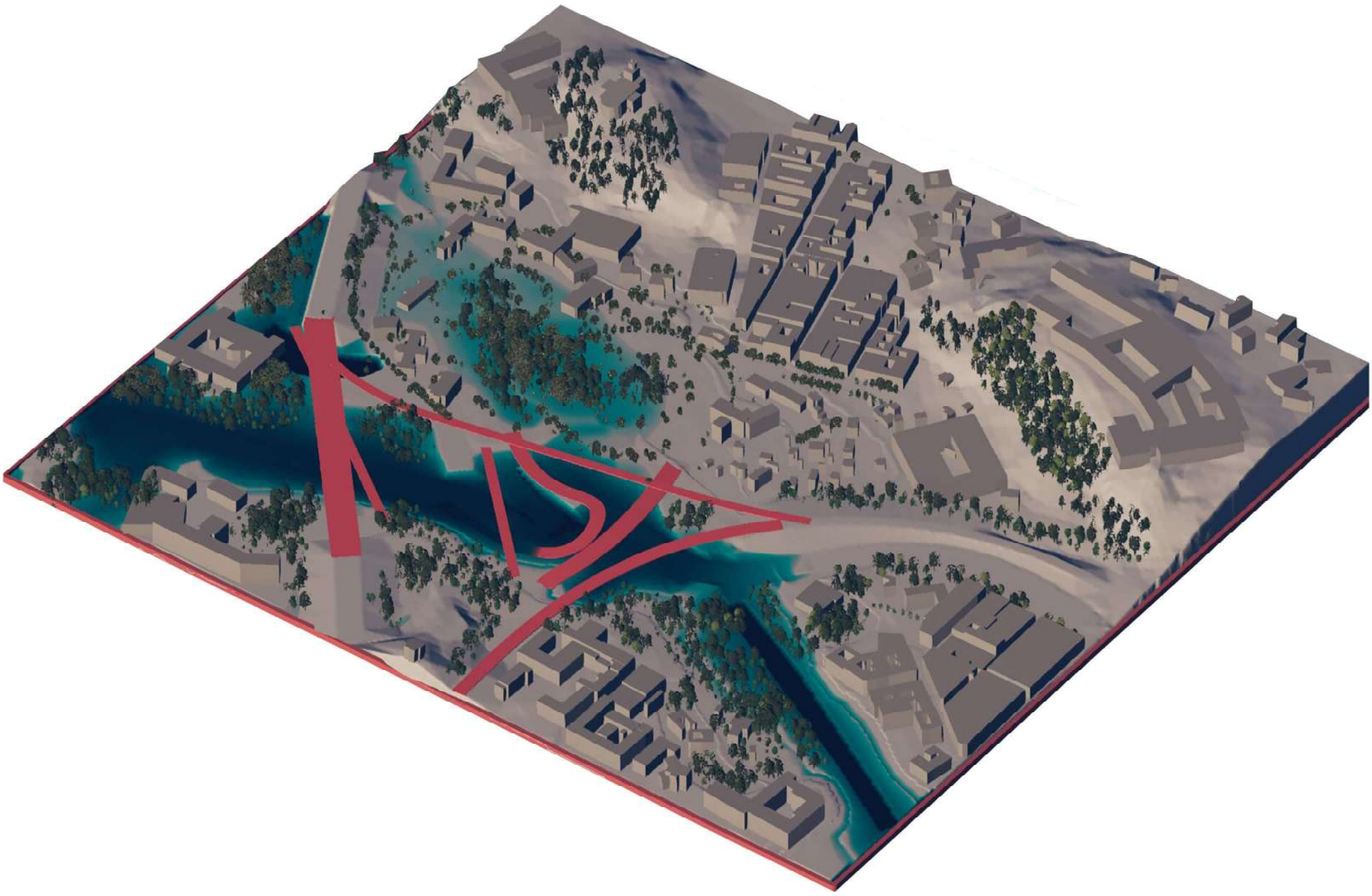
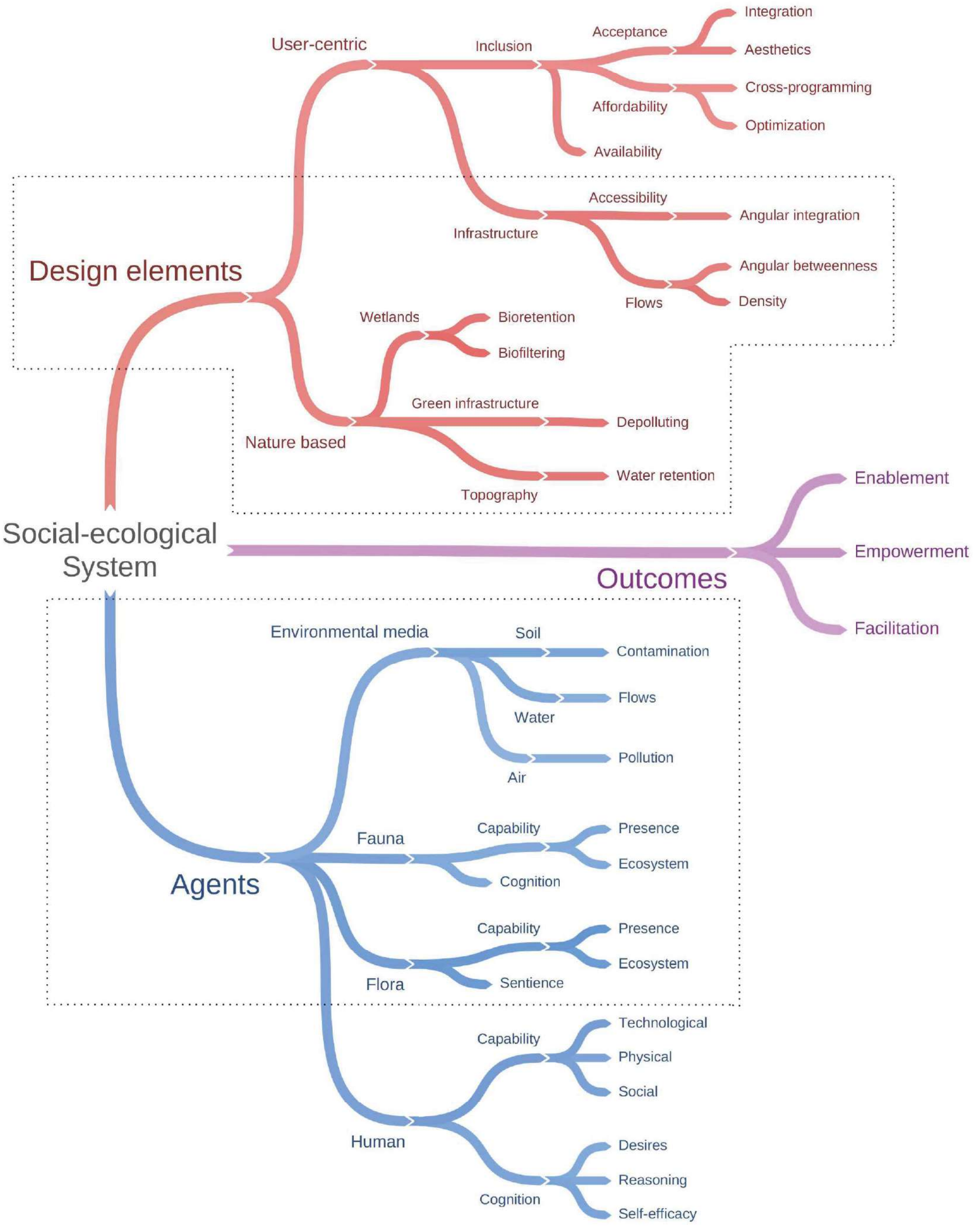



Design elements
User-centric
Inclusion
Acceptance
Integration
Aesthetics
Affordability
Cross-programming
Optimization
Availability
Infrastructure
Accessibility
Angular integration
Flows
Angular betweenness
Density
Nature based
Wetlands
Bioretention
Biofiltering
Green infrastructure
Depolluting
Water retention
Topography
Social-ecological System
Outcomes
Enablement
Empowerment
Facilitation
Agents
Environmental media
Soil
Contamination
Flows
Water
Pollution
Air
Fauna
Capability
Presence
Ecosystem
Cognition
Flora
Capability
Presence
Ecosystem
Sentience
Human
Capability
Technological
Physical
Social
Cognition
Desires
Reasoning
Self-efficacy

0 750 1,500 m

flooding risk dm
- flood_risk_10
- flood_risk_worst case
- flood_risk_15
- flood_risk_20
- flood_risk_25
- flood_risk_30
- flood_risk_35
- flood_risk_40
- flood_risk_45
- flood_risk_50
- flood_risk_100

References:

Compendium Remediation of Contaminated Sites in Sweden, 2021, Version 1.

Borges J. Luis, 1969, Labyrinths: Selected Stories & Other Writings.

Stavroulaki I., Marcus L., Berghauser Pont M., (2019), GIS-based Time model. Urban development in Gothenburg, 1960 to present, Research report, Fusion Point Gothenburg, Älvstranden Utveckling AB DOI: https://doi.org/10.13140/RG.2.2.18909.97760

Swedish environmental protection agency report 7074, 2022.

Intertwined with infrastructure like the E6 motorway causing pollution, going through historically contaminated sections, and heavy water run off coming from the east. This valley grapples with severe environmental challenges, facing heightened flooding risks during intense rainfall or storms, distinguishing it as *the most vulnerable river valley.*

buildings
- Industry
- public space
- commercial
- water_surfaces

Assets

River Valleys: The presence of river valleys provides a natural framework for creating blue-green ecological corridors. These corridors can support biodiversity such as the many species of birds, insects and amphibians. Many freshwater and saltwater species are today endangered and at risk of extinction.

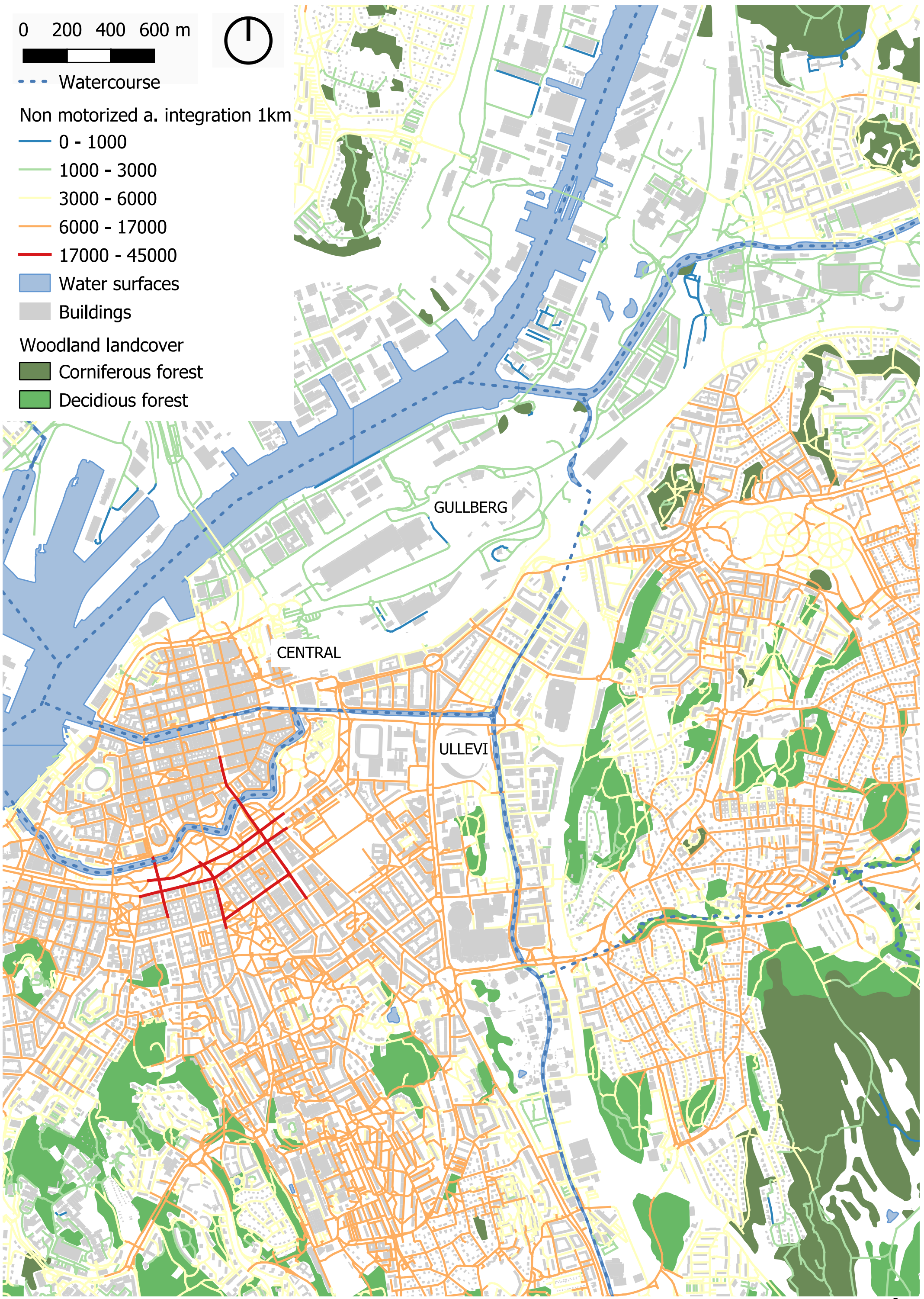
Historic Core: The historic core represents cultural and architectural heritage that can be integrated into a sustainable urban development plan. It serves as a potential asset for enhancing the area's attractiveness and livability.

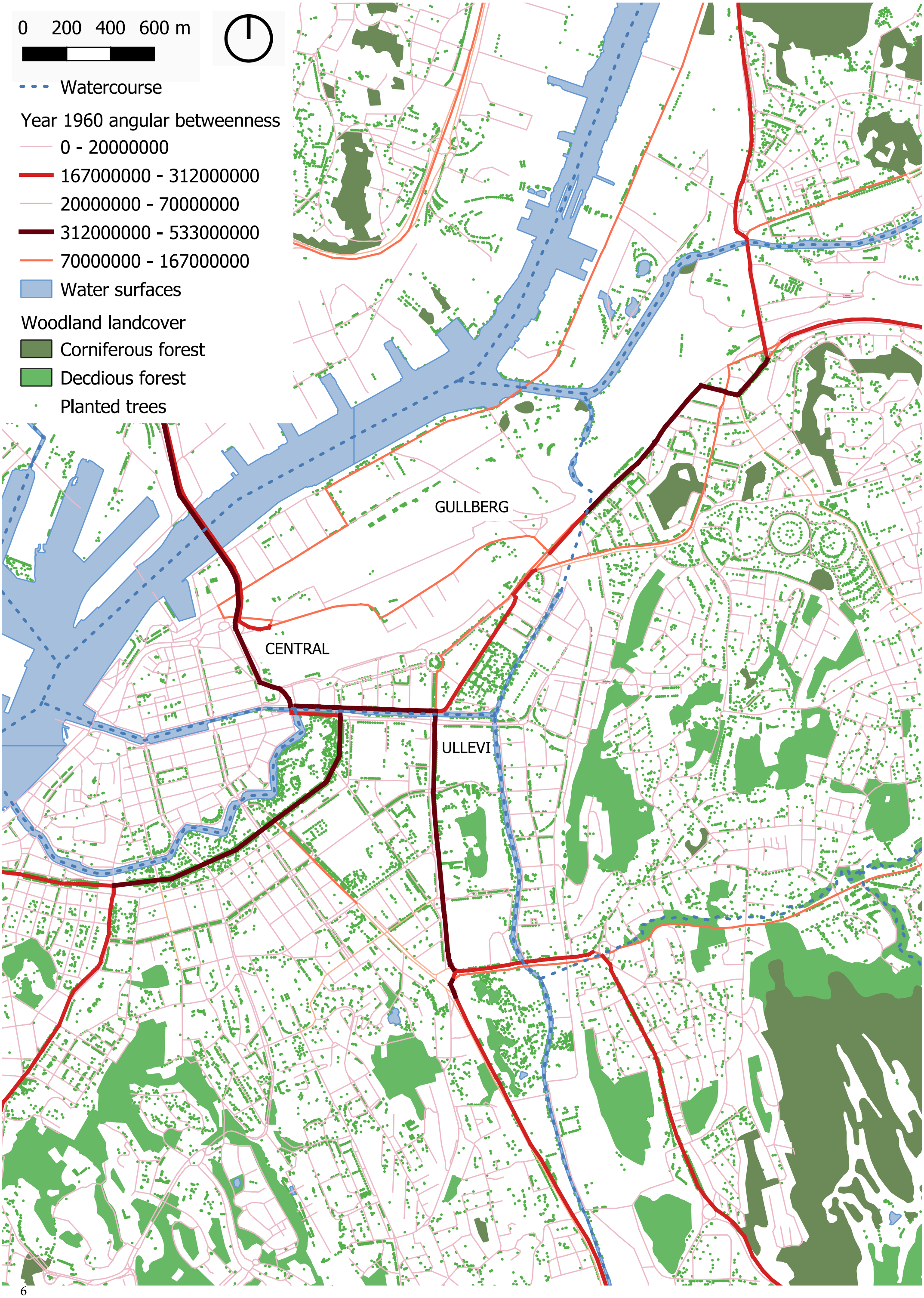
Challenges

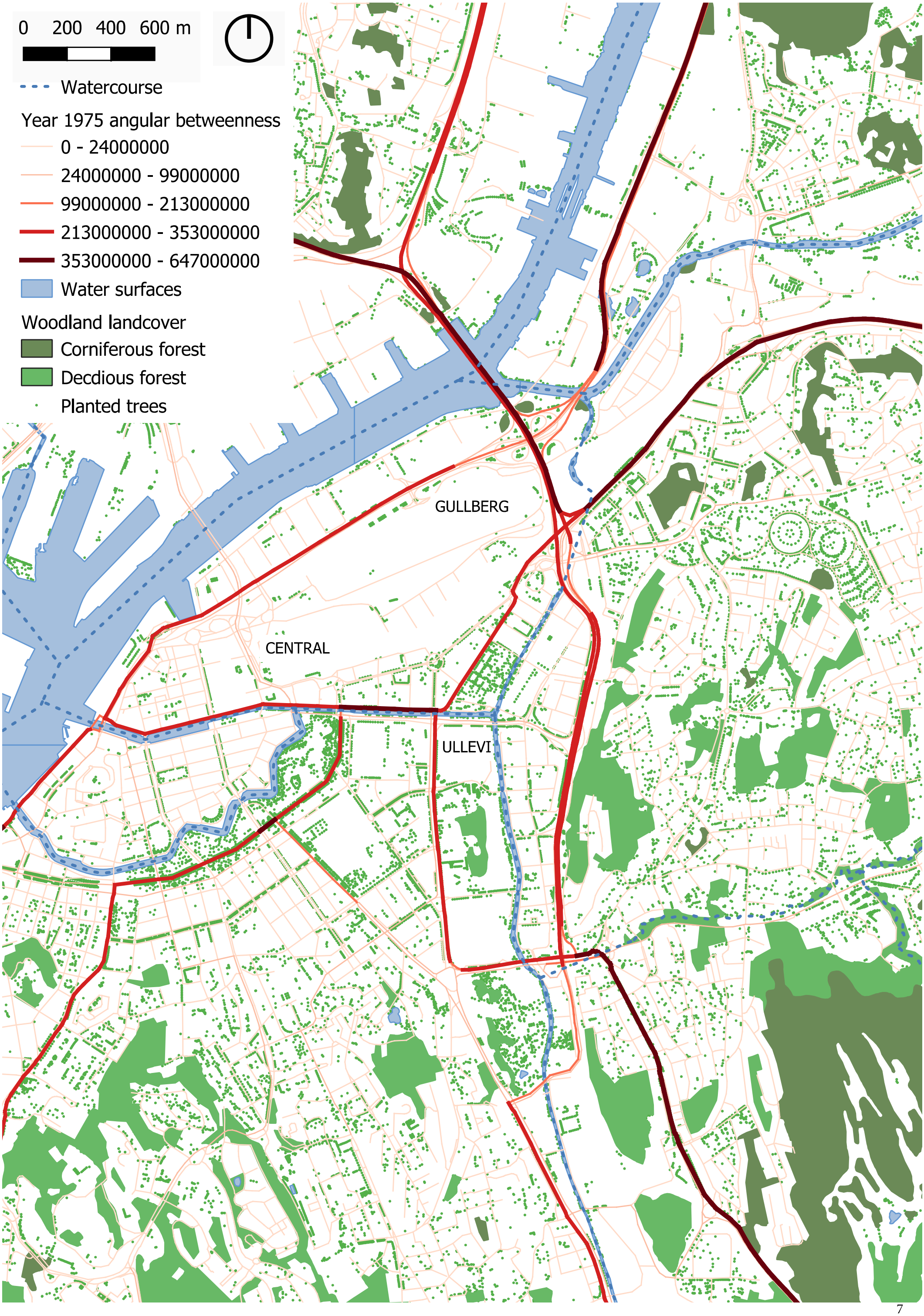
Transporation and separation: The construction of a motorway in Gullberg is a significant challenge. It not only generates noise, air and light pollution but also acts as a physical barrier that disrupts the continuity of the river valleys. This disruption negatively impacts wildlife movement and the overall ecological health of the area, division between the historic core and the excavated canal, which is a historical challenge (Stavroulaki et al., 2019), limits accessibility and connectivity of the corridor hinders the potential for integrated urban planning.

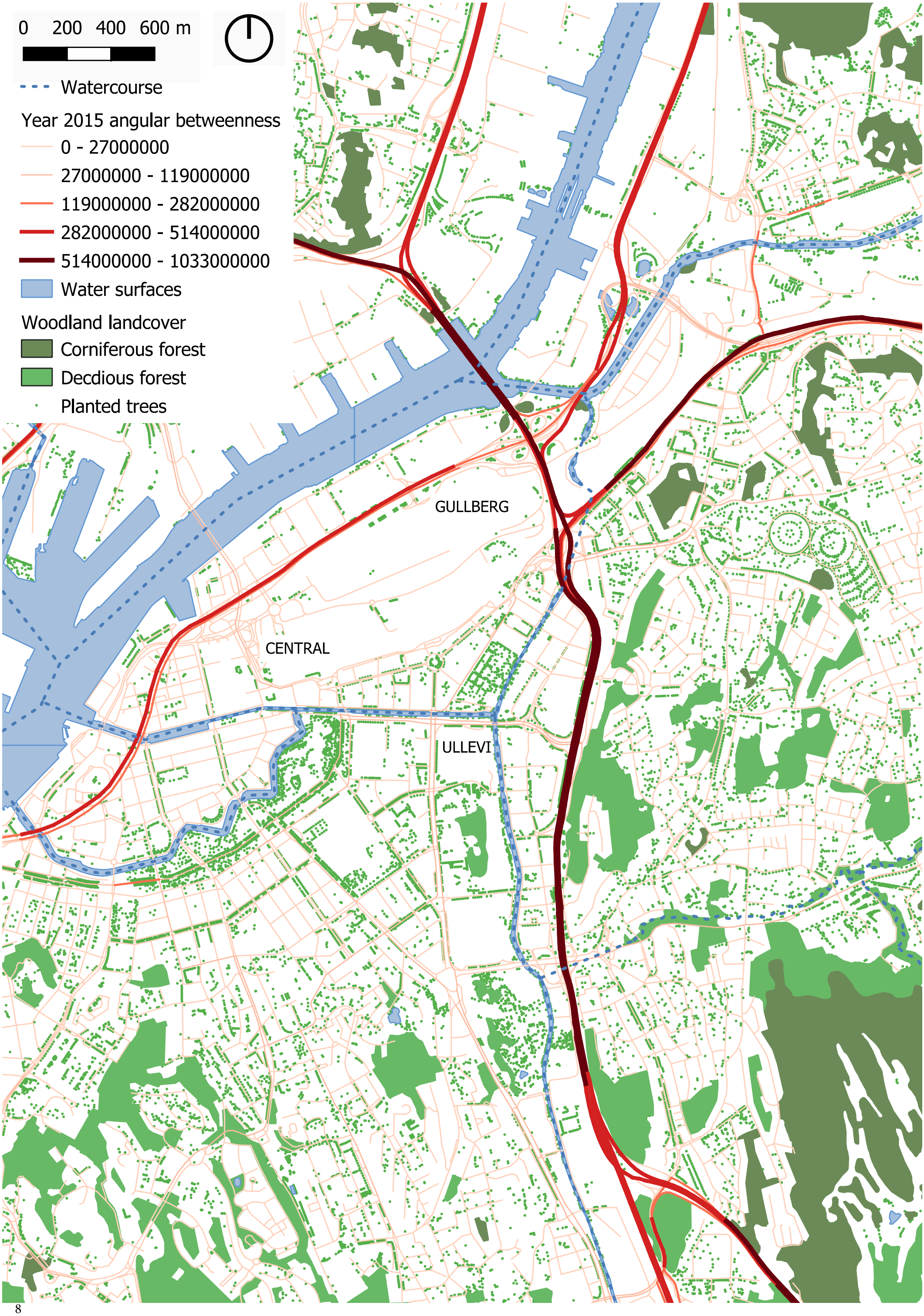
Lack of Green Infrastructure: The area does not have sufficient green infrastructure or nature-based solutions for water management. This deficiency becomes problematic in the event of flooding or other environmental disasters, as there are no natural mechanisms to absorb excess water.

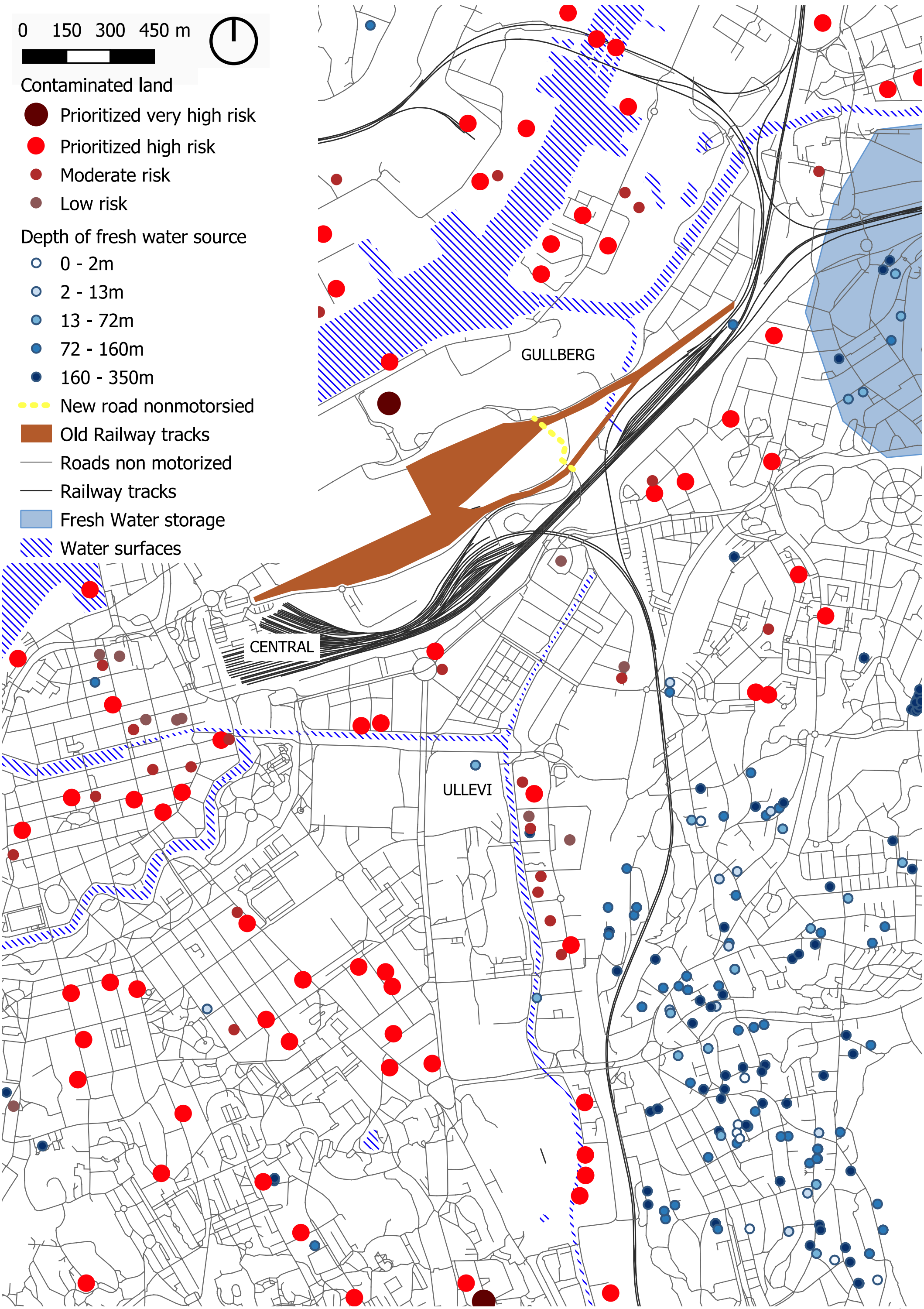
Contaminated sites and pollution: There is a lack of ecosystem services that can cleanse contamination, which are needed to support commercial, ecological, public or residential land use. This missed opportunity does not harness the full potential of the river valleys as ecological assets that benefit human and animal well-being.


0 200 400 600 m
Watercourse
Non motorized a. integration 1km
0 - 1000
1000 - 3000
3000 - 6000
6000 - 17000
17000 - 45000
Water surfaces
Buildings
Woodland landcover
Corniferous forest
Decidious forest
GULLBERG
CENTRAL
ULLEVI


0 200 400 600 m
Watercourse
Year 1960 angular betweenness
0 - 20000000
167000000 - 312000000
20000000 - 70000000
312000000 - 533000000
70000000 - 167000000
Water surfaces
Woodland landcover
Corniferous forest
Decdious forest
Planted trees
GULLBERG
CENTRAL
ULLEVI

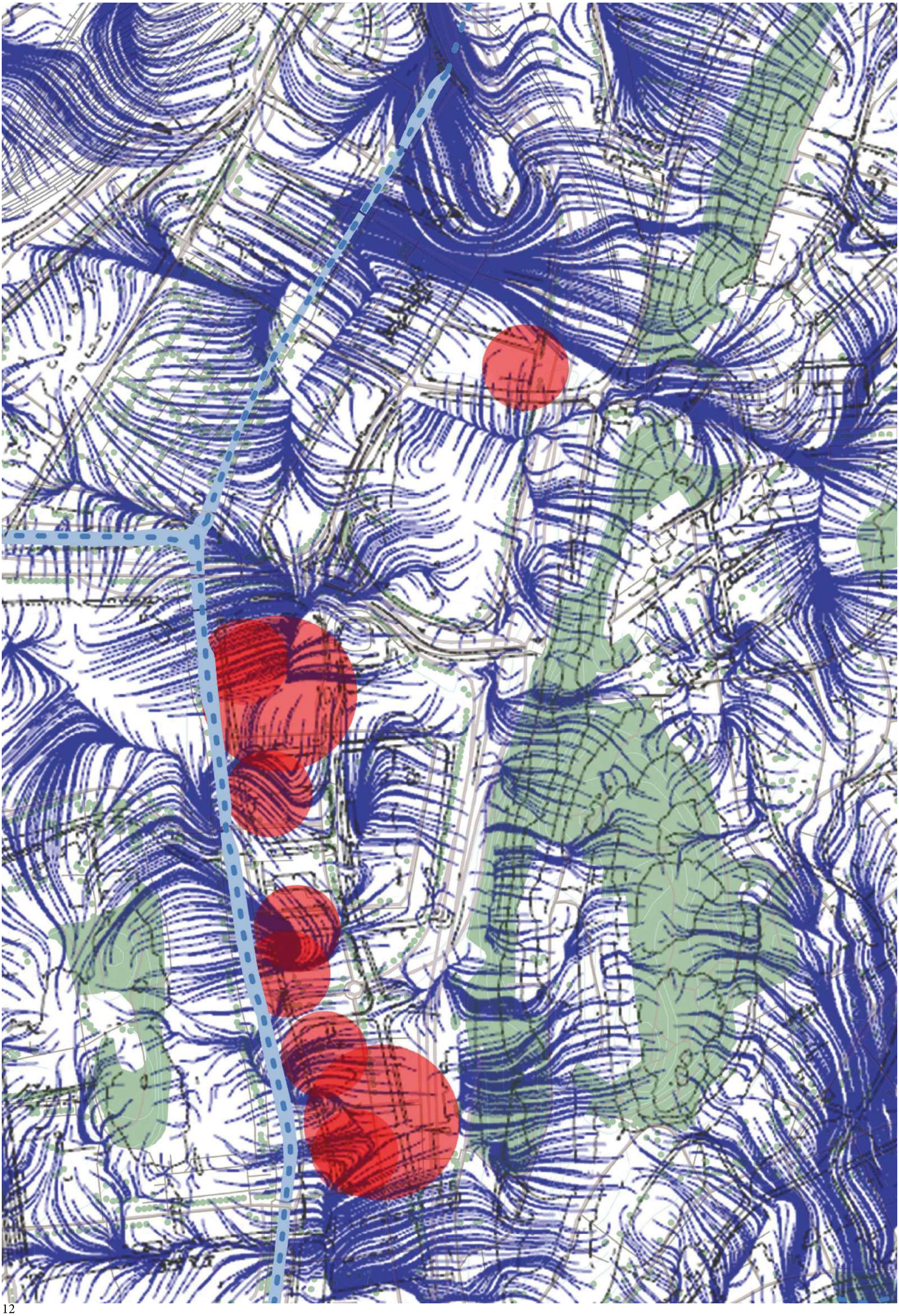

0 200 400 600 m
Watercourse
Year 1975 angular betweenness
0 - 24000000
24000000 - 99000000
99000000 - 213000000
213000000 - 353000000
353000000 - 647000000
Water surfaces
Woodland landcover
Corniferous forest
Decdious forest
Planted trees
GULLBERG
CENTRAL
ULLEVI


0 200 400 600 m
Watercourse
Year 2015 angular betweenness
0 - 27000000
27000000 - 119000000
119000000 - 282000000
282000000 - 514000000
514000000 - 1033000000
Water surfaces
Woodland landcover
Corniferous forest
Decdious forest
Planted trees
GULLBERG
CENTRAL
ULLEVI


0 150 300 450 m
Contaminated land
Prioritized very high risk
Prioritized high risk
Moderate risk
Low risk
Depth of fresh water source
0 - 2m
2 - 13m
13 - 72m
72 - 160m
160 - 350m
New road nonmotorsied
Old Railway tracks
Roads non motorized
Railway tracks
Fresh Water storage
Water surfaces
GULLBERG
CENTRAL
ULLEVI


0 150 300 450 m
Contours
Worst case scenario flooding
Buildings
Soil types
Excavation and filling
Glacial clay
Moraine sorted sediments
Postglacial finesand
Postglacial clay
Postglacial sand
Postglacial silt
Sandy moraine
Ancient mountain
GULLBERG
CENTRAL
ULLEVI

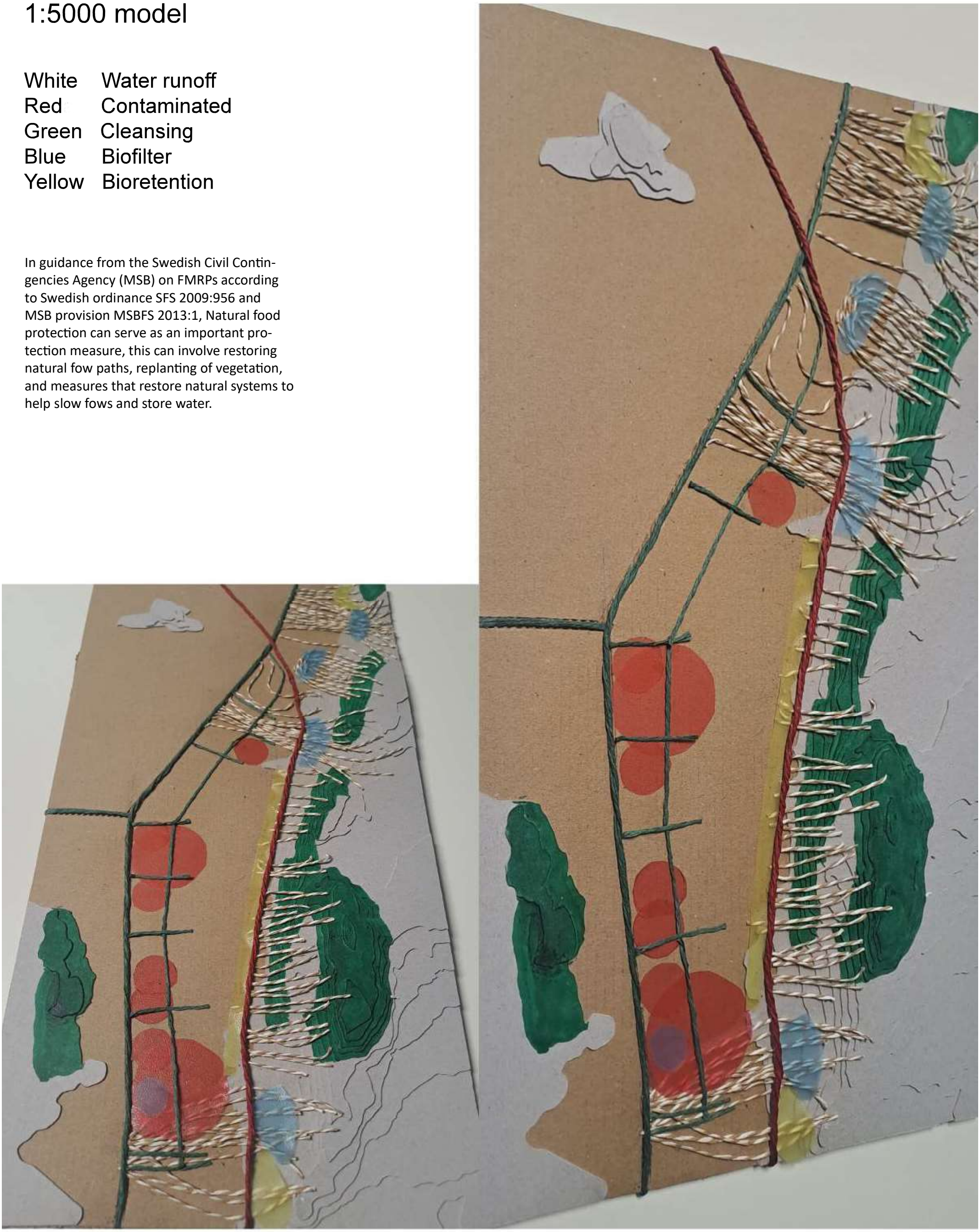

0 100 200 300 m
Water_surfaces
Railway tracks
Tram tracks
Roads motorized
Max Traffic noise dB
40
45
50
55
60
65
70
GULLBERG
CENTRAL
ULLEVI

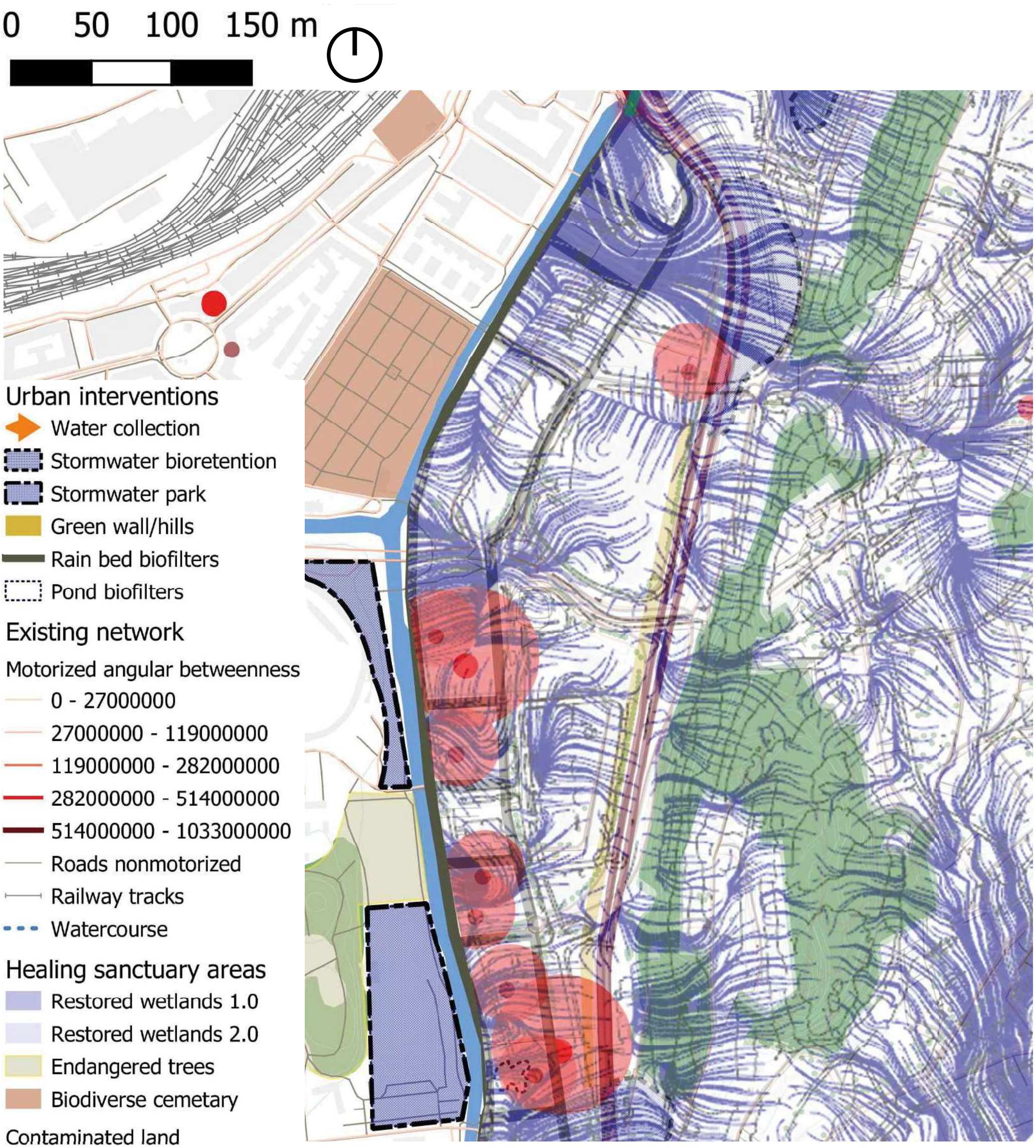


1:5000 model

White	Water runoff
Red	Contaminated
Green	Cleansing
Blue	Biofilter
Yellow	Bioretention

In guidance from the Swedish Civil Contingencies Agency (MSB) on FMRPs according to Swedish ordinance SFS 2009:956 and MSB provision MSBFS 2013:1, Natural food protection can serve as an important protection measure, this can involve restoring natural fow paths, replanting of vegetation, and measures that restore natural systems to help slow fows and store water.





Diagnosis

Mitigation Measures: Implement measures to mitigate noise, air and light pollution from the motorway and explore ways to make it more permeable to ecological movement.

Green Infrastructure: Introduce green infrastructure and nature-based solutions to enhance flood resilience, improve water management, reduce contamination and pollution.

Integrated Planning: Reconnect the historic core with the industrial area by developing pedestrian and cycling pathways across or under the motorway. These solutions would require regulations and strategic planning to reduce speed or traffic on the motorway and enhance the blue-green corridor.

Cleansing: Prioritized contaminated areas present high-risk to welfare and need to be addressed. Compendium Remediation of Contaminated Sites (2021) has done analysis which considers number of factors to assess the risk:

Hazard assessment, which contaminants are present and how dangerous they are.
Migration potential, how rapidly the pollutant spreads through various media.
Sensitivity/protection level of people, plants and/or animals.
Contamination level, derived from quantitative analysis.

This table was made by the:
Swedish environmental protection agency report 7074

Main benefit of this solution
Co-benefit: High provision
Co-benefit: Medium provision
Co-benefit: Low provision

Environmental																						Social/ Cultural			Economic		
Surface water flood mitigation	Improved water quality	Regulation of the water cycle	Groundwater recharge	Erosion prevention	Improved air quality	Noise mitigation	Biodiversity	Pollination	Carbon storage	Health and quality of life	Recreation, education & gathering	Regeneration of degraded areas	Spiritual, religious &artistic values	Amenity value	Employment	Food provision	Water provision	Energy savings	Income generation	Increased value of land/property	Increased tourism						
																						Green roofs					
																						Vertical greening systems					
																						Urban parks, forests, spaces					
																						Greening transport infrastructure					
																						Urban gardens					
																						Wetland protection & restoration					
																						Constructed wetlands					
																						Floodplains					
																						Restoration of streams					
																						Re-meandering					
																						Lake restoration					
																						Riparian woodland					
																						Coastal wetlands					
																						Sand dunes					
																						Shore & beach nourishment					
																						Sustainable drainage systems					
																						Rainwater harvesting					
																						Pervious surfaces					
																						Infiltration basins					
																						Swales					
																						Rain gardens					
																						Stormwater runoff park (detention basin)					
																						Retention ponds					
																						Filter strips					

0 50 100 150 m

Landscape prototype
- Area of analysis

New connector
- Blue-green network

Urban interventions
- Stormwater bioretention
- Stormwater park
- Green wall/hills
- Rain bed biofilters
- Pond biofilters

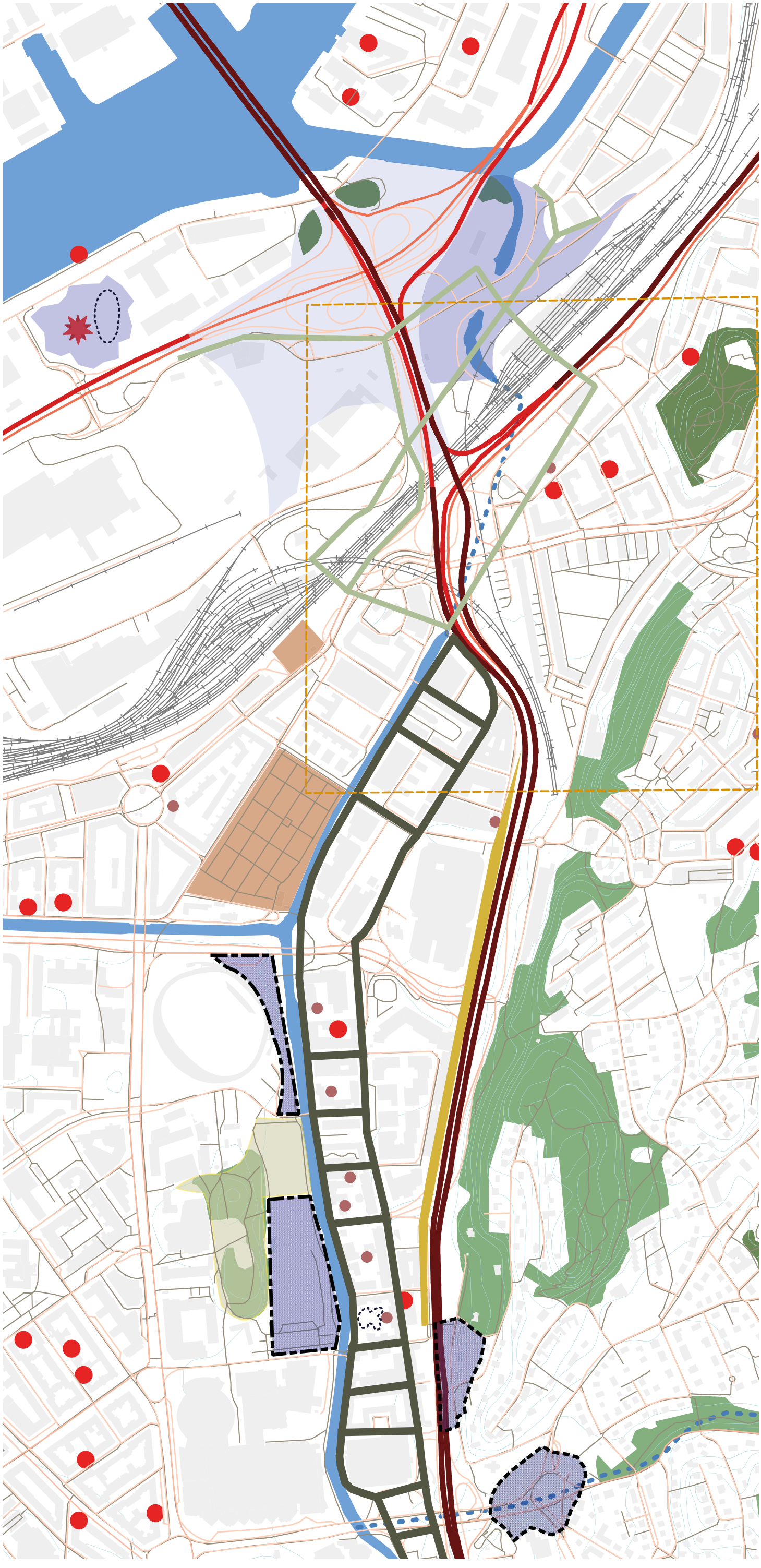
Existing network
Motorized angular betweenness
- 0 - 27000000
- 27000000 - 119000000
- 119000000 - 282000000
- 282000000 - 514000000
- 514000000 - 1033000000
- Roads nonmotorized
- Railway tracks
- Watercourse

Healing sanctuary areas
- Restored wetlands 1.0
- Restored wetlands 2.0
- Endangered trees
- Biodiverse cemetary

Contaminated land
- Prioritized very high risk
- Prioritized high risk
- Moderate risk
- Buildings
- Contours

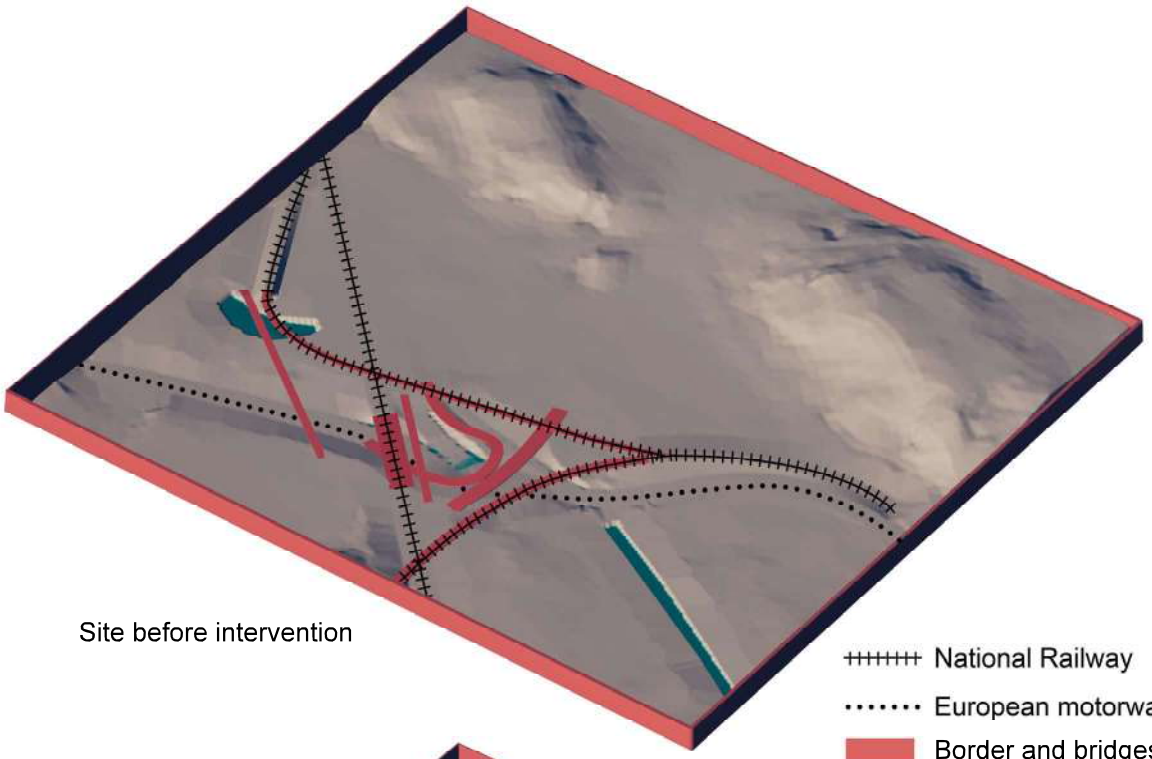
Existing green & blue
- Water surfaces

Woodland landcover
- Corniferous forest
- Deciduous forest



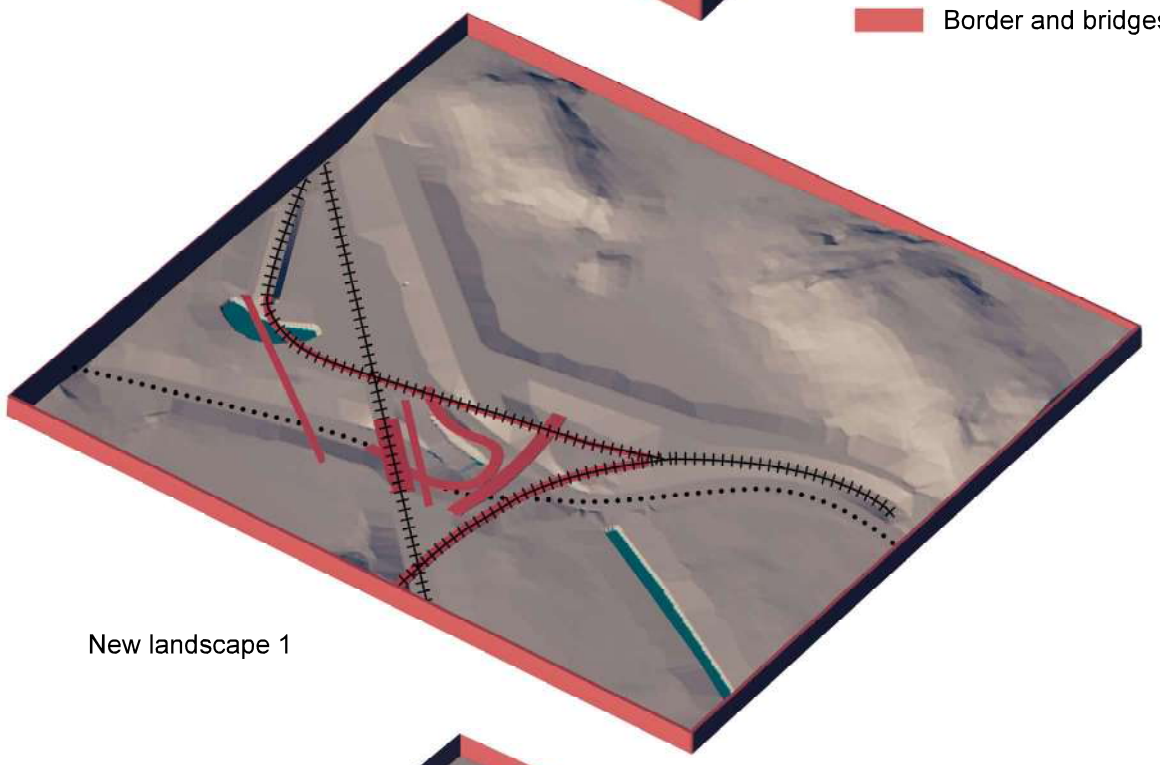
Time is the substance I am made of.
Time is a river which sweeps me along, but I am the river;
it is a tiger which destroys me, but I am the tiger;
it is a fire which consumes me, but I am the fire.

/ Jorge Luis Borge

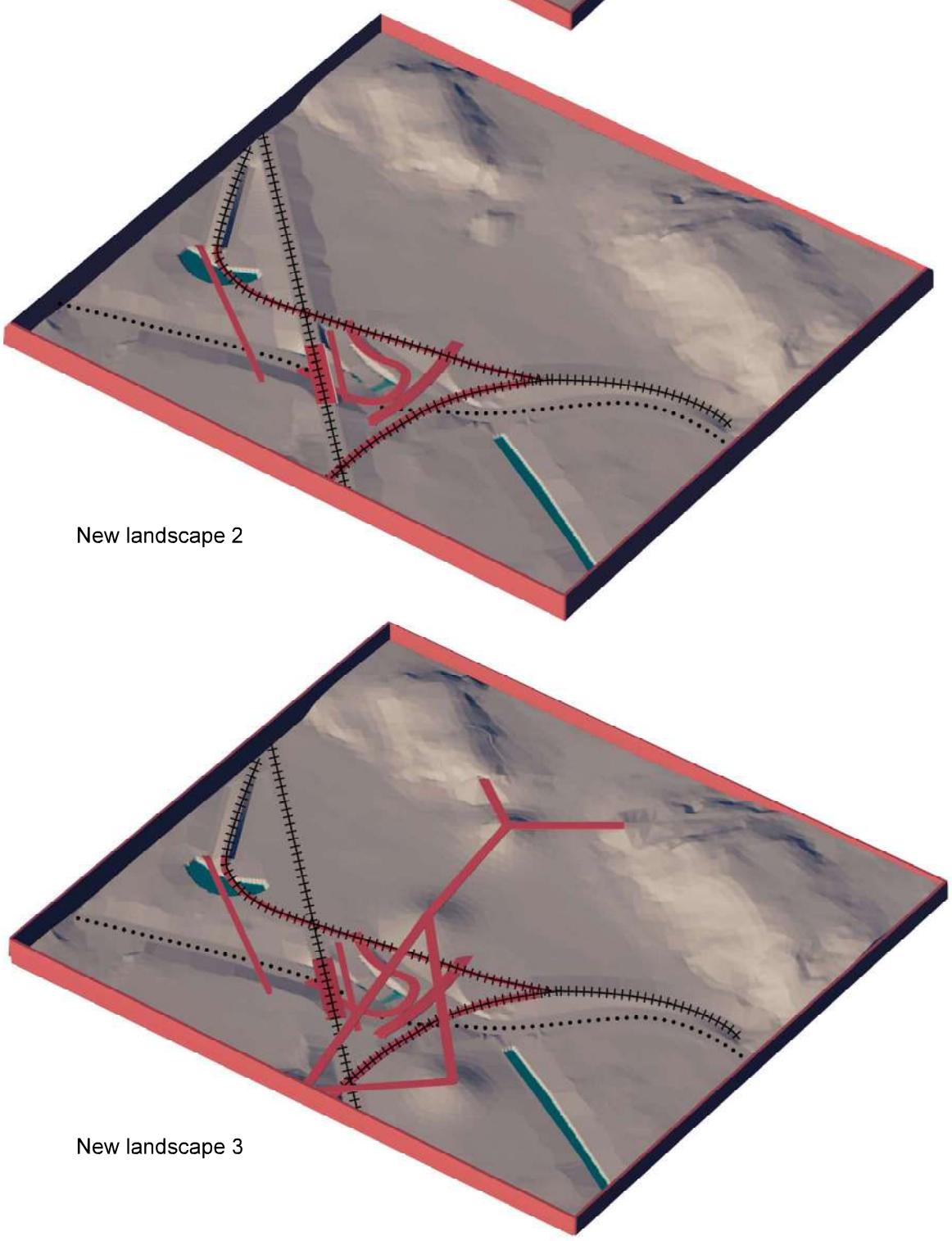


Site before intervention

National Railway
European motorway
Border and bridges

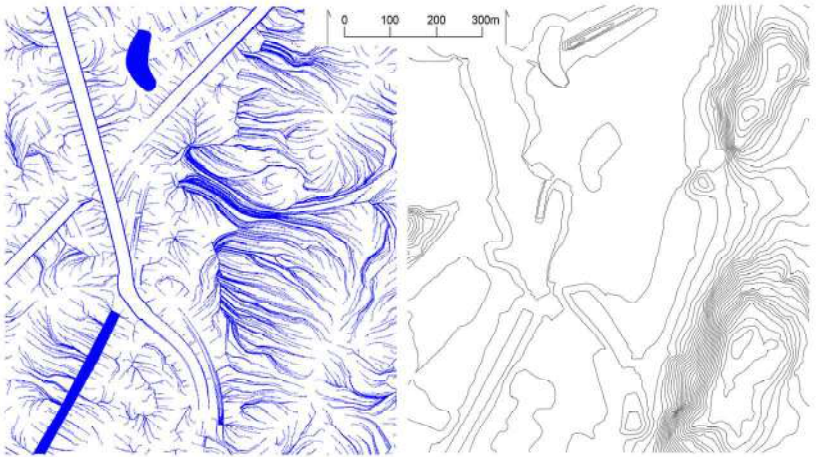


New landscape 1



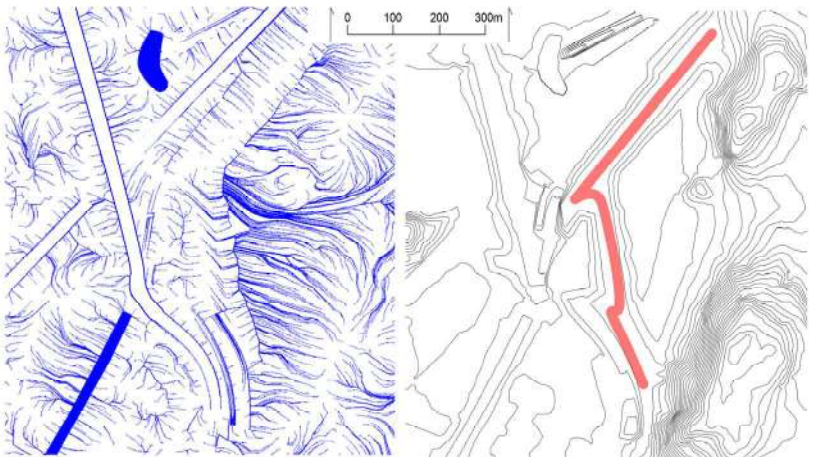
New landscape 2

New landscape 3



Estimated water runoff
Topography 2 meters

The present scenario depicts a convergence point of motorways and railways, where the E6 bears the highest traffic volume, passing underneath multiple bridges. Additionally, a prominent railway route extends directly towards the central station, traversing Skansen Lejonet, a significant cultural landmark situated atop the hill to the west of the site. The estimated water runoff anlysis shows the area is in danger of flooding during heavy rain with the current landscape offering little resistance or resilience.



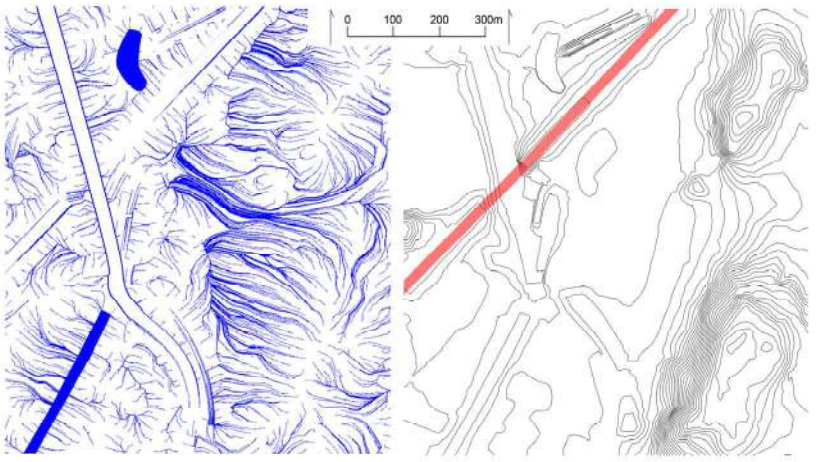
New landscape 1: Hydrodynamic Green Corridors with Dikes

⊕ **Eco-friendly Resilience**: Implementation of green corridors utilizing natural water-absorbing vegetation to mitigate water runoff from hills, promoting ecological balance.

Aesthetic and Recreational Value: Creates visually appealing landscapes that also serve as recreational areas while managing water flow.

⊖ **Limited Coverage**: May not fully address the protection needs of the E6 and the wider transportation network.

Time-Intensive Implementation: Establishing effective green corridors requires time for vegetation growth and ecosystem services development, delaying immediate results.



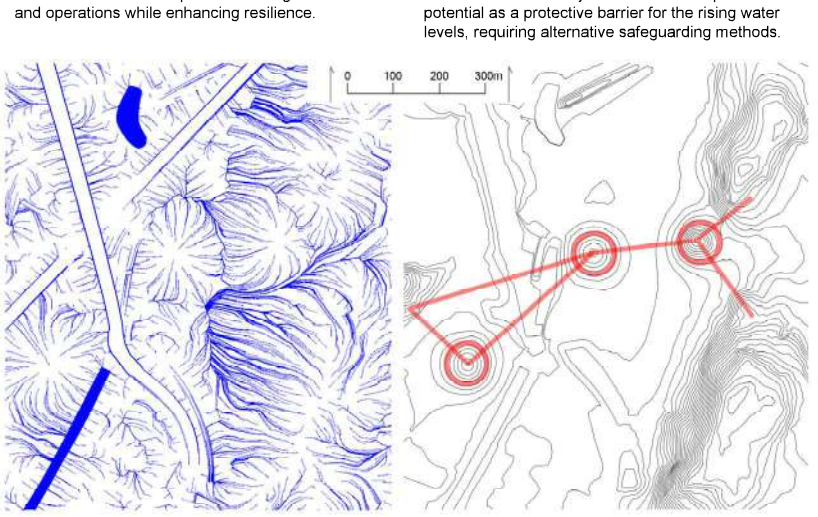
New landscape 2: Raising Existing Infrastructure

⊕ **Maintained Connectivity**: Preserves the integrity of essential transportation routes, safeguarding movement and connectivity during flooding or water-related challenges.

Minimal Disruption: Targeted elevation modifications limit disruption to existing urban fabric and operations while enhancing resilience.

⊖ **Limited Coverage**: Focused elevation might leave smaller offshoots of the railway and other infrastructure vulnerable to water-related risks, necessitating additional protective measures.

Design Constraints: The E6's structure underneath the railway limits the landscape potential as a protective barrier for the rising water levels, requiring alternative safeguarding methods.



New landscape 3: Amphibious Archipelago Network

⊕ **Multi-purpose Design**: Platforms serve as evacuation zones, recreational spaces, and adaptable infrastructure during flood situations or increased water levels.

Scalable and Versatile: Can expand or contract based on water level fluctuations, providing a scalable solution to changing climate patterns.

⊖ **Infrastructure Complexity**: Building and maintaining an archipelago network require intricate design, construction, and ongoing management.

Limited Immediate Protection: Initial phases might not shield existing infrastructure from immediate water runoff or flooding risks.

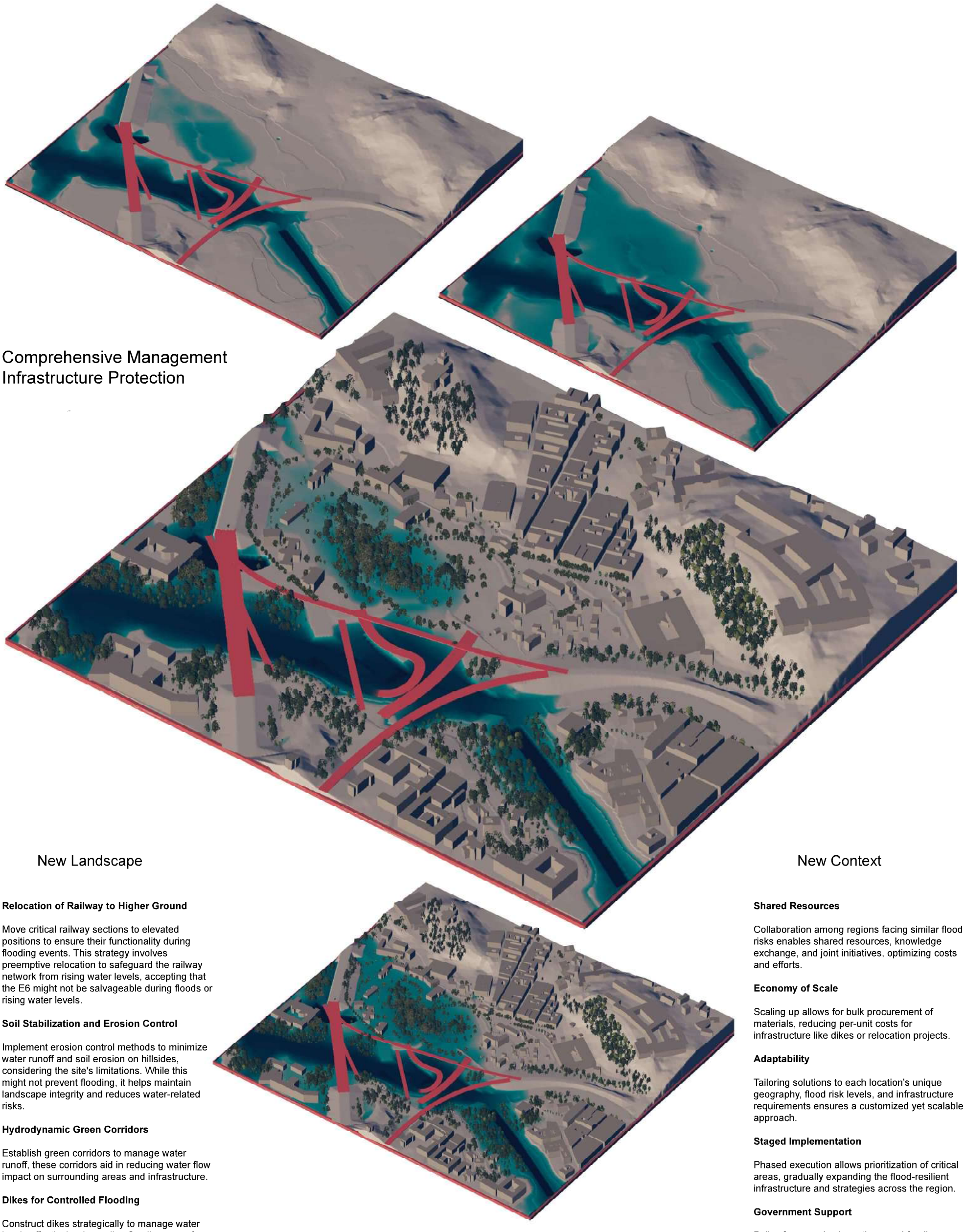
The left shows estimated flood level
up to 1.5 meters during heavy rain.

Water level change and tipping points is
hard to estimate, to the right it shows how
flooding would increase with +1 meter level.

New landscape 1

New landscape 2

New landscape 3



Relocation of Railway to Higher Ground

Move critical railway sections to elevated positions to ensure their functionality during flooding events. This strategy involves preemptive relocation to safeguard the railway network from rising water levels, accepting that the E6 might not be salvageable during floods or rising water levels.

Soil Stabilization and Erosion Control

Implement erosion control methods to minimize water runoff and soil erosion on hillsides, considering the site's limitations. While this might not prevent flooding, it helps maintain landscape integrity and reduces water-related risks.

Hydrodynamic Green Corridors

Establish green corridors to manage water runoff, these corridors aid in reducing water flow impact on surrounding areas and infrastructure.

Dikes for Controlled Flooding

Construct dikes strategically to manage water levels effectively, channeling flooding away from critical infrastructure and the relocated railway. Recognizing the site's constraints, controlled flooding becomes an integral part of water management.

The best time to plant a tree was thirty years ago.
The second best time is right now.

/ proverb, unknown origin

Shared Resources

Collaboration among regions facing similar flood risks enables shared resources, knowledge exchange, and joint initiatives, optimizing costs and efforts.

Economy of Scale

Scaling up allows for bulk procurement of materials, reducing per-unit costs for infrastructure like dikes or relocation projects.

Adaptability

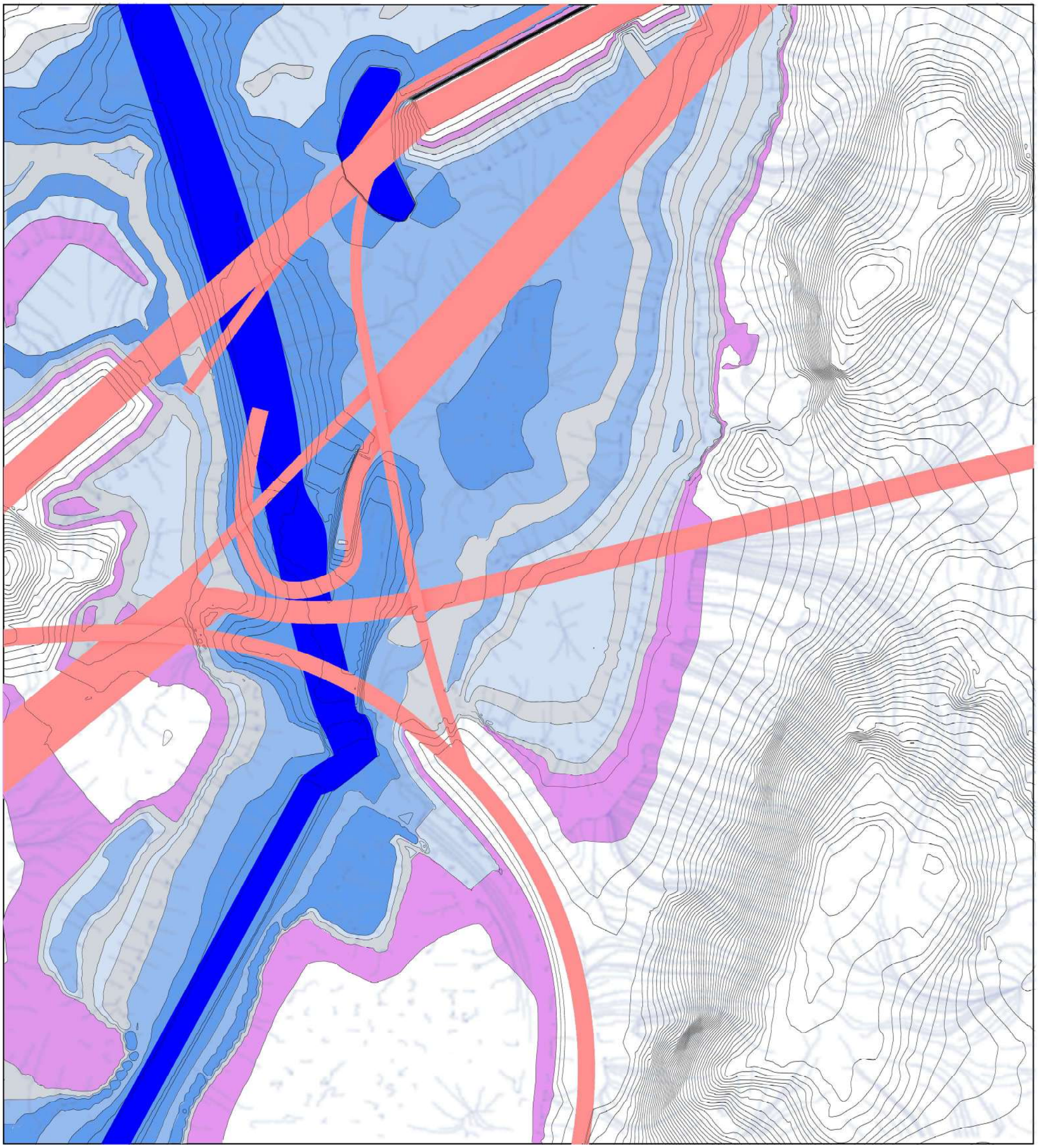
Tailoring solutions to each location's unique geography, flood risk levels, and infrastructure requirements ensures a customized yet scalable approach.

Staged Implementation

Phased execution allows prioritization of critical areas, gradually expanding the flood-resilient infrastructure and strategies across the region.

Government Support

Policy frameworks, incentives, and funding support from governments at various levels are crucial for successful implementation and long-term maintenance of flood-resilient measures.



Topography Map with Water Management and Infrastructure
Darker shades of blue represents flood risk levels
Grey represents dikes and elements protecting water levels
Purple represents water runoff areas

Panarchy, a concept rooted in ecological systems, illuminates the interconnectedness and cyclical nature inherent in landscapes and architecture. When seen through the lens of panarchy, landscapes and architecture cease to be static entities but emerge as dynamic, interconnected elements within a larger system of perpetual change and renewal.

In this perspective, the essence of panarchy mirrors the perpetual flux encapsulated by landscapes and architectural forms. Much like the adaptive cycles within ecosystems, landscapes and architectural structures undergo phases of growth, accumulation, maturation, release, and reorganization.

The interplay between landscapes and architecture embodies a constant cyclical force, where each element influences and is influenced by the other. Just as ecosystems experience periods of stability (conservation) followed by disruptions (release), architectural designs and the environments they inhabit undergo phases of establishment, evolution, adaptation, and potential transformation.

At the heart of this synergy lies the recognition that landscapes shape architecture, and conversely, architectural interventions influence and redefine landscapes. This reciprocal relationship signifies an ongoing dialogue—a cyclical dance—wherein designs respond to the evolving needs of their surroundings, while landscapes, in turn, adapt to the structures imposed upon them.

Embracing panarchy in human perception of landscapes and architecture fosters an understanding that change is not only inevitable but also essential for resilience and sustainability. By acknowledging this cyclical force, architects and landscape planners can incorporate adaptive strategies that anticipate and respond to dynamic environmental and social shifts.

Amidst the challenges posed by rising water levels and the increasing frequency of extreme rainfall events, the endeavor should be centered on harnessing adaptive strategies through design, underscoring a shift, towards multi-function design elements encompassing retention, cleansing and runoff features.

The orchestration of research-based design interventions amalgamates the wisdom encapsulated in Borges' contemplation on time and the profound implications embedded within old wisdom advocating action in the present while learning from the past. While acknowledging the irrevocable impact of past actions on our current environment and human society, architecture can emphasize the pivotal role of the present, a moment that serves as the fulcrum for transformative change.

Embedded within the fabric of research by design findings lies an inherent poetry. When confronted with the pressing challenges of our times, it is in these moments of creativity that we unearth landscapes that not only withstand the tides of change but can thrive in their embrace.

Architecture does not only endure but dynamically engage with the forces of change.

The synthesis achieved through ecological insights, hydraulic understanding, and strategic design propositions serves as a testament to the transformative potential inherent in purposeful intervention. As we navigate the realm of ecological uncertainty, water could become the profound union between ecosystems and humans.