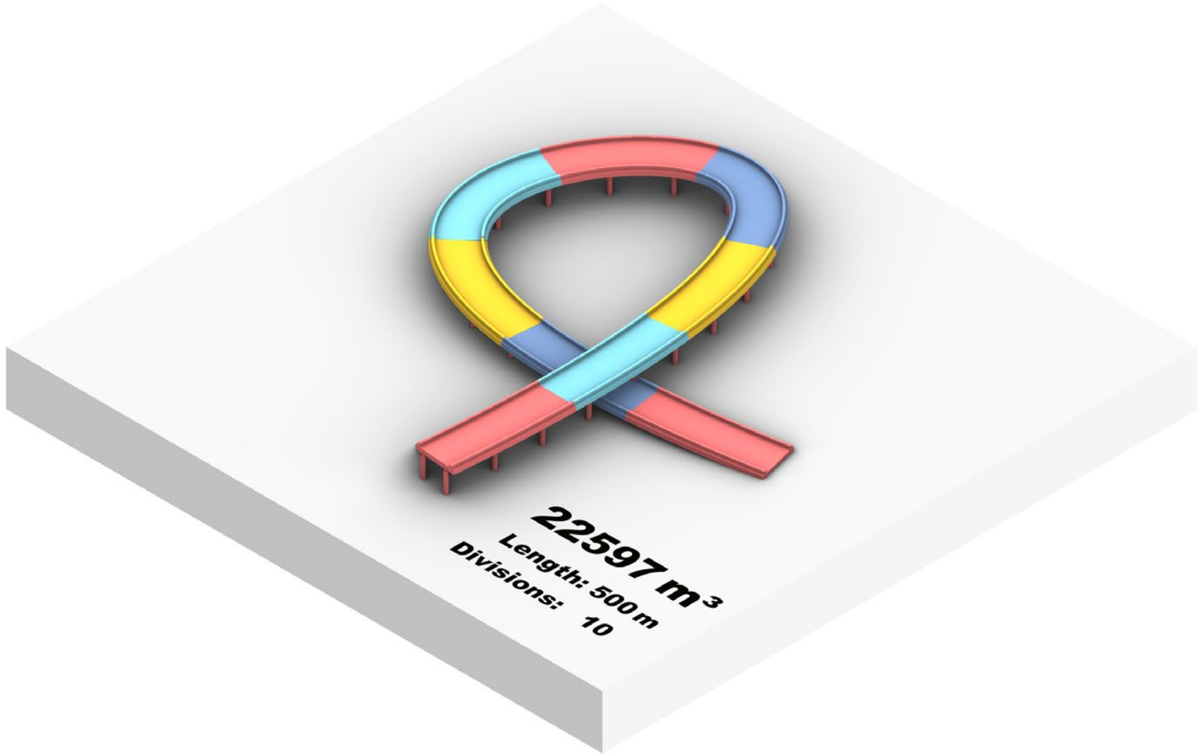
By analyzing the programmatic functions* in close proximity we can suggest certain synergies and connections between the existing and the emerging additions.



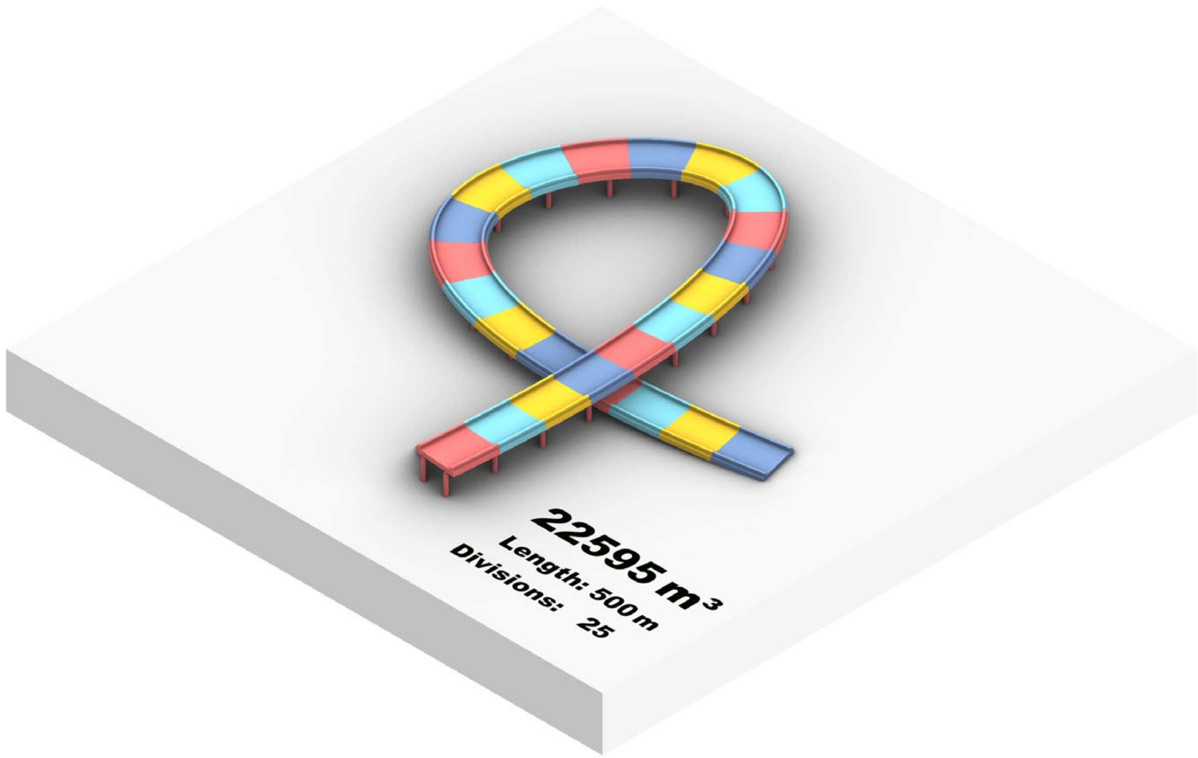
* Programmatic functions extracted from eniro/google maps. When data was missing the functions were arbitrarily divided within the total volume.

Prototype model / subdivisions

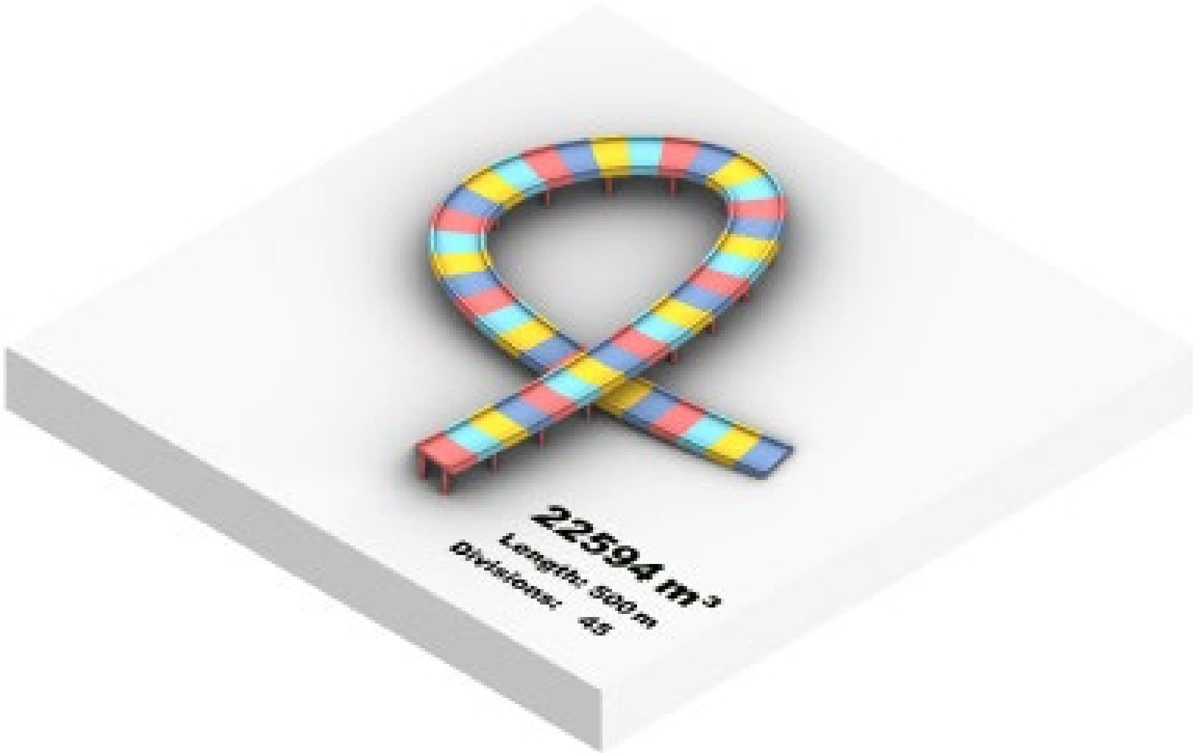
Different number of subdivisions. The model instance could be divided into different fragments, were the fragments may have unique or similar properties to respond to various conditions.



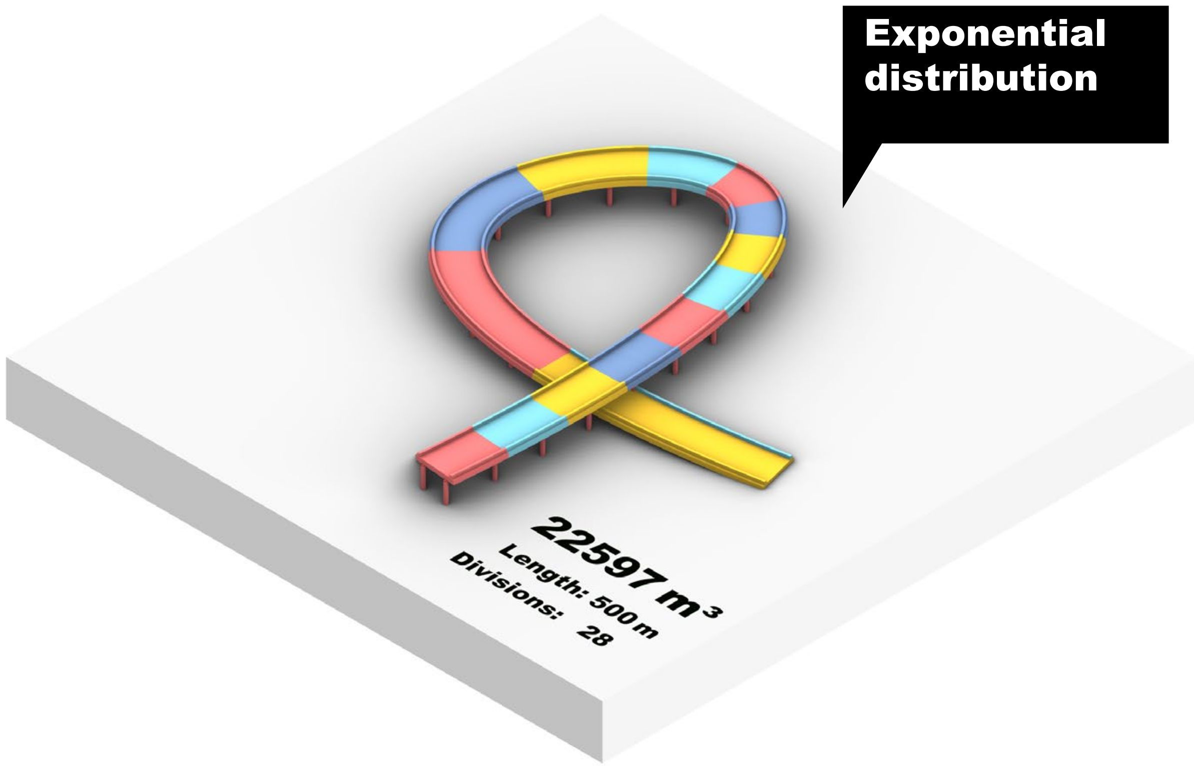
10 Linear divisions



25 Linear divisions



45 Linear divisions

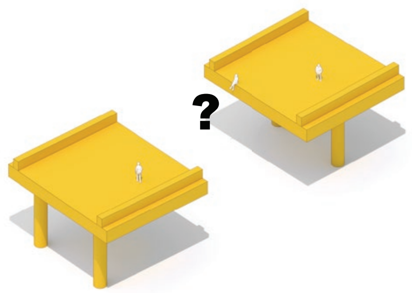


14 Exponential divisions

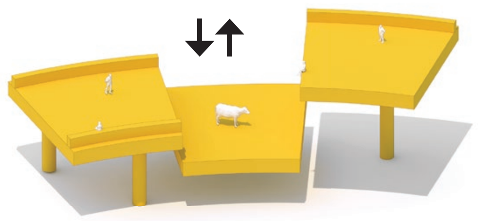
Prototype model / Observations

During the deconstruction process different interesting spatial relations emerges.

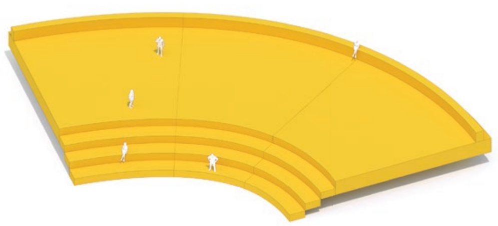
Void
Removing or enforcing the mental and physical barrier the infrastructure constitutes. Infill structure?



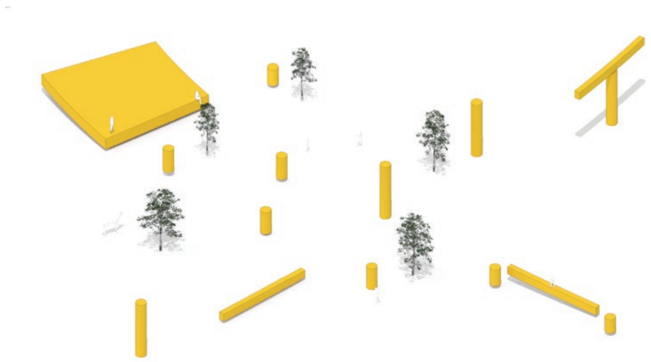
Levels
Differentiating functions by levels



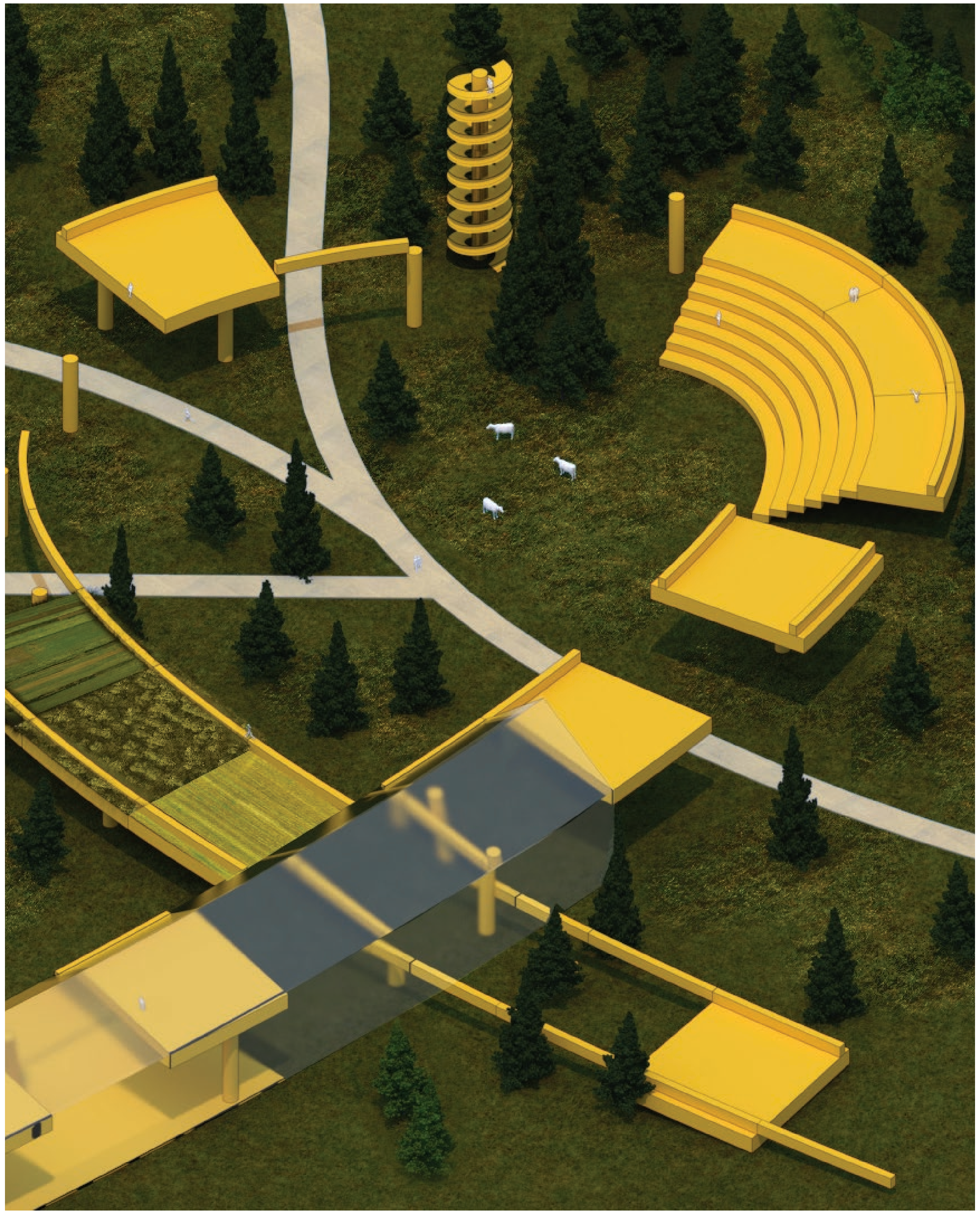
Enforcing
Utilizing the existing shape to accommodated certain functions. May also be further extended and adapted.



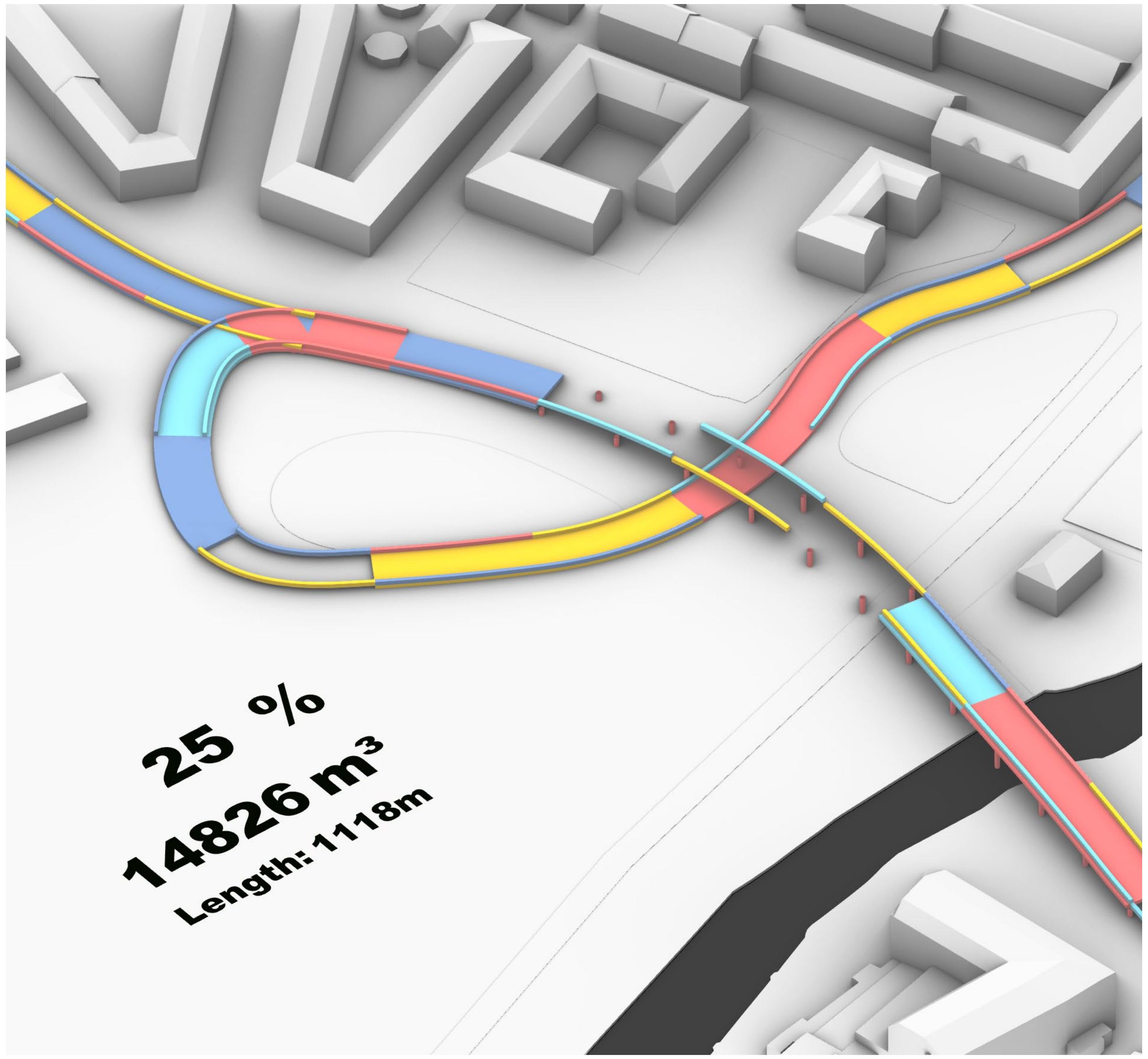
Solitary
Further emphasizing and strengthen the dissolved structure could result in a new urban nature



Composition
Testing how the spatial elements can work together in a fictive context.



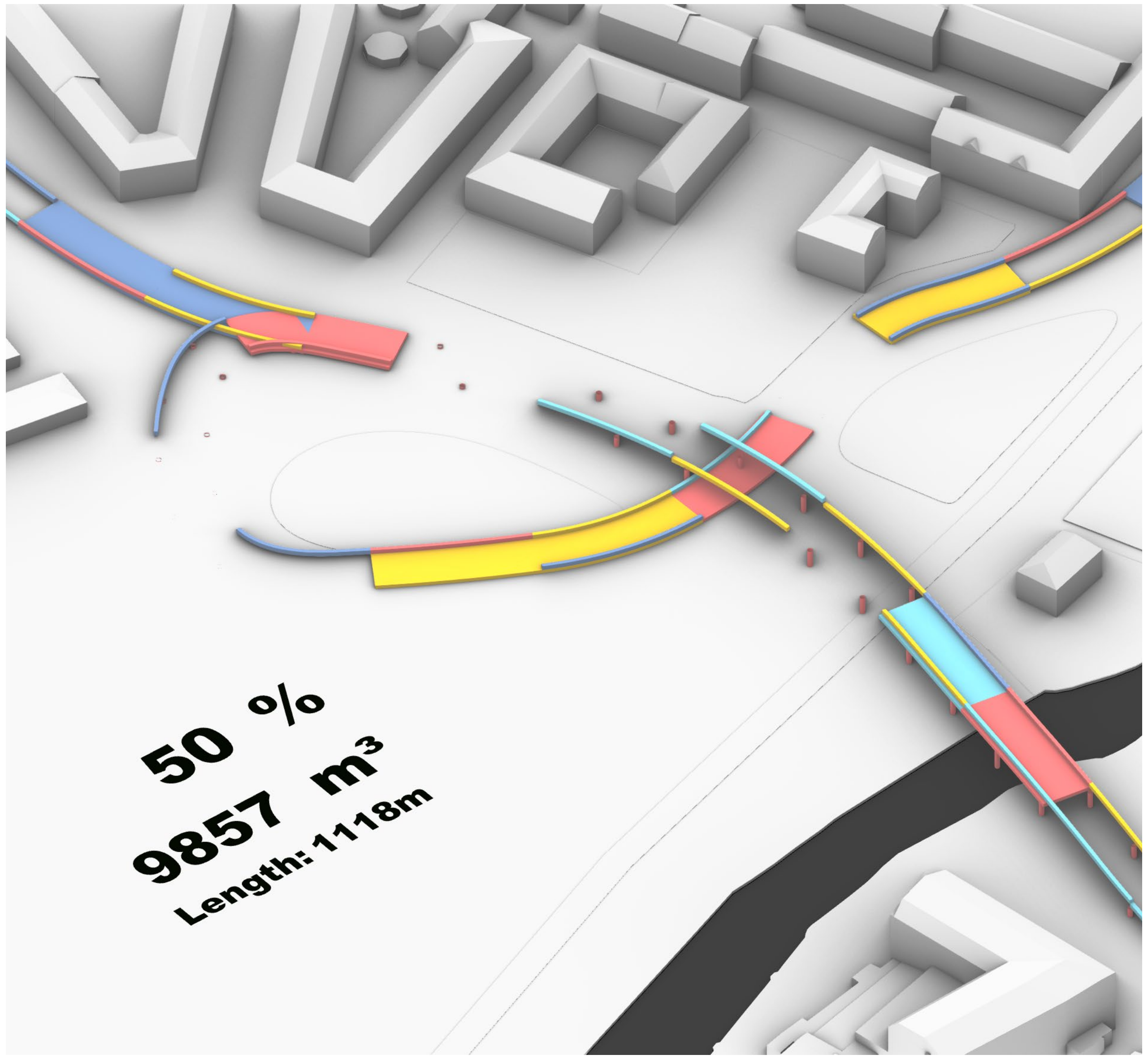
Sketch iteration / Contextual input
Reducing a infrastructural system with contextual parameters



Observations
The initial reduction invites adjacent buildings and the border starts to dissolve

25%
Reduced

Length : 1118 m
Volume : 14 826 m³

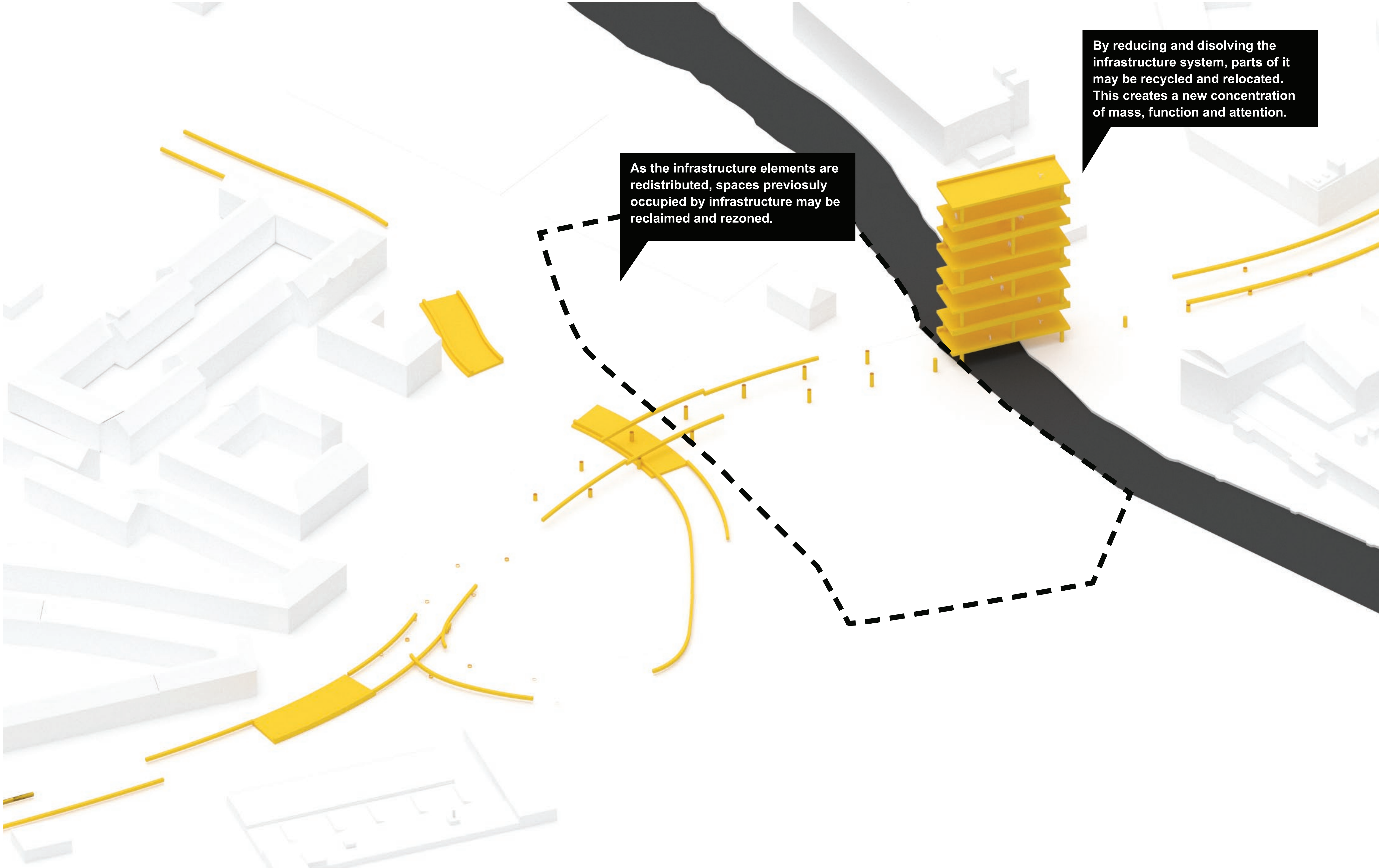


Observations
The reduced space creates a new relation with adjacent residential build-ings

50%
Reduced

Length : 1118 m
Volume : 9857 m³

Sketch iteration / Contextual input



Sketch iteration / Contextual input