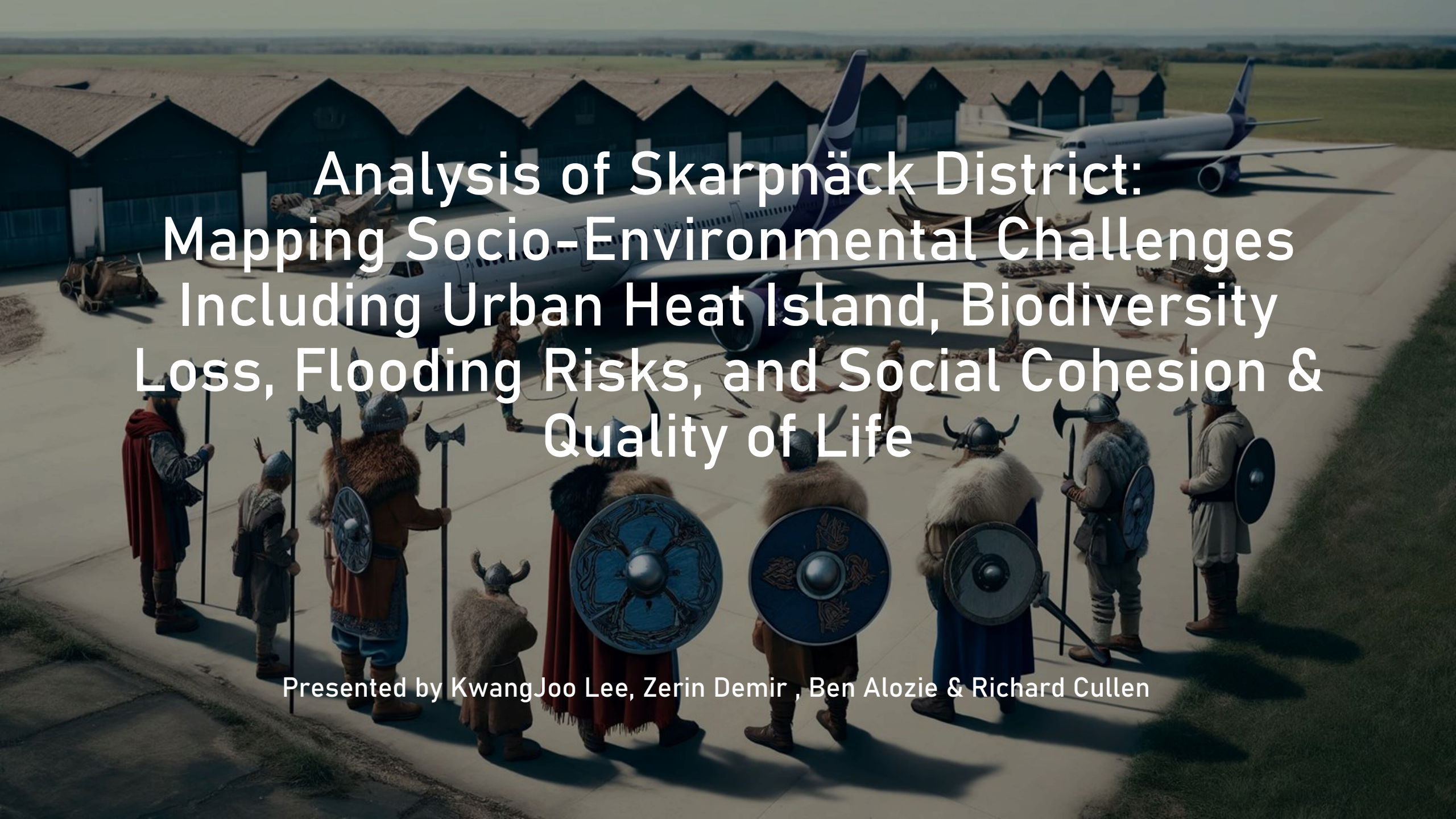


Analysis of Skarpnäck District: Mapping Socio-Environmental Challenges Including Urban Heat Island, Biodiversity Loss, Flooding Risks, and Social Cohesion & Quality of Life

Presented by KwangJoo Lee, Zerin Demir , Ben Alozie & Richard Cullen

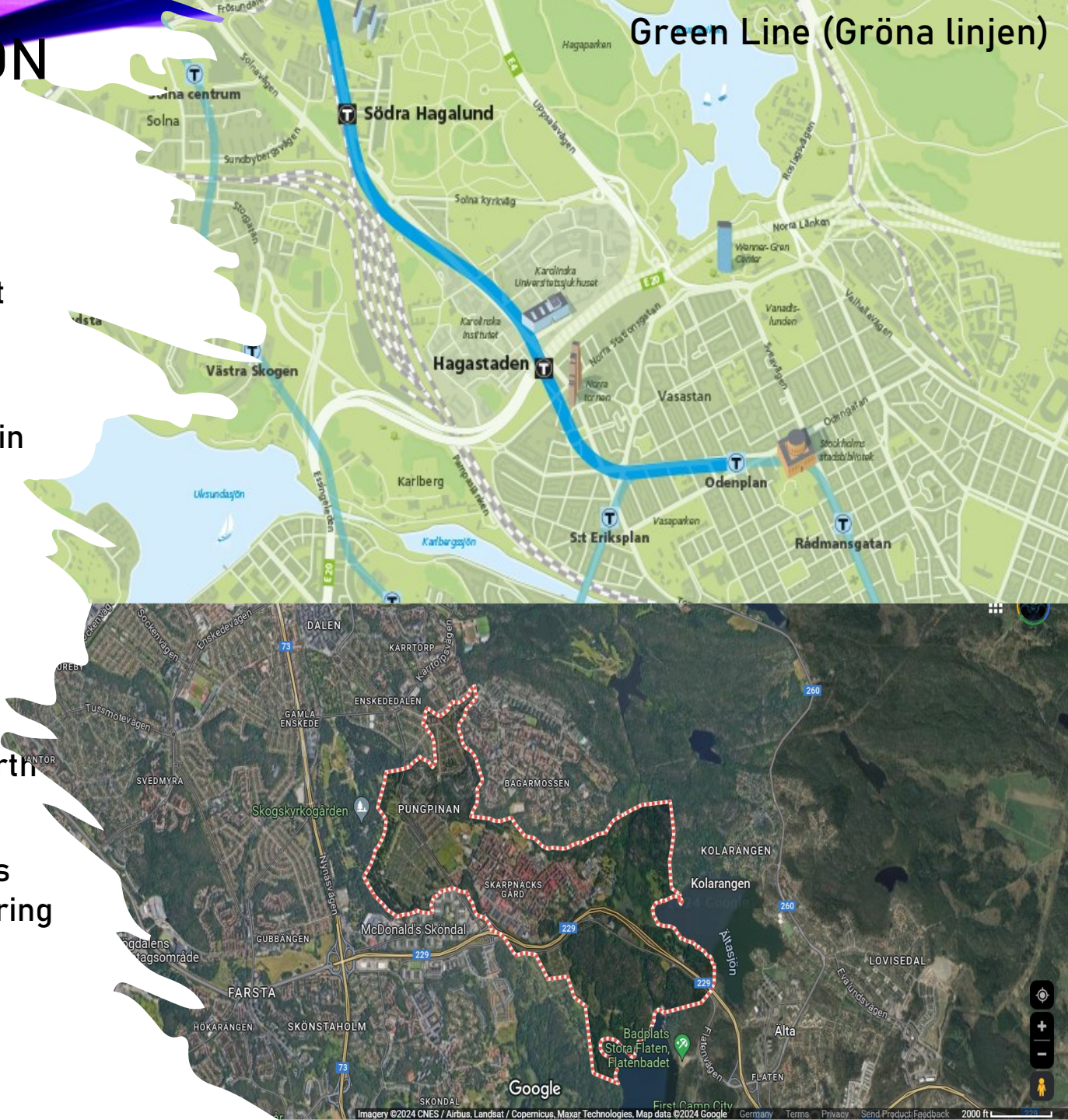
Table of Contents

Skarpnäck: District's Location and Characteristics

- Location: Skarpnäck is a southern suburb in Stockholm that was built in the 1980s. The area is dominated by residential buildings and is characterized by a great variety in terms of roof angles, balcony placements and window proportions (Borg, 2021).
- Population: Approximately 40,000
- Region Configuration: Hammarbyhöjden, Björkhagen, Enskededalen, Kärrtorp, Bagarmossen, Skarpnäck Gård, Flaten, Orhem and Skrubba
- Development time: The district of Skarpnäck is located on a former airfield, and on the same site that Skarpa village did in the Middle Ages. In the early 1980s, the military no longer needed an airfield (Stockholmskällan, 2023).
- The Stockholm City Council decided that housing should be built on the site instead. The district is planned as a neighborhood city - in the same way as in Stockholm's inner city (Stockholmskällan, 2023). The streets form a sort of grid, and the houses are built in square blocks with courtyards. Almost all the houses in Skarpnäck are built of red brick..

SKARPNÄCK: DISTRICT'S LOCATION AND CHARACTERISTICS

- Since the 1980s, no extensive change has happened in the character of the area. The municipality of Stockholm has defined several areas in Skarpnäck for future development and in some of these areas the work has already started fueled by its proximity to the city (Borg, 2021).
- In 1958 the subway's green line went to Bagarmossen, but in 1994 it was extended and Skarpnäck became the terminus. Before the subway existed, trams ran from Slussen to the residential areas around Skarpnäck (Stockholmskällan, 2023).
- Today new lines connect to Stockholm such as the Gröna linjen
- Major roads such as Tyresövägen and Nynäsvägen, run north south through the area and also connect to Stockholm.
- Anthropogenic development suggests that fragmentation is occurring to natural ecosystems specifically spaces bordering protected areas.
- For instance, Tyresövägen, a major road is cutting off the Nacka nature reserve from the Flaten nature reserve



Skarpnäck City Plan Observation

- Of the total area, the northern part, close to Stockholm, is highly urbanized, while the southern part consists mostly of lake areas and nature reserves.
- Parts of Skarpnäcks Gård and Skrubba have developed as industrial areas.
- Good natural environment, including Nacka nature reserve, Flaten nature reserve and Hammarbybacken.

Stockholm City Plan

- Plans to add residential units through further extension of public transportation.
- The Skarpnäcks area's industrial zones are adjacent to residential neighborhoods, so it is recommended to locate light industry, warehousing, and office functions.
- Plans to create 3 new schools
- Plans for new spaces to attract cultural industries.
- Plans for two sports halls and a possible pool and ice rink are in consideration for construction.
- There is a necessity to overcome the disconnection caused by the main roads.

Urban Heat Island Effect in Skarpnäck District DPSI(R)

Skarpnäck is experiencing mounting concerns in relation to the Urban Heat Island (UHI) effect as it continues to develop and urbanize. This phenomenon, where urban regions experience warmer temperatures than their rural surroundings, is particularly pronounced in Skarpnäck due to several contributing factors.

Skarpnäck Central and Residential Blocks

Location:

- The heart of Skarpnäck including Skarpnäck Torg and surrounding high-density residential areas.

Problems:

- High-Density Urban Structures: Many of the buildings utilize materials such as concrete and metal, which absorb and re-radiate heat more than natural landscapes.
- Limited Green Spaces: The central residential areas have limited greenery, contributing to higher temperatures.

Driving Forces (D):

- Economic Growth: As cities expand economically, there's increased demand for housing and business spaces.
- Population Growth: Rising population in urban areas necessitates expansion into surrounding areas.
- Preference for Low-Density Living: Desire for larger living spaces and suburban lifestyles drive the expansion outward from city centres.

Google Earth 3D view of Skarpnäck with Torg in the background

URBAN HEAT ISLAND EFFECT IN SKARPNÄCK DISTRICT

Industrial Area Near Skarpnäck

Location:

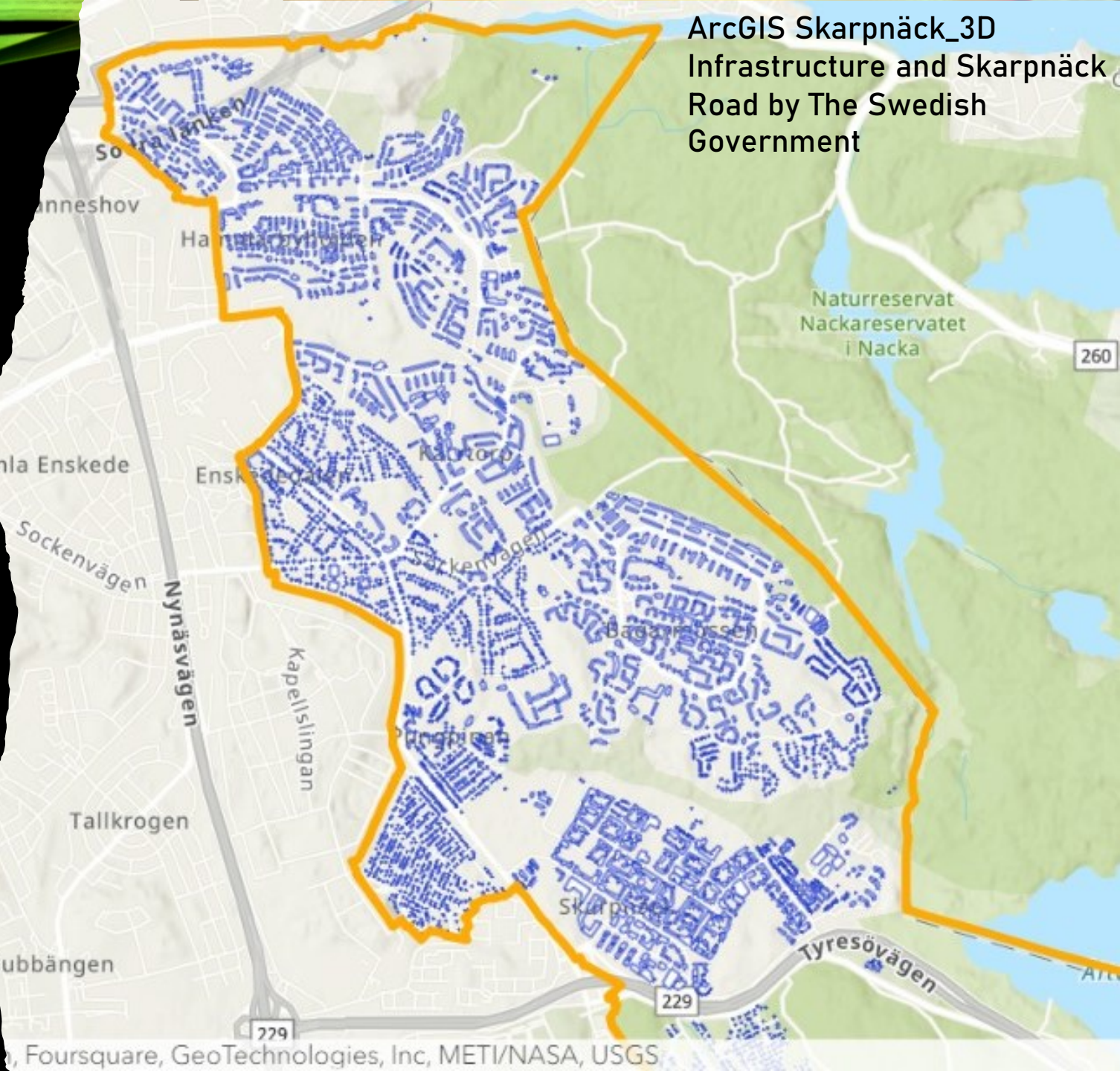
- The industrial zone located to the northeast of Skarpnäck, adjacent to the residential area.

Problems:

- Heat Absorption from Pavements and Buildings: Large expanses of asphalt and concrete in parking lots and warehouse roofs significantly contribute to local heat increases.
- Lack of Tree Cover: Minimal tree cover in these areas exacerbates the heat retention.

Pressures (P)

- Land-Use Changes: Conversion of agricultural lands, forests, and other natural habitats into residential, commercial, and industrial developments.
- Increased Traffic and Mobility Needs: As residential areas move farther from city centres and workplaces, the need for extensive transportation networks grows, leading to more roads and infrastructure developments.




Flatten Nature Reserve in Stockholm

Urban Heat Island Effect in Skarpnäck District

Recreational and Natural Spaces

Location:

- Green areas such as Flaten Nature Reserve and along the walking paths connecting to Nacka Nature Reserve.

Problems:

- Fragmented Green Spaces: While these areas are generally cooler, the fragmentation due to urban development reduces their effectiveness in cooling the broader urban environment.

State (S):

- Altered Landscapes: Urban sprawl changes the physical landscape, characterized by increased built-up areas and reduced green spaces.
- Fragmented Habitats: The natural habitats become fragmented and isolated, affecting local biodiversity.

URBAN HEAT ISLAND EFFECT IN SKARPNÄCK DISTRICT

Expansion Areas Near Public Transport Hubs

Location:

- Areas around Skarpnäck metro station and planned new developments.

Problems:

- Potential for Increased Density: As these areas develop, without careful planning, they could contribute to worsening the UHI effect.

Impact (I)

- Environmental: Increased pollution, higher carbon emissions from vehicles, and disruption of local ecosystems.
- Social: Potential for increased socioeconomic disparities as some communities may have limited access to urban amenities and services.
- Health: Increased commuting times and reliance on automobiles can lead to reduced physical activity and associated health risks.

Conclusion:

- The UHI effect in Skarpnäck represents a significant challenge, specifically in areas of high urban density and limited natural landscape integration. Through strategic implementation of mitigation strategies such as green roofing, reflective materials, increasing green spaces, and enhanced ecological connectivity, Skarpnäck can substantially reduce its UHI impact. These efforts will not only improve the environmental quality but also enhance the overall livability of the district, promoting a healthier and more sustainable urban environment.

FLOODING RISK ANALYSIS

Contributions of fresh water from glaciers and ice sheets can produce changes in both temperature and salinity of the ocean, and in this manner may change the patterns of ocean currents, and by extension local sea level (Church et al., 2013).

When uplift is accounted for, the sea level in Stockholm has been decreasing for a long time and will continue this trend until the global sea level rise exceeds regional uplift. If the regional uplift is disregarded, it is evident that the sea level in Stockholm has been steadily increasing since 1886

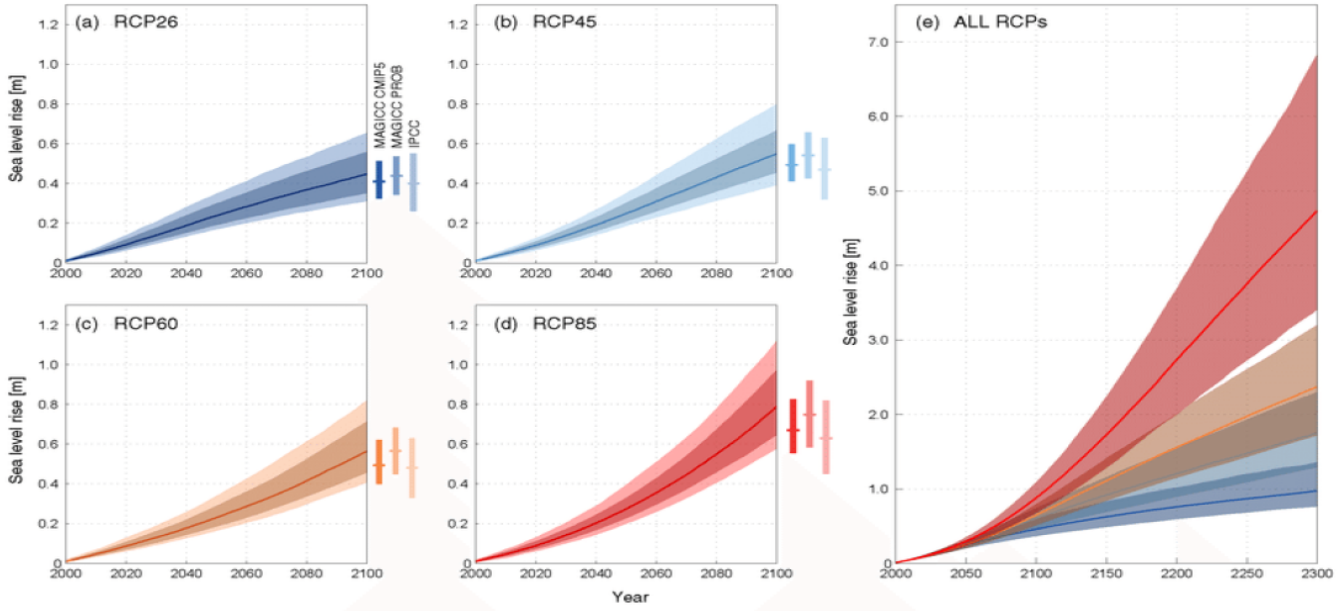


Figure 3. Projections of sea level rise according to the four RCP-scenarios developed by IPCC (Nauels et al., 2017).

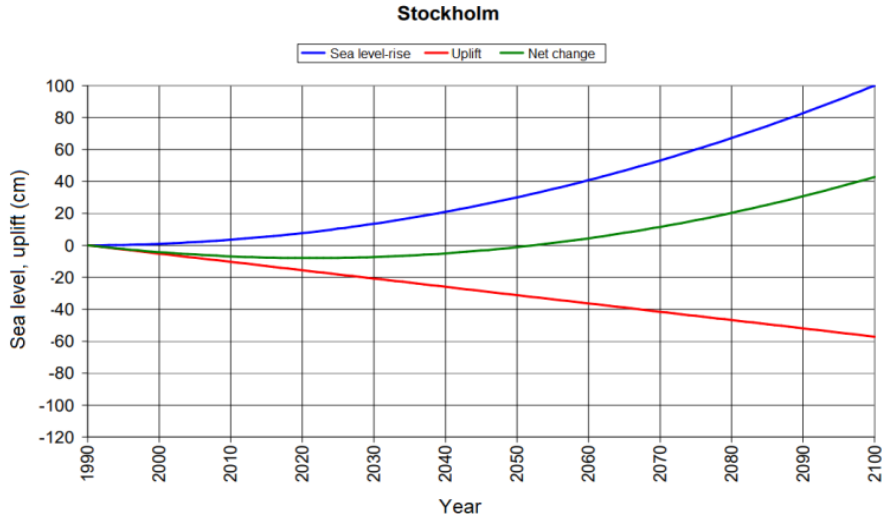


Figure 4. Projected rates of sea level-rise, uplift and net change in Stockholm. The rate of sea level-rise is 0.5 cm/yr 1990-2050, and 0.91 cm/yr 1990-2100. The projection of sea level rise in the figure is corresponds roughly to RCP 8.5. Modified from Stensen et al., 2010.

Flooding Risk Analysis

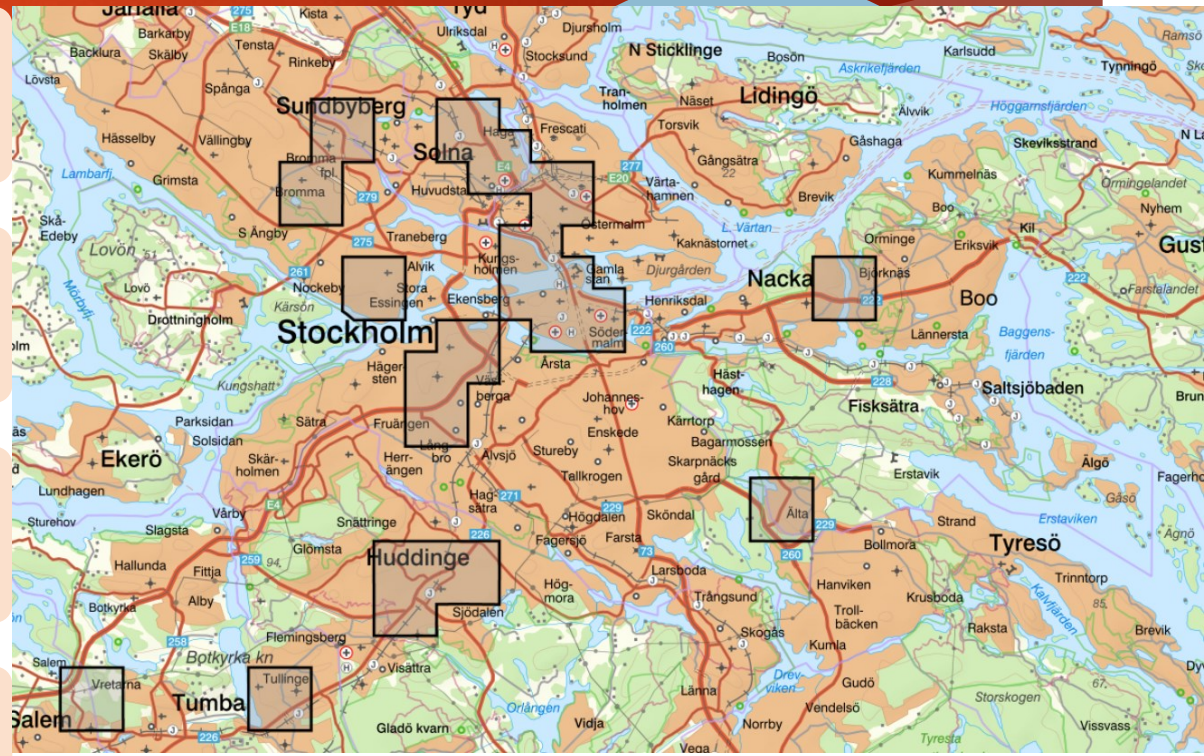
Flooding Vulnerability

Skarpnäck's susceptibility to flooding due to low-lying terrain and urbanization, especially during heavy rainfall or snowmelt

Infrastructure Assessment

Stormwater management is needed for flood-risk mitigation

Flooding involves the risk of property damage as well as risks to human and animal health and life.



The database shows known floods that occurred as a result of rain in Stockholm County during the period 1900-2010. The material has collected during the autumn of 2010 in the work with the Flood Ordinance step 1 (https://ext-geodatakatalog.lansstyrelsen.se/)

Maximum Water Flows

The risk and severity of floods can experience significant amplification when accounting for multiple physical processes happening simultaneously. This combination of processes is referred to as compound events (Zscheischler et al., 2018)

The map layer shows maximum water flows during a 100-year rainfall with a climate factor of 1.25. By maximum water flow is meant maximum flow for each calculation box over the entire calculation, there is no time aspect.(Skyfall,2018; https://miljodataportalen.stockholm.se/)

Loss of Biodiversity

City planning goal

A growing city

More and more people are moving to the cities of the world. Cities open up opportunities and enable people to be themselves. Cities bring together people with different backgrounds, interests and characteristics, they create relationships and exchange ideas. The urbanisation trend is particularly clear in Sweden and in Stockholm. Many people want to live in Stockholm and the city's clear ambition is for Stockholm to continue to grow and develop as an open, tolerant and welcoming city. Stockholm is to have room for more inhabitants – and everyone who is born here, moves here to study or work, or comes as a new arrival to Sweden must have the opportunity of finding a home.

Driving forces	**Population growth, transportation development, expanding industrial capabilities**
Pressure	**Additional construction of residential units and industrial facilities, Infrastructure. Increase vihicles and noises,**
State	**Air pollution, water pollution, and changes in plant and animal species and populations**
Impact	**Poor health, forest resource degradation, etc.**
Response	**Creating environmentally centered plans, ect.**

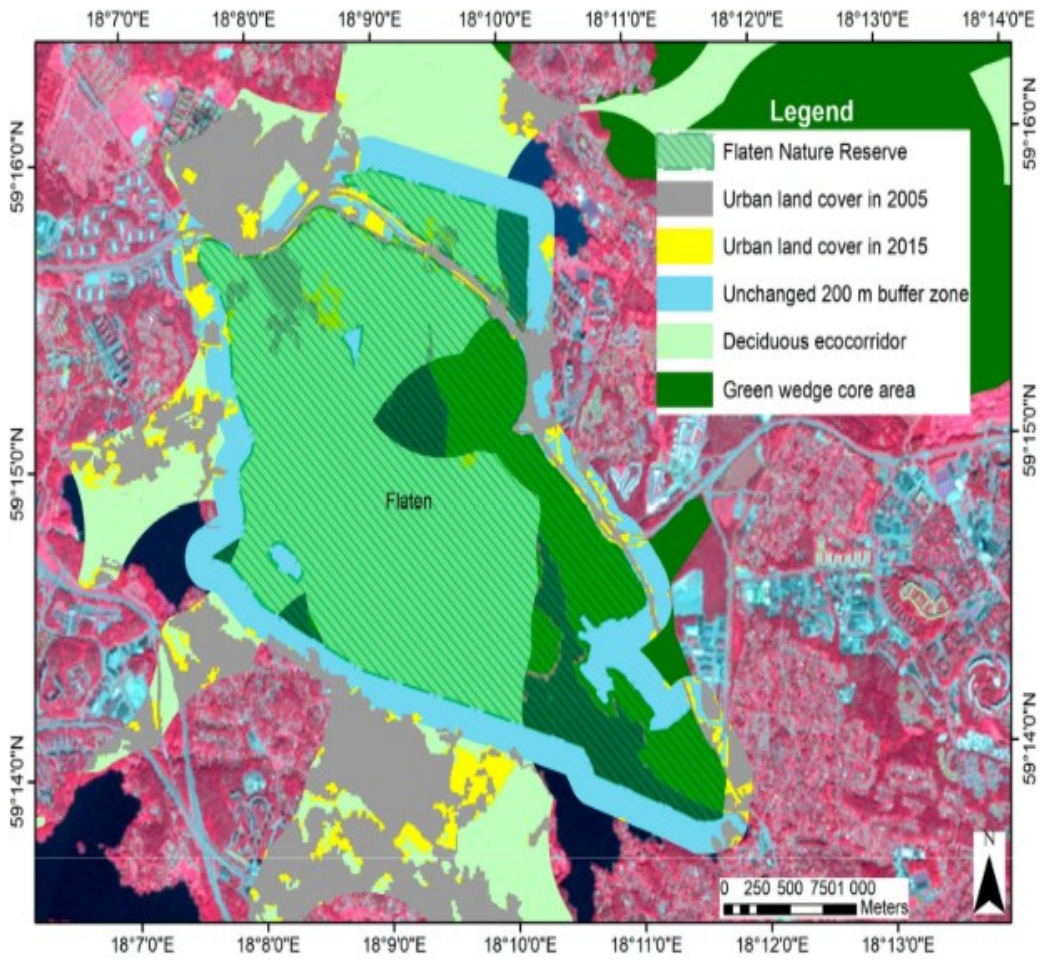
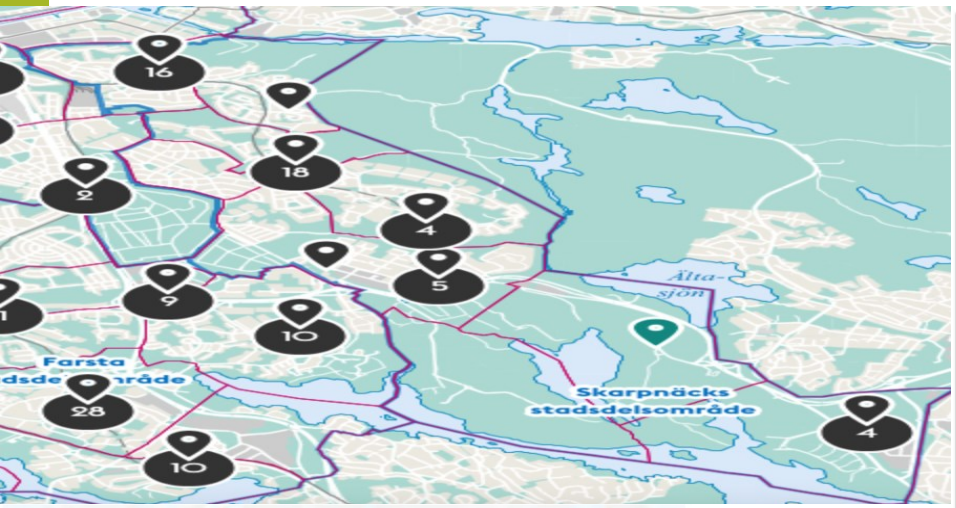
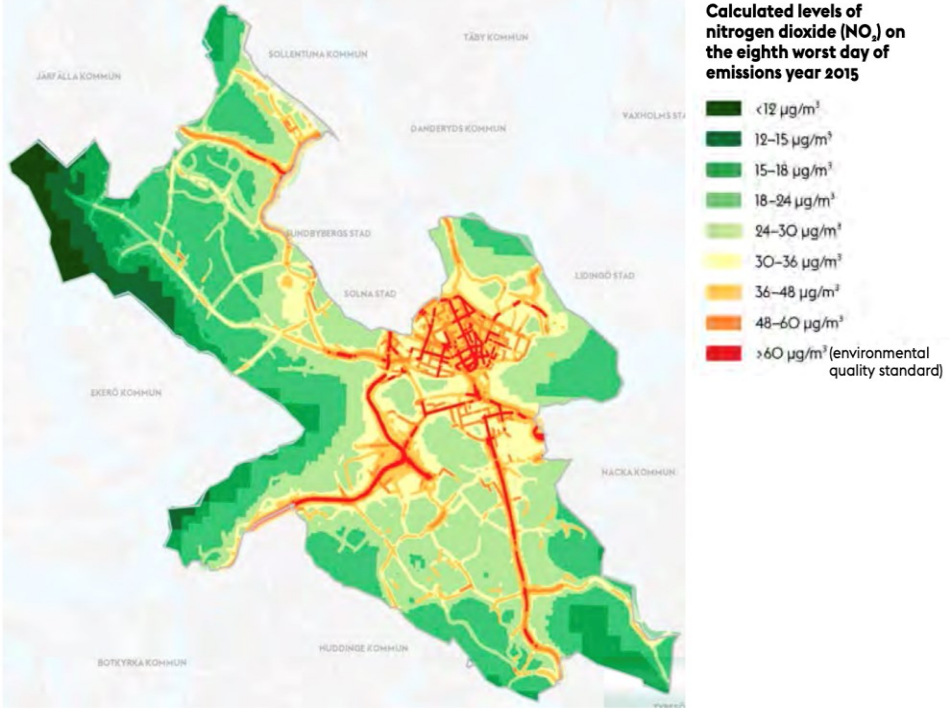


Figure 13. Change in urban land cover near Skarpnäck, Trångsund and Älta in and around three different types of Stockholm's green infrastructure: Flaten nature reserve buffer zone, a deciduous forest ecocorridor and green wedge core area.

Loss of Biodiversity





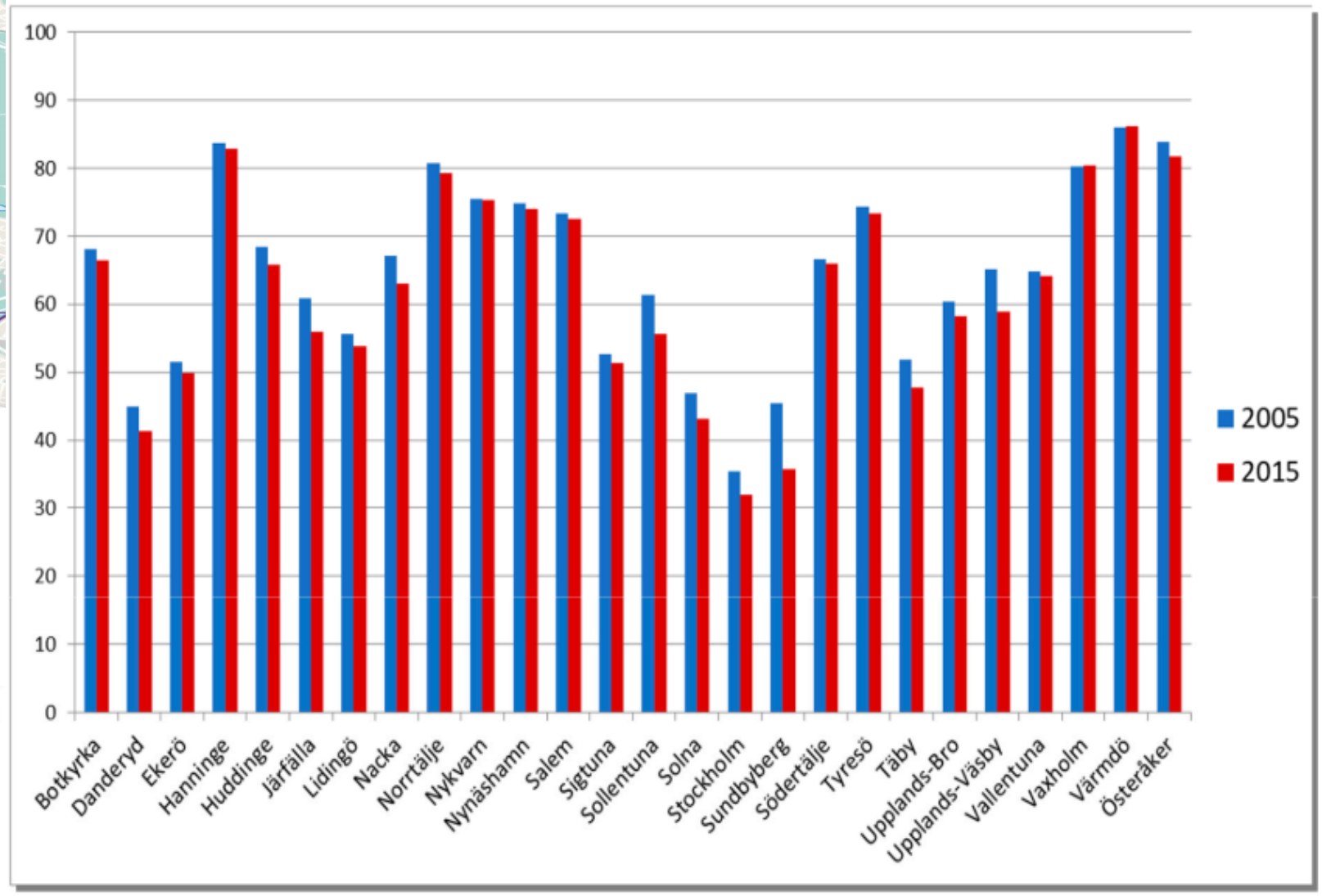
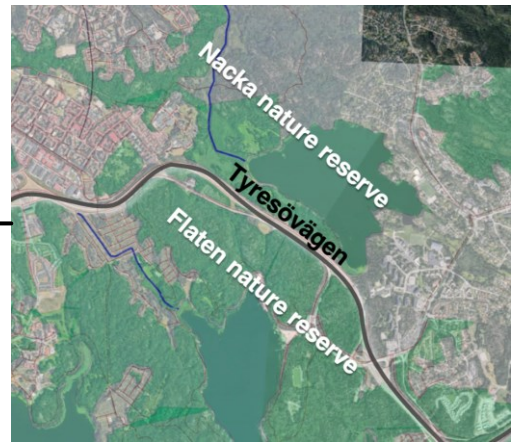
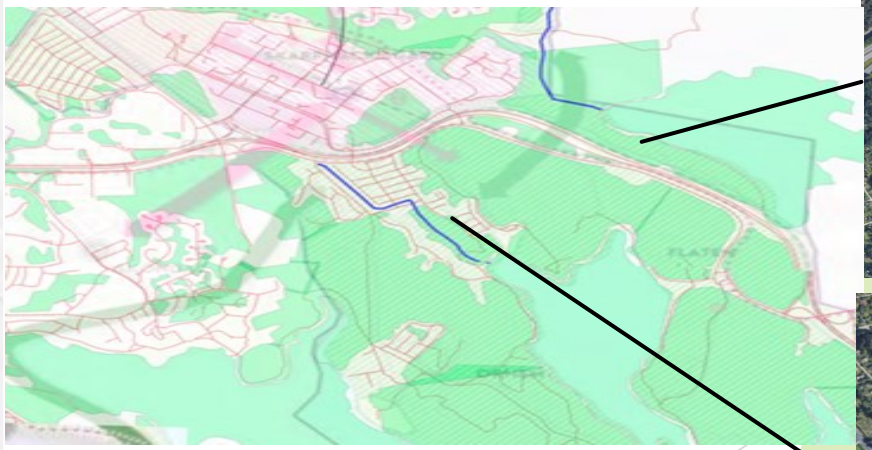


Figure 6. Change in green structure land area percentage per municipality in Stockholm County between 2005 and 2015.

Loss of Biodiversity

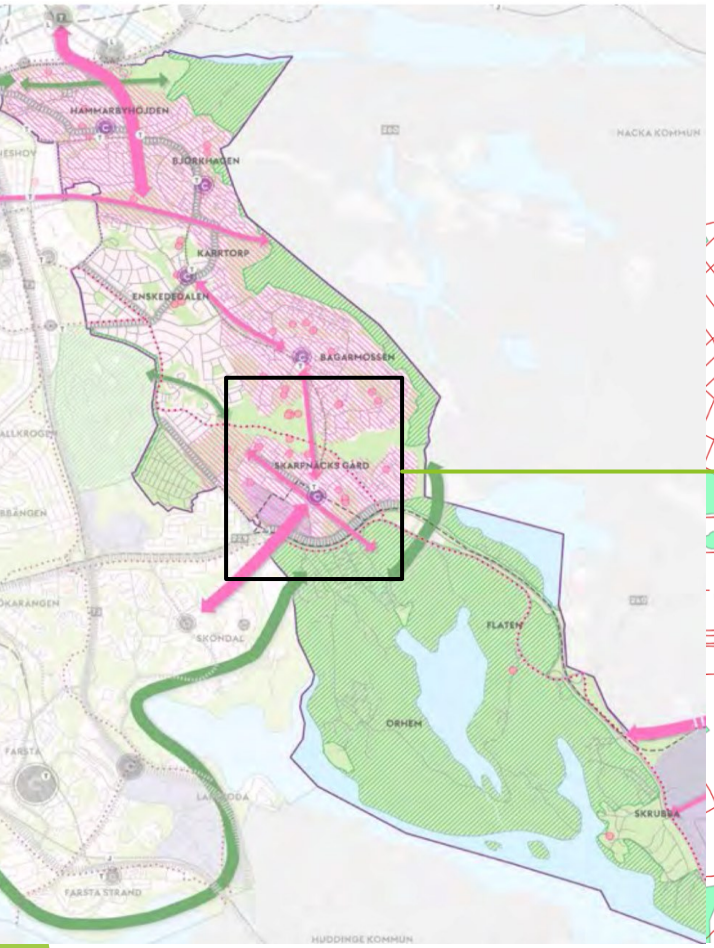


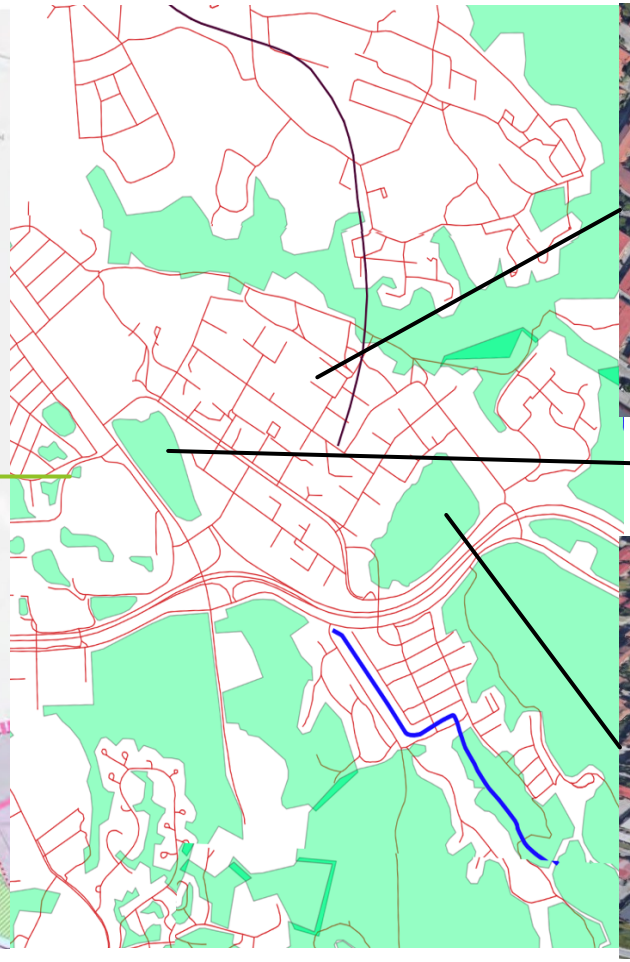
Major road is cutting off the nature reserve area

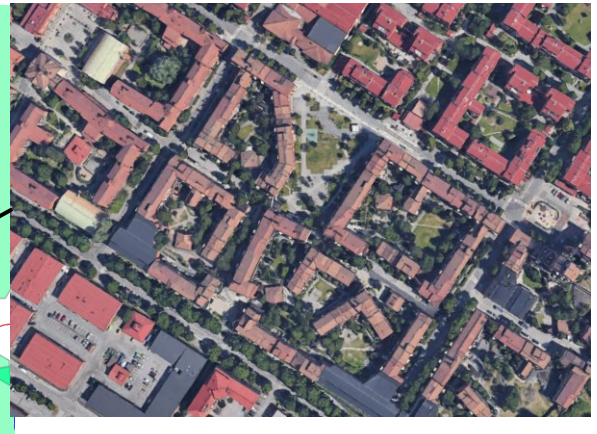


Anthropogenic developments are fragmenting natural ecosystems

Loss of Biodiversity







- No green roof in the city
- Loss of small green spaces in cities due to development (Housing, schools, social infrastructure, Industrial buildings)

→ Urban heat island

Flooding Risk

Social cohesion & Quality of life

Social Cohesion & Quality of Life

Drivers

- **Immigration, population growth, and infrastructure development** patterns appears to be some of the major drivers of social distance and life quality degradation in the Skarpnack district as in all of Stockholm.

Pressures

- Increasing population levels lead to **increased consumption of resources**, resulting in greater greenhouse gas emissions. This contributes to climate change and can have a devastating effect on the environment and life quality. (Kolkowska, 2023).

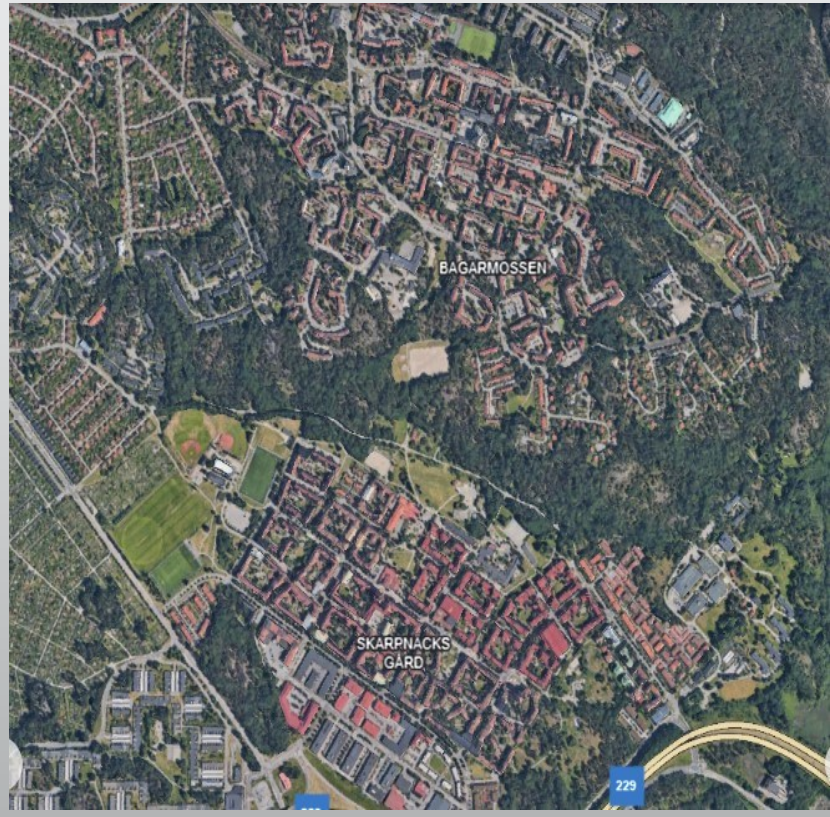
- The history of Skarpnack can be traced as far back as the Viking era. The people with strong connections to this heritage consider themselves natural-born to the city and often discriminate against others.
- For a region that has history with segregation of groups considered to be outsiders as evident in the social discrimination against Swedish Romas in the early to mid-20th century (Stockholm city archives, 1960), **the tendency that social cohesion is endangered with respect to existing and new immigrant groups persists.**

Social Cohesion & Quality of Life

State

- Total population = 46,988 as per 2022 data.
- Registered foreigners = 8.9%
- Birth rate = 11%
- Death rate = 6.7%
- Average population growth rate of 0.5%.
- The population is projected to reach 64,574 by 2040 (Stockholm city plan 2017). That's about 40% increase.
- Mixed population with different backgrounds.

The built environment in Enskededalen and Skarpnäck Gard is largely based around closed blocks.



With an average age of 38.7 years old and an age index of 80% implies that there's a fair distribution of old and young in the area. The different age classes have different environmental requirements for quality life and social bonds.

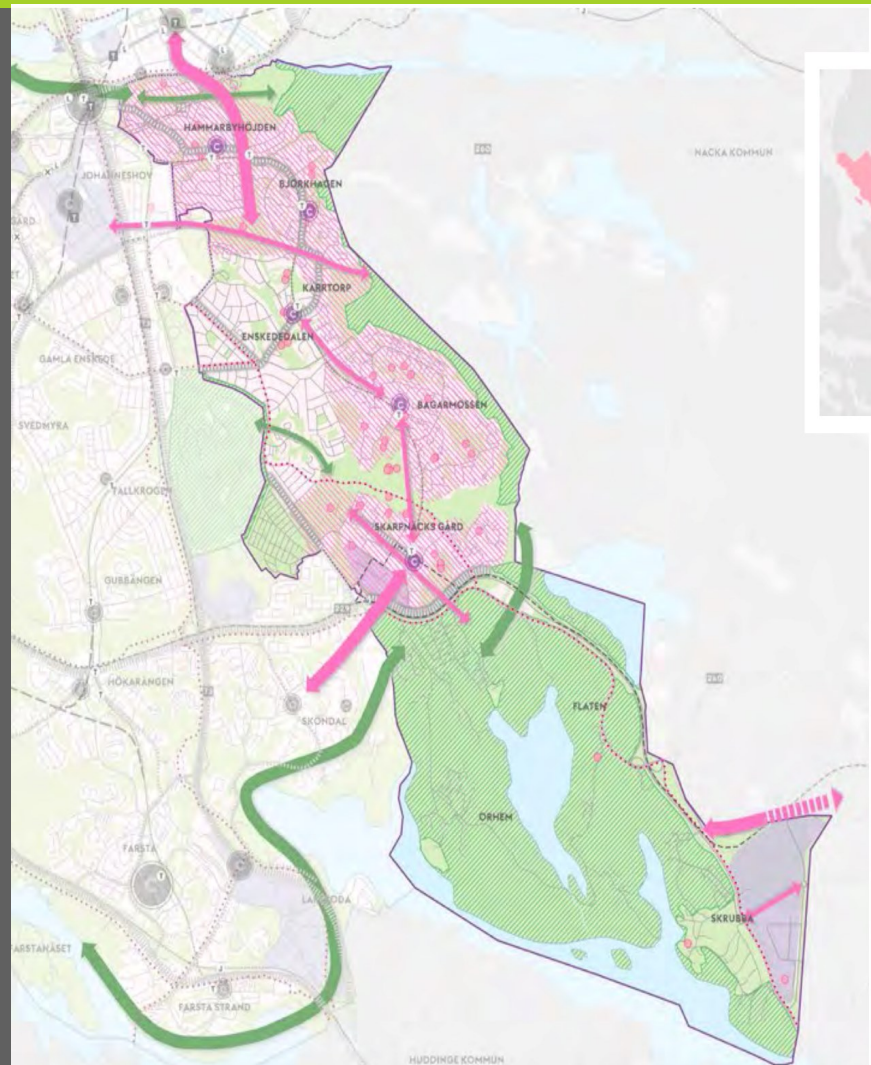
SOCIAL COHESION & QUALITY OF LIFE

Impact

- Areas of detached houses, apartment blocks and industrial areas are sometimes kept apart like small islands. Parts of the city are often separated by roads, tracks, water, and green spaces. In many places, this creates a sense of distance between areas.
- Growing population demands new schools, and new culture and community centres.

Response

The essential summary quote of Stockholm's city plan for Skarpnäck reads: *"It is essential to improve navigability within the city district with joined-up pedestrian and cycle paths".* This response by the city indicates the existence of barriers to fluent navigation across neighborhoods in the district.



SKÄRGÅRDSSKOGEN, SKARPNÄCK

The proposal enables approximately 900 homes in new quarters in Skarpnäck. The planning area consists of the Archipelago Forest and is located between

"If a forest is characterized by forestry, then the land use becomes forestry. The user of the biotope data base can later assume that the surface is also suitable for recreation depending on its location in relation to distance and accessibility to the public" (Skånes, 2022)

"If a forest is not characterized by forestry, there is often potential for higher biodiversity and more ecosystem services than if it is cultivated" (Skånes, 2022)

This Ties into Henri Lefebvre's Theory That Space is a Social Construct

Number of Apartments	Estimated Start of Construction	Architect
Around 80	2029 at the earliest	Bergkrantz Architecture

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