

# Grass track and its role as a green infrastructure strategy within Stockholm's public transport sector

A qualitative study of the Spårväg Syd project as a future tram project with social example from Hammarby Sjöstad

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## **Abstract**

The implementation of grass tracks is uncommon in Stockholm compared to Central Europe where it is more popularized. As more tram projects are planned in the future such as the Spårväg Syd project, the aim of this study is to explore the role of grass tracks in the public transport sector by theoretically conceptualizing grass tracks as a green infrastructure strategy. The research questions were to study how residents perceive the grass track between Sicka Udde and Sickla Station, and how the grass track could contribute to noise concerns, traffic safety, and financial resource in the Spårväg Syd project. Qualitative methods were used in which online surveys were sent out to residents in Hammarby Sjöstad and interviews with the municipality and county workers from Lund, Norrköping and Stockholm were conducted. The result showed that the resident was more positive about the grass track compared to the municipality and county workers which highlighted the additional cost and work effort to provide the public with a well-maintained and visually attractive grass track. The conclusion of this study has covered previous and new discoveries which open discussions for further reflection on what project planners shall consider before deciding to implement grass tracks in future tram projects.

**Keywords:** grass track, green track, tram, tram project, urban vegetation, green infrastructure, public transport.

## **Preface**

I would like to extent my gratitude to my supervisor Lennert Jongh for his guidance and feedback. I would also like to extent my gratitude to my friends and family that has supported me throughout the months I've been working with my thesis.

## Innehållsförteckning

<b>1. Introduction</b>	<b>5</b>
1.1 Aim and research questions	6
1.2 Definition of the tram and different track design	6
1.3 Disposition	8
<b>2. The theoretical framework</b>	<b>9</b>
2.1 The concept of green infrastructure in urban planning process	9
2.2 Green infrastructure in relation to the public transport sector	10
2.2.1 Integrating green infrastructure in public transport goals	10
<b>3. Background</b>	<b>12</b>
3.1 Literature review	12
3.1.1 History of green tracks	12
3.1.2 Different types of grass tracks	12
3.1.3 Grass track and its various usage	13
3.1.4 The social perception of grass tracks	15
3.1.5 The geographical challenges of maintaining grass track in cold climate	16
3.1.6 The economical consideration of maintenance	17
3.2 The historical development of Stockholm's tramway	18
<b>4. The study areas</b>	<b>20</b>
4.1 The grass track in Hammarby Sjöstad	20
4.2 The Spårväg Syd project	21
<b>5. Methodology</b>	<b>24</b>
<b>6. Method</b>	<b>25</b>
6.1 Online surveys	25
6.1.1 Sampling of participants	25
6.1.2 Construction of the questionnaire	26
6.1.3 Distribution of the survey	27
6.2 Interviews	28
6.2.1 The procedure of contacting participants	28
6.2.2 Performing the interviews	29
6.3 Thematic analysis	31
6.4 Limitations	32
6.5 Ethical consideration	32
<b>7. Result</b>	<b>33</b>
7.1 The residents' perception of grass tracks in Hammarby Sjöstad	33
7.2 Lund, Norrköping and Stockholm's experience with grass tracks	34

7.2.1 Noise .....	34
7.2.2 The traffic safety .....	35
7.2.3 Increase requirements for investment and resources.....	39
<b>8. Analysis .....</b>	<b>44</b>
<b>9. Discussion.....</b>	<b>45</b>
6.1 Driving factors that makes grass tracks popular .....	45
6.2 Factors that make cities question the usage of grass tracks .....	46
<b>10. Conclusion.....</b>	<b>48</b>
<b>11. References .....</b>	<b>49</b>
<b>Appendix .....</b>	<b>55</b>
Appendix 1 .....	55
Appendix 2.....	57
Appendix 3.....	58
Appendix 4.....	58

# 1. Introduction

Trams are one of the most fascinating types of public transport mode in modern time. No other public transport can be used in multiple environments and within the same traffic line as trams. Ranging from functioning as commuter trains on separate railway track to acting as cable-bound buses on asphalted roads in the middle of the street (Hedström, 2004). The multiple and diverse ways of operating trams have led to unique track design, such as having grass tracks. Grass tracks or tramways with a vegetated surface has been built in central Europe since the early 20<sup>th</sup> century and is loved by the public because of its ecological and social benefits, but more importantly because of its attractive and aesthetic feature to the urban environment (Kappis & Schreiter, 2016; Pfautsch & Howe, 2018). However, with beauty comes a price and lately the common drawbacks have been the financial cost of maintenance (Sikorski et al., 2018; Steckler et al. 2012). Nevertheless, the approach to integrate vegetation in urban areas is considered to fit well with the environmental goal of Stockholm's ambition in relation to green roof and facades, but grass track is not an approach that is equally as popular in Stockholm as in Europe (S, Troëng, personal communication, 4 April 2023). Grass track has been considered an example of green infrastructure by a previous study by Sikorski et al. (2018) but apart from that, little is known about grass track as a green infrastructure strategy within the transport sector in Sweden. The lack of academic studies conducted in Sweden regarding green infrastructure has mainly focused on regional issues such as forestry. Furthermore, previous Swedish studies has covered grass track as a climate mitigation tool (Ashman & Sollerhed, 2013), as well as grass track as impose of its practical and economic factors compared with ballast and asphalted tracks (Khoury & Howe, 2015).

Trafikverket, the Swedish Transport Administration, shared a national proposal to increase the investment in rail traffic to minimize the environmental degradation caused by car traffic for 2022-2033. Which suggest that more tramways projects are needed in the future (Naturskyddsföreningen, 2022). Region Stockholm is currently working on tramway project called Spårväg Syd. However, despite the mentioning to use green tracks in the project, little information has been made public about how the green tracks are going to be used, be built, and to what extent (Trafikförvaltningen, 2015a). Stockholm has only built one grass track between Sickla Udde and Sickla in Hammarby Sjöstad since extension of the Tvärbanan line in 2017 (SL, 2017). With the time gap of 6 years prior to the writing of this thesis, it is uncertain how future Swedish tram projects like the Spårväg Syd project can integrate grass track in ways that consider both the environmental impacts while simultaneously ensuring safe traffic conditions and most importantly, the overall financial cost.

Other Swedish cities such as Norrköping have been using grass tracks since 1999 (SMHI, 2018), and Lund is the most recent Swedish city to officially use grass track since the inauguration of their first tramway in 2020 (Lunds kommun, 2023).

Though the Spårväg Syd project mentioned the idea to use green track in their project back in 2015 (Trafikförvaltningen, 2015a). This study finds this a relevant topic that need more qualitative based research in a Swedish context, especially when more tram projects are likely to develop in the future. Thus, this thesis will use the knowledge from individuals with different backgrounds to understand the role of using grass track in future tram projects, by using the grass track in Hammarby Sjöstad to receive the perception of the local residents and by using the Spårväg Syd project as an example of a future tram project.

## **1.1 Aim and research questions**

With this study, I hope to provide planners and strategists for future tram projects with academic-based information and inspirational insight that could be useful when considering the expansion of grass track outside of Stockholm's city centre. Besides its significance for project planners, this thesis also hopes to add a new contribution to the academic work that highlights the importance of green tram tracks. Thus, this study aims to explore the importance of grass tracks for urban planning of future tram project, and the grass track's role as a green infrastructure strategy within the public transport in Stockholm's suburban areas, by using the following questions:

- How do residents perceive the grass track between Sicka Udde and Sickla Station?
- In which ways would grass track contribute to the noise concerns, traffic safety, and financial resource management in the Spårväg Syd project?

## **1.2 Definition of the tram and different track design**

### **Tram**

Trams are commonly slow to medium speed rail-bound vehicles that can run in both separate and shared tracks in various environments, ranging from single purpose traffic to mixed traffic. Trams drive on tramways are usually not fully fenced along its route in areas of mixed traffic to allow other transports to pass through (Hedström, 2004)

### **Macadam tracks**

Macadam tracks is a type of track that consist of ballast (crushed stone) which hold the tracks and all its components, such as rails, sleepers and fasteners. This is the most common type of tram track and is used for both trams and trains (Figure 1)

### **Asphalted tracks**

Asphalted tracks have a surface layer made of asphalt. Commonly used in urban areas where the tram shares driving space with buses, cars, cyclists, and pedestrians.

### **Grass tracks**

Grass track is referred to a specific tram track design where vegetation is implemented on the surface layer of a tramway, along with a layer of soil and a permeable geotextile which separate the soil from the macadam (Figure 1).

### **Green tracks**

Although this study focuses mainly on grass track, this thesis will also use the term ‘green tracks’. Green tracks will be referred to tram tracks that are said to have different type of vegetations other than grass, or when the specific vegetation is not specified by authors from previous studies.



**Figure. 1.** Macadam track in Hammarby Sjöstad, Stockholm (left), and grass track in Ullevi, Gothenburg (right). Source: Author’s own pictures.

## **1.3 Disposition**

This thesis is divided into nine chapters. The first one is the introduction in which the reader has already read. The following chapter is the theoretical framework which presents the concept of green infrastructure and how this study will incorporate it in the result in connection with the public transport goals. Next up is the background chapter which review the historical development of tram and grass track, as well as presenting relevant finding from previous studies. After that, a short presentation of the study areas is presented with illustrated pictures. Thereafter, the methodology and method is presented. Where a review of the data collecting process is presented in detail. The Seventh chapter presents the results based on the structure of the research questions. Followed up with an analysis and ending with discussion and conclusion.

## **2. The theoretical framework**

The use of a theoretical framework is an essential part of research studies because it functions as a guiding structure that ensures a reliable statement that can be connected to existing knowledge. The theoretical basis of this research will use the concept of green infrastructure (GI) to contextualize grass tracks within the transport sector. Thus, this chapter will explain GI as a concept in urban planning process and how GI strategies can be linked with the public transport sector.

### **2.1 The concept of green infrastructure in urban planning process**

In Sweden, green infrastructure are commonly viewed from a regional perspective, and is considered as measures that is based on environmental goals which link the ecological network in the landscape (Naturvårdsverket, n.d.). The concept of green infrastructure has not always been the same throughout the time. For example, Lindholm (2017) stated that in the early years of the 21st century, the concept of green infrastructure was defined as a mean to preserve the ecosystems for its beneficial functions for human usage such as recreational areas. However, as years passed, the definition of green infrastructure has changed to a more adaptable and adjustable approach since cities have become more knowledgeable about the technical and functional understanding of green infrastructure. By the mid 2010's, the concept of green infrastructure has changed toward a more opportunistic approach which begun to take form in the urban spaces. The started to involve strategic thinking of implementing eco-functional solutions in urban areas to enhance the green area that already exist.

At first impression, the concept of green infrastructure seems as an ambiguous approach with a broad goal. That's why green infrastructure measure usually come together with a set of principles. According to a more recent study by Monterio et al (2020), there is a total of eight planning principles for green infrastructure measures.

According to Monteiro et al (2020), is the first principle, connectivity, which is about creating a well-established link or a network between animal species and human activities. The second is multifunctionality, which states that a measure should provide benefits with other services such as cultural, economic, and social purposes other than ecological. The third principle is similar to the previous principle, but the difference between multifunctionality and multitask is that multitask emphasize the ability to be flexible and adaptable in performing task for a project. Anyhow, integration is the fourth principle, and it states that green infrastructure should have a clear connection to grey infrastructure, that is urban structures that handle the stormwater such as water pipes and drains. The fifth principle is diversity and here it highlights the essential need

for green infrastructure measures to be available in various designs and sizes to suit a larger range of environmental issues in different areas or places. Meanwhile in the sixth principle, it is important that the green infrastructure measure is applicable regardless of which project it may be. The seventh principle highlights the importance of communication and collaboration between the locals and the state actors. Finally, the eight and last principle is continuity, which is to ensure to monitor and maintain the green infrastructure measure after the implementation to increase the longevity of the desired services.

Though, green infrastructure has the potential to minimize the negative environmental impact of various projects. One of the major challenges of green infrastructure is the requirements for sufficient financial resources to cover expenses for the preparation and essential post-maintenance (European Commission, 2016; and Monteiro et al., 2020)

## **2.2 Green infrastructure in relation to the public transport sector**

In the context of transport, green infrastructure are regarded as a tool to reduce the negative impact from the transport sector due to the amount of environmental destruction the transport sector has contributed to the environmental ecosystem, such as emission of greenhouse gases and obstruct the water infiltration (European Commission, 2016). From the examples presented by the European Commission (2016), the concept of green infrastructure in the transport sector is normally referred to green passages over roads and motorways, but also as new innovative ways to decrease the risk for storm water run-off on roads. Although roads are displayed as the more direct approach, it is important to acknowledge that roads are only one of many elements in the transport sector. In a previous study such as Sikorski et al (2018), green infrastructure measures such as grass tracks are shown to be linked with the public transport sector. Though Sikorski et al (2018) did not specify the reason, it is theorized that the grass track fulfils many of the eight principles.

The issue with green infrastructure and the public transport sector is that both have distinct aims but have factors can relate to each other. As previously mentioned, the concept of green infrastructure in urban planning processes is more embedded in developing strategically and enhanced ways to integrate eco-based solutions in the urban environment (Lindholm, 2017). On the other hand, the public transport focus more on distribution and service. For example, in the context to Stockholm, the public transport sector is responsible for safely transport people and distribute to accessible and sustainable travel option (Region Stockholm, n.d.b).

### **2.2.1 Integrating green infrastructure in public transport goals**

However, nowadays the public transport sector is becoming more aware of its environmental impact and cities such as Stockholm have developed public transport goals which includes areas that focus on minimize the environmental impact caused by public transport (Region Stockholm, 2017).

Stockholm's public transport goals is based on the vision to become the most attractive metropolitan region in Europe and intend to use these goals to achieve their vision by 2030 (Region Stockholm, 2017).

Though, there are a total of three goals. This study will only use the goal that focus on the public transport's adaptability to 1) reduce the negative environmental impact caused by public transport, 2) reduce the amount of severely injured and killed people from rail traffic, and 3) reduce and maintain the annual cost of developing and maintaining public transport.

The first focus area includes various factors such as energy efficiency, renewable energy, noise, and emission of nitrogen oxides and dust particles (Region Stockholm, 2017). However, this study has chosen to focus only on noise because it is the only environmental indicator that is measurable with units (the noise level from public transport shall not exceed 70 dBA in outdoor areas (Region Stockholm, 2017)). The second focus area, traffic safety, goes hand in hand with the primary responsibility of public transport. Whereas the third focus area, financial resource effectiveness, relate to the green infrastructure major challenge as a planning tool.

## **3. Background**

This chapter will present what is already known about grass track by reviewing the history of green tracks and examples from how green tracks have been perceived in previous studies. Followed by a description about how tramway was developed in Stockholm.

### **3.1 Literature review**

#### **3.1.1 History of green tracks**

The oldest published discussion about green tracks can be found in a New Zealand newspaper from December 1910. The original idea of using vegetation layer is an alternative for asphalt or concrete layer, which are the most common surface layer in cities which are typically characterized with sealed hard surfaces (Novales & Conles, 2012). However, the world's first evidence of using green tracks is found in photos from Berlin's city centre between 1910-1920's (Kappis & Schreiter, 2016). The beginning of the 20<sup>th</sup> century was a time where many major cities in Europe, including New Orleans (USA), started to try green tracks (Novales & Conles, 2012). Nevertheless, it wasn't until urban planners and public transport authorities began to be more aware of the environmental consequences in 1980-1990's, when green track became immensely popular in Europe (Kappis & Schreiter, 2016; SMHI, 2018). As more cities began to look for opportunities to implement environmental-friendly traffic strategies, the idea to use green tracks were once again back on the authorities' planning table (Kappis & Schreiter, 2016; SMHI, 2018).

#### **3.1.2 Different types of grass tracks**

Grass tracks are the most common type of green track in Europe and can be seen in countries such as France, Spain, Germany, Switzerland, and Bulgaria, as well as countries outside of Europe, such as USA, and China (Pfautsch & Howe, 2018). The country with the most grass tracks is Germany, followed up by France (Steckler et al, 2012). The extensive usage of grass track is also apparent in the Nordic countries. For instance, grass track is mentioned to be used in Oslo, Norway (Burns, 2005), and Gothenburg, Lund, Norrköping and Stockholm in Sweden (SMHI, 2016; Lunds kommun, 2023).

The reason grass is widely used is because of its vast range of grass species worldwide that makes it possible to easily adaptable. For example, there are grass species that are tolerant to hot and sunny condition, whereas other grass species are more suitable for a cool and wet environment (Jakubcová & Horváthová, 2020).

Grass tracks can come in different forms, such as rolled-out grass and grasscrete. (Khoury & Grönskog, 2015). Rolled out grass is pre-cultivated grass lawns that allows for easy and fast installment and makes it possible to customize according to one's requirement (Pfautsch & Howe, 2018). The second type of green tracks is grasscrete, this variant is less common than rolled out grass tracks but it does occur in smaller cities such as the suburban areas of Wolfartsweier in Germany (Burns, 2005). According to VäxtEko (n.d.), grasscrete is hollowed concrete plates in which grass is allocated/planted between the hollow spaces. Grasscrete has the advantage of facilitating the water drainage the same way as rolled out grass track. The main difference is that grasscrete can create and preserve semi-green areas in open areas that are subjected to road wear and tear by the traffic by allowing traffic to operate as usual.

### **3.1.3 Grass track and its various usage**

#### *Ecological benefits*

In fact, Jakubcová and Horváthová (2020) stated that green tracks also share similar environmental advantages as green roof because both integrate vegetation in a harsh urban environment with high exposure of insolation. The major different between green tracks and green roof is that green tracks are affected by frequent external activity by passing trams compared to green roof that rarely get affected by other external factors other from the weather.

The main arguments for using grass tracks lies in its environmental and ecological benefits. For example, grass tracks are known to absorb air pollution, managing the storm water management and infiltration in urban areas, minimizing the risk for flooding. Furthermore, grass track is also known for its contribution to cool the microclimate. However, the cooling effect is believed to be not as much as one might have thought if there is an asphalted road next to it which could minimize the estimated thermal reduction (Jakubcová & Horváthová, 2020). On top of that, grass tracks have also been mentioned to promote biodiversity by providing more green space for small scale flora and fauna (Grüngleisnetzwerk, n.d.).

#### *Noise mitigation*

One of the most debatable features of grass track is the grass track's effectiveness of reducing the noise level from passing tram trains. There have been agreements and disagreements about whether grass track can be used as a noise mitigation or not. For example, according to a Swedish noise investigation in Norrköping, green track was shown to reduce the noise level by approx. 5-6 dBA in comparison to asphalt, but the result showed little to no significant difference compared to macadam tracks around that were around 2 dBA (Ramböll, 2008). Meanwhile, green tracks with high vegetation is

said to be able to reduce noise by 3 dBA compared to ballasted tracks (Pfautsch & Howe, 2018).

However, Grüngleisnetzwerk (n.d.) stated that the noise dampening ability of green tracks is technically overvalued since the sound bonus of approx. 2 dBA is too small to even consider as valuable. Furthermore, Grüngleisnetzwerk (n.d.) and Jakubcová and Horváthová (2020) stated that the presence of green vegetation is a sufficient method in order to leave a positive impact on nearby residents. Both authors referred to this situation as a psychological impact or a shared social interpretation in which green tracks is perceived as more quiet and pleasant to the hearing compared to conventional tram tracks.

#### *Urban design*

The visual presence of green tracks has shown to have an important role in improving urban design. For instance, Pfautsch and Howe (2018) showed a case where the grass track in Kagoshima, Japan went for a more aesthetic approach of integrating vegetation in their urban areas by focusing on mixing different types of vegetation and how to place these plants along the tramway to enhance the scenic view of that urban landscape. Meanwhile, Burns (2005) showed that cities such as Strasbourg, Montpellier and Bordeaux in France used grass tracks as a strategy to showcase a transition from urban to suburban environment. The green tracks were used in suburban areas, meanwhile granite tracks were used in urban areas to characterize certain areas that hold an important value for the city's historical identity. Burns (2005) concluded that green tracks can be used as a track design to express and reflect specific locations by characterize the tram track by using the same element from the surrounding area. This is considered an ideal approach when aiming to enhance the attractiveness of urban areas and achieve a feeling of harmony.

#### *Ensure safety traffic environment*

There is a lack of studies conducting research about the traffic safety aspect in relation to green track. There were, however, one study by Fontaine et al (2016) that compared green tracks in a context for traffic safety. Their study showed that the integration of vegetation in otherwise grey and hard surfaced dense urban areas are shown to be a useful tool to improve the safety condition on the tramways. By occupying a part of the road and reserve it to tramway, it will greatly improve the tram driver's visibility over the tramway which is the most important factor for a safe journey. Furthermore, Fontaine et al (2016) found that if green tracks were combined with metallic barrier between the street and the tramway, then it would contribute to less tramway-related traffic incident compared to an open tramway with asphalted tracks. By choosing this approach, it would eliminate distractions and make it easier for the tram driver to spot potential pedestrians and vehicles on the tramway.

### *Economic growth*

Grüngleisnetzwerk, (n.d.) stated that the implementation of green vegetation in urban areas, can enhance the city's image and is often used as a strategy to market the city in a global and regional context. An example of this can be seen in Steckler et al. (2012) study, where they mentioned the city Freiburg which is known as the 'German capital of green track' because nearly 50% of their tram track is covered with vegetation. Furthermore, Grüngleisnetzwerk, (n.d.) pointed out that the aesthetic features of grass track could bring economic benefits for businesses that are located along the tramways. Since the presence of green vegetation increases the chances of customer to willingly pay more in business that have a surrounding with lots of green vegetation.

### **3.1.4 The social perception of grass tracks**

Although grass tracks are often used for its aesthetic and physical appearance as seen in Burns (2005) and Fontaine et al (2016) study. There haven't been many studies that focus mainly on the social perception of grass track on a local level. Upon searching for a social-based study on grass track, only one study was found by Sikorski et al (2018). Sikorski et al (2016) performed a comparative study of the optical perception of tracks made of grass and grass mixed with herbaceous plants (low-lying flowering plants with no vascular stems) in Warsaw, Poland. Their research was based on online surveys with 153 residents in urban and mostly suburban areas and focused mainly on their perception and opinion.

The result of Sikorski et al (2018) study showed that the color and coverage of vegetation can determine how successful green track is perceived by the public, even though the majority is already positive towards green tracks compared to conventional tracks. For example, a green track with full and dense coverage with no color defect where appreciated the most by the respondents, compared to a green track with an uneven surface coverage with different color patches. The latter examples were said to resemble weeds. Thus, tram track with herbaceous plants were considered undesirable compared to grass. One of the other key findings of Sikorski et al. (2018) research showed that the general view of how a green track is supposed to look like were based on a shared mental image of a lush and well-maintained grass lawn. It was highlighted that the residents had positive opinions of green tram as long as it contributed to more green spaces in the urban area and is taken good care of it. In addition to the residents' perception, Sikorski et al. (2018) research also studied whether the distance from the green tracks could have a significant impact on the resident's perception. The result showed that the greater the distance is from green tracks, the more positive will green track perceive positive reactions. The reason was that on a greater distance, the respondents could not spot imperfections that is only visible from up-close.

On that note, Sikorski et al. (2018) revealed that grass track is not perceived positively throughout the year. The reason was said to be the high requirements for maintenance.

### **3.1.5 The geographical challenges of maintaining grass track in cold climate**

According to Amsler and Hoogendorn (2010) is green tracks an environmental-traffic investment that requires to be evergreen, easy to install, absorb noise and vibration, be sustainable in terms of longevity, contribute to eco-functional, sustain an optical quality, and require low maintenance to save the overall financial costs over the years. However, implementing and maintaining a grass track in an environment with regular traffic activity in hope for longevity depends on the climate of the region. Pfautsch and Howe (2018) explained that it is important that the chosen vegetation needs to be tolerant to the various weather conditions and the seasonal changes. According to the updated version of Köppen climate classification map from Peel et al. (2007), the climate in Europe is generally divided into three zones: cold climate in the north and east, temperate climate in the west, and arid climate in the south. In addition to the climate zones, each country needs to take careful consideration of the variational seasons. For example, Mediterranean countries needs to adapt to drier and hotter seasons, compared to the Nordic countries that needs to consider the contrasting and differentiating temperature during the summer and winter season which brings precipitation of rain and snow.

Peel et al. (2007) version of the Köppen climate maps shows that Stockholm belongs to the climate type named Dfb. Dfb is characterized for having cold climate where the coldest month is below 0 C and generally has warm summers with dry seasons where the warmest month is above 10 C. The climate type Dfb are shown to extent over several countries in the central and eastern Europe and among those countries, previous researcher such as Sikorski et al. (2018) and Steckler et al. (2012) have conducted studies about grass tracks in few of those cities.

The following sections shows how seasonal temperature changes can affect the maintenance of grass tracks in cities with Dfb climate.

Summer drought is the most common issue when it comes to maintaining grass tracks. For instance, both Vienna and Warsaw have had problems with summer drought which have made their grass track to look dull and brown due to dehydration. Several attempts have made find alternative vegetation that is more tolerant to drought and heat (Sikorski et al., 2018; Steckler et al., 2012). For instance, Sikorski et al. (2018) investigated the potential of using herbaceous flowers mixed with grass in Warsaw and the result showed that herbaceous plants remained green and could endure the summer drought better than grass. Meanwhile, Steckler et al. (2012) investigated three types of mostly

local seed mixtures in Vienna. The first was a seed mixture of grass and herbaceous plants in partly shaded area, the second was mainly open and sunny area with more tolerant grass species than the previous one. Lastly, the third is salt tolerant grass species in slightly shaded area. The first and third seed mixture showed satisfactory result toward the green tracks which include herbaceous plants, compared to the seed mixture of tolerant grass species because the herbaceous plants could endure drought during a longer period of time.

One of the notable inconveniences of using grass tracks in countries with Dfb climate is the recovery process after the winter season. Steckler et al (2012) explained that cities that usually receive seasonal snow during the colder months needs to be willing to pay extra to recover the damages caused by snow ploughing and other winter services for tramways. Machines such as snowplow, unintentionally destroy the vegetated surface layer by scraping away plants and soil along with the snow.

### **3.1.6 The economical consideration of maintenance**

The number of new grass tracks in European cities with new tram network were revealed to have decreased since the 2010's but has increased in cities that has had existing grass tracks since the 1990-2010's (Steckler et al., 2012). In Sikorski et al. (2018) study it was stated that insufficient funds are usually the main problem that stops the developing expansion of greening European cities.

A previous study by Khoury & Grönskog (2015) compared the installation cost (per meter) and the maintenance cost (per km and year) between grass-, asphalt- and ballasted track in Stockholm, and found that grass track is cheaper than asphalt tracks, but more expensive than ballasted tracks, whether if it is installation or maintenance. According to Khoury & Grönskog, (2015) require conventional tram tracks maintenance such as rail grinder, switchgear cleaning, lubrication, when necessary, and snow ploughing during the winter. The implementation of grass tracks leads to additional maintenance in forms of mowing and irrigation, as well as fertilization if it is deemed as necessary. The additional work that needs to be put into grass track leads to a higher total cost, which tends to be the reason why grass track is generally more expensive than conventional tracks.

Lately, there have been cases when cities have begun to find alternatives to grass tracks due to the increased financial requirement for the maintenance. For example, Steckler et al. (2018) stated that Warsaw was trying to find a cheaper and effective solution because the maintenance of grass track has become more expensive over the years. Moreover, the green urban supply company Sempergreen (n.d) reported that in 2017. Warsaw change from grass track to a sedum-mixed track. Sedum a flowering succulent (thick leaf) plant that are more restricted in terms of the geographical distribution

compared to grass since sedum is naturally adapted to very hot and dry environments (Jakubcová & Horváthová, 2020)

Jakubcová and Horváthová, (2020) study took place in two Czech cities, namely Prague and Ostrava, and used sedum as an example of a low-maintenance track. The result of their study showed that the installation cost for grass tracks are similar to sedum tracks and both grass tracks and sedum tracks have higher installation cost than ballast tracks. However, when it comes to maintenance, sedum is known to be 30 times cheaper than grass tracks, although still higher than ballast track.

Another solution apart from using different types of vegetation has been to implement a technical track design with low vegetation, instead of high vegetation. In Portland, in Oregon, USA focused on using a different green track design where the entire rail, footings and fasteners are fully visible above the vegetation. The reason for their method was to make it easier for the workers to reach the track and its components (Pfausch & Howe, 2018).

## **3.2 The historical development of Stockholm's tramway**

The first Swedish tram line was installed in Helsingborg in June 1877, between a hotel and its newly established bathhouse. It used a prototype of a horse-drawn tram and was only open during the summer season (Spårvägssällskapet, 1999a). One month later, Stockholm installed their first horse tram line (Spårvägssällskapet, 1998), and operated on horizontal paving stones but struggled on steep hills. Fortunately, in 1887, the officially first steam-powered tram was introduced to Stockholm's city traffic and was quickly put into use due to its being able to generate more power than the horse tram (Stockholmskällan, 2022c).

The usage of steam trams quickly ended after the first electric trams were established in 1901 (Spårvägssällskapet, 2021). The technical benefits of electric trams made them cheaper to operate compared to horse and steam trams. This made it possible to extend the tram traffic to the suburbs, which never had access to other travel modes other than by horse carriage (Stockholmskällan, 2022c). Remarkably, the horse trams were still in service even after the introduction of the electric trams but had to officially end their nearly 30 years long service in 1905 (Spårvägssällskapet, 2021). Since then, the electric tramways underwent a rapid period where nearly 20 new tramway lines were extended across northern, western, and southern Stockholm (Spårvägssällskapet, 2013) The electric tram had its peak during the first half of the 20th century, but it was more prominent during the 1920s (Spårvagnsstäderna, n.d.). For example, in 1924, Stockholm attempted to introduce petrol trams between Karlaplan and Frihamnen, but the concept failed and was soon forced to shut down in 1929 (Spårvägssällskapet, 1999b).

Nevertheless, the prosperous and thriving years of the electric trams were later faced with hardship after the Second World War ended in 1949. The aftermath of the war left cities around Europe in desperate need of modernization and innovative technology to rebuild their urban environment and transportations. The development of Stockholm's tram traffic was drastically impeded once the first automobile vehicles (e.g., mainly cars but also busses) were getting more affordable and accessible for the middle class, followed by the first operated underground metro line in the 1950s (Spårvagnsstäderna, n.d.; Stockholmskällan, 2022a, 2022c; 2022d). The government had to quickly adapt and rebuild the urban environments to deal with the demands caused by the increasing use of cars (Hedström, 2004). Furthermore, the new underground metro was much faster than trams and it made it possible for Stockholm's public transport network to extend further out in the suburbs, compared to the electric tram lines (Stockholmskällan, 2022c, 2022d). Lastly, the national conversion to right-hand traffic in 1967 was the final impact that affected the usage of the tramways as many of the trams were originally constructed for left-hand traffic (Stockholmskällan, 2022c). As a result of these historical and competitive events, almost all of Stockholm's tramway lines were shut down between 1949-1967 (Spårvägssällskapet, 2013). The only tramway lines that survived the dismantling of Stockholm's tram system were tramway lines that were located outside the inner city such as Nockebybanan (Spårvägssällskapet, 2013; Langert, 2018).

It eventually took 24 years until the government decided to develop the tram service again. The developing process were naturally slower because Stockholm's metro and buses have become more advanced and extended since the mid-20<sup>th</sup> century. Nevertheless, three more tram lines were added between the 1990s and 2010s (Spårvägssällskapet, 2013), and by 2021 the number of tram lines had increased to five regular lines: Line 7 (Spårväg City), Line 12 (Nockebybanan), Line 21 (Lidingöbanan), Line 30 (Tvärbanan (Solna station - Sickla station)) and Line 31 (Tvärbanan (Bromma flygplats - Alvik strand)) (Spårvägssällskapet, 2021).

## 4. The study areas

This chapter present the study areas for each of the research questions in this study. Starting with the grass track between Sickla Udde and Sickla station in Hammarby Sjöstad and ending with the ongoing tram project Spårväg Syd.

### 4.1 The grass track in Hammarby Sjöstad

In 2017, Stockholm installed their first grass track on Tvärbanan between Sickla Udde and Sickla station (Stockholms stad, 2022a; SL, 2017). The area in which the grass track was built on is called Hammarby Sjöstad, and is used as the study area for the first research question in this study (figure 2).

Hammarby Sjöstad is a redevelopment area that aims to build new housing, business- and workspace areas and to manage the services and facilities for these new areas with an environmental consciousness by putting more attention to minimize the redevelopment areas overall environmental impact and promote as an environmental and sustainable profile for Stockholm's future (Stockholms stad, 2022b).

The grass track was used as an esthetical solution to lower the noise level and create a space for insects, small birds, and other smaller animals (Stockholms stad, 2022a). Furthermore, the grass track was seen as an important environmental effort to improve the transportation infrastructure in Stockholm and it is emphasized as a positive environmental feature that will enhance the attractiveness of the route between Sickla Udde and Sickla station. (SL, 2017).



**Figure 2.** Grass track in Hammarby Sjöstad. Source: Author's own picture.

## 4.2 The Spårväg Syd project

For this study, the Spårväg Syd project will be used as an example of a future tram project which plans to implement grass tracks.

The Spårväg Syd project is one of the major tram project of Stockholm and was created as a collaboration between Huddinge municipality and Stockholm county. The project was founded during the Sverigeförhandlingen and is an ambiguous project that strives to connect Flemingsberg with Älvsjö, through several important pitstops such as Kungens Kurva and Skärholmen in the southwestern part of Stockholm's suburban areas (Region Stockholm, n.d.a).

Additionally, the project plan was developed to cope with the expected population growth and the increased demand for reliable public transport in Stockholm. In amidst of it all, it was made clear that Stockholm also desires to become a world-leading representative as the most attractive metropolitan region in Europe with the help of the Spårväg Syd project. The project's contribution to Stockholm's vision is to invest in sustainable and environmentally friendly traffic solutions in the form of suburban tramways. The reason for building a new tramway line between Flemingsberg and Skärholmen city centre, is because these areas have been considered as important city centers that need improvements in accessibility to public transport for more than 10 years (Trafikförvaltningen, 2015b).

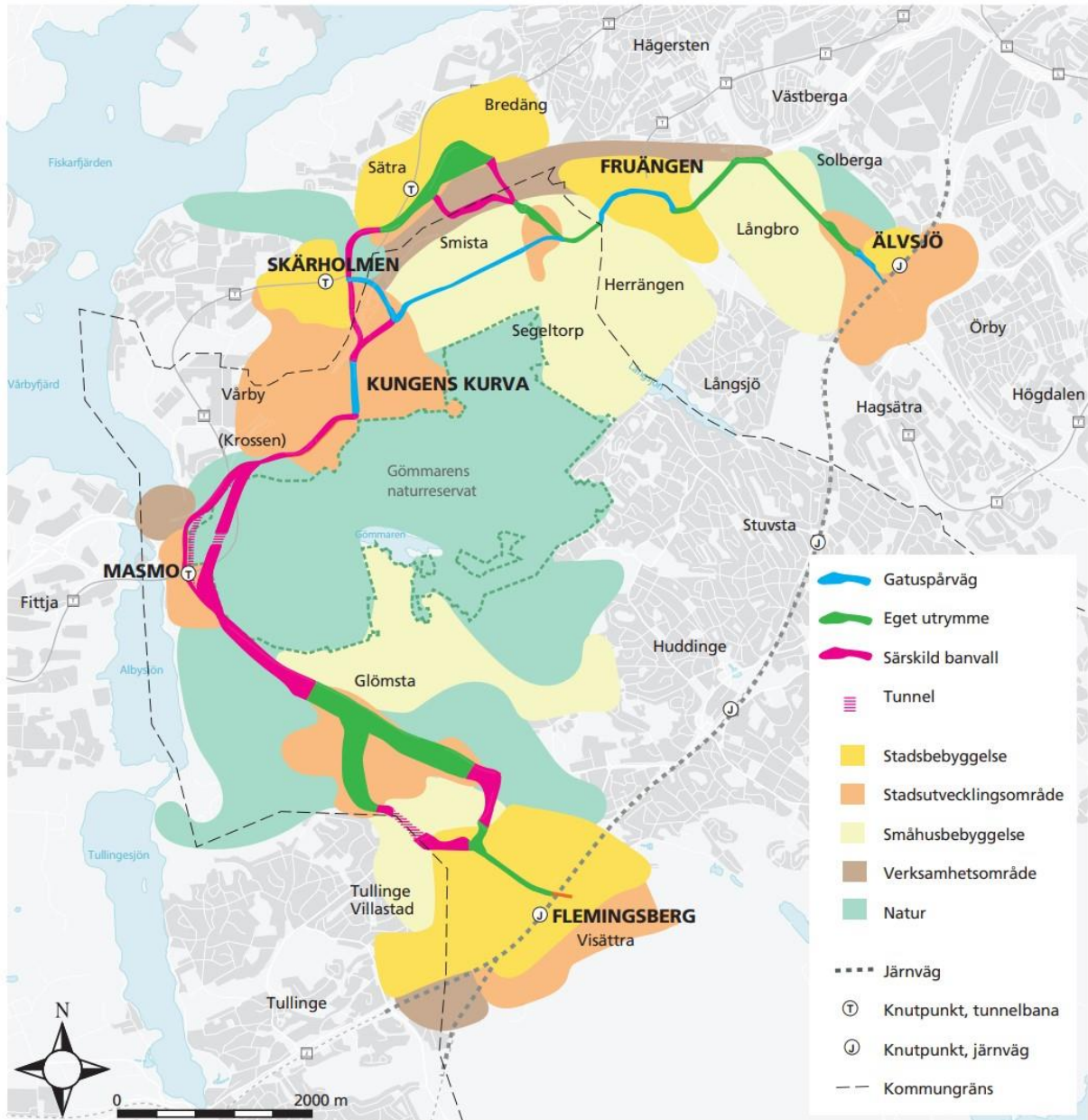
### *Routes and tram tracks*

The project has identified existing areas and estimated the development of such areas in year 2030, such as urban areas (stadsbebyggelse), urban development areas (stadsutvecklingsområde), single-houses areas (småhusbebyggelse), business and industry areas (verksamhetsområde) and nature areas (natur). Furthermore, the project is divided into five sub-areas or sub routes in which the tramway is going to operate (figure 3) (Trafikförvaltningen, 2015a):

Flemingsberg ↔ Glömsta  
Glömsta ↔ Krossen  
Krossen ↔ Skärholmen

Skärholmen ↔ Fruängen  
Fruängen ↔ Älvsjö

For the convenience of the people in these areas, the tramline will also have interchangeable connections to the commuter rail at Flemingsberg and Älvsjö, and to the metro at Masmo, Skärholmen and Sättra (Trafikförvaltningen, 2015a).



**Figure 3.** Map over the area of the Spårväg Syd project and location of the planned tramway types for 2030. Source: (Trafikförvaltningen, 2015a)

The Spårväg Syd project plans to use three types of tramways along the routes: Specific embankment, reserved space, and shared space (figure 3). The first type of tramway is specific embankment (särskild banvall) and have similar to railway track since the tram will be the only one that has allowed on the track. This tramway will allow for high-speed travel between 50-80km/h and most of its usage are planned to be in the outskirt of urban areas and in industrial areas. The second is reserved space (eget utrymme) and is the main approach in the tramway will be separated from other traffic with an elevated lane in an urban area. Good visibility is preferred here since the tram is closer to other traffic. A medium-speed of around 40-60 km/h are allowed here. Lastly, there

are shared spaces (gatuspårväg), which allow the tramway to mix with buses, cars, cyclists, and pedestrians. A low speed of 30-50km/h is planned to be held with buses and cars, while a very low speed with max 30km/h is set to be in spaces with cyclists and pedestrians (Trafikförvaltningen, 2015a)

Green tracks were proposed as one of the alternative track design options on routes where the tramway run on specific embankments and in reserved space. In regard to the varying environments along the routes, the green tracks were suggested to be adapted to the local environment. The examples that was presented was that green tracks can be used in nature areas, while industrial areas would have macadam tracks (Trafikförvaltningen, 2015a).

#### *Identified environmental impacts and public reactions*

By the time of writing the thesis, the Spårväg Syd project is currently in the early stage of consultation, and the location of the tram stations has yet to be decided (Region Stockholm, n.d.a). Nevertheless, a lot of environmental investigation has performed since its first proposals and one of them stated that noise is one of the most concerning environmental aspects that is expected to affect residential and green areas. The residential areas along the planned tram route are estimated to have a noise level that exceeds 70 dBA. Meanwhile, the nature reservate Gömmaren in the sub-sections Glömsta - Krossen and Krossen - Skärholmen are expected to receive higher noise levels to a varying degree of moderate negative impact (Trafikförvaltningen, 2015c).

Furthermore, the scale of the project has reached media for its potential risk of affecting areas with high cultural and natural values. For instance, the newspaper 'Mitt I' announced that the project is assumed to affect the environment and mentioned the risk for flooding, the impacts to biodiversity, and an anticipated increase of noise and vibration along these areas (Broberg, 2022).

## 5. Methodology

The ontological perspective of this study is shaped by the belief that reality exist of multiple truths. This so-called relativism is the fundamental perspective that believe that truth can evolve and change over time. The truth is dynamic, it is in constant motion and can be endless in both amount and depth. The idea that the reality of this world can be seen through a monocular type of vision is strongly rejected because the knowledge, in which this research is interesting in, is subjective and is based on the personal experience of the individual's interaction with the society (Cope & Hay, 2021). Hence, this is another reason to why this research chooses to view the concept of green tramway as both a climate adaptation and mitigation measures, and not only a pre-dominantly climate adaptation measure. If the green tramway was only seen as an adaptation measure, the research would miss out essential information that would normally be ignored or forgotten.

Furthermore, the approach to collect, or what Mason (2018) preferably describe it as "generate", data is the major next step which demonstrate how the social phenomenon and knowledge are validated. This epistemological perspective consists of multiple principles with their own rules and can be applied to various research depending on the nature of the subject. Due to the reason this study uses an ontological position that believe that the truth of this world is socially constructed by individual behavior and personal experiences, the appropriate principle to use is the perspective of the interpretivist. Mason (2018) describes the 'interpretivist' as when the researcher set their mind and practice into emphasizing the sense of people's action, as well as interpretate the meaning behind their way of making sense of the world.

Generating information about people's experiences, opinions, and perceptions, requires qualitative research. According to Cope and Hay (2021), and Mason (2018), qualitative research is directed to studies which require non-stackable information that can draw connections and create meanings between different social issues on different levels and situations. It is a social-oriented approach that seeks to explore and understand subjective information, rather than qualify and validate objective data. Furthermore, Mason (2018) explained that since qualitative research is rooted in the ontological perspective, the generated data from qualitative research should not be seen as a direct reflection of the truth. Cope and Hay (2021) also added that the result from qualitative research should be viewed as a representation of a small section of the reality. It is theoretically and practically difficult to cover all aspects of different realities in this multilayered and intertwined social world. Therefore, both Mason (2018) and Cope and Hay (2021) highlighted extra cautions when presenting results from research of qualitative nature to avoid misleading interpretations of the research.

## 6. Method

This chapter presents the choice of methods used for collecting empirical data and how it was analyzed. The validity, reliability and generalizability of each method are discussed, and the method limitation and ethical considerations are presented.

### 6.1 Online surveys

As mentioned in the introduction, the first research question of this study was:

- How do residents perceive the grass track between Sicka Udde and Sickla Station?

To answer this question, this study has used online survey which is the same method as Sikorski et al (2018) study. According to McGuirk and O'Neill (2021), the advantage of using online surveys is the ability to simultaneously collect data from multiple participants via a shared platform about people's opinions, behaviours, social interactions, and awareness. It is an effective method to save time and cost for printing and distributing individual questionnaires, compared if it was handed out via door-to-door or sent out via traditional post. Furthermore, the respondents will be allowed to keep their privacy and be able to respond the questions at their own pace wherever and whenever they might be. However, with the easy and widespread accessibility comes some drawbacks. A common disadvantage of using online survey is the inability to control over who is taking the survey since it is presented to everyone that have access or use the designated website or social platform. Secor (2010) added that issues regarding the validity and reliability is a recurring topic that has always been debated in surveys. Furthermore, a "good quality" survey is highly valued depending on the quality and the sampling procedure. To overcome this issue, McGuirk and O'Neill (2021) suggested researchers to locate and send out the online survey to specific groups or forum which fulfill the research's requirements the most. The survey data have a higher chance of being more accurate but, consequently, the number of potential respondents is decreased.

#### 6.1.1 Sampling of participants

The purpose of the survey was to gather local information about the perception of the grass track in Hammarby Sjöstad. For that reason, the participants for this survey were residents along the grass track. The residents were selected because they are the people that spends most time near the grass track and could carry on useful information that the municipality or the authorities might have overlooked or missed out.

### **6.1.2 Construction of the questionnaire**

Although, this study has chosen to use the same method as Sikorski et al (2018), the structure of the questionnaire and types of questions in this study have been adapted to only include qualitative questions. McGuirk and O’Neill (2021) stated that studies which conduct qualitative questionnaire are advised to use four distinctive types of contents to structure the format of the questions. Those four types of contents are said to be focusing on questions covers the demographic information about the participants, their behaviour, attitude, and belief. This study has incorporated these type of content questions but did also taken inspiration from how Sikorski et al (2018) have constructed their survey. The following sections presents how the questionnaire of this study have been constructed.

The questionnaire was created in Google Forms and were written in Swedish. An introduction was put at the beginning of the questionnaire, which included a short presentation about the researcher’s identity, a general information about the purpose of the research, the content of the questionnaire, and a description to whom the questionnaire is for, and what the answers would contribute to after the study is finished. Furthermore, informed about the ethical and confidential technicalities and the average time to complete the survey was also added, as well as the date for the deadline that informed how long the participants can access to the online survey before it is closed. The questionnaire consisted of a total of 9 questions, which is divided into 6 closed questions and 4 open questions (Appendix 1).

The first section of the questionnaire is the introduction which aims to gather an overall understanding of the participants. It covered demographic information about the participants gender, age group, and their education- and employment status. McGuirk and O’Neill (2021) explained that these types of information are normally formulated as closed questions and is characterize by the way the respondents are required to follow certain structures and answer the questions by either ranking or selecting pre-presented items and categories, and evaluate various statements on scales. In this first section, the respondents were only required to select between different categories. Further down the questionnaire, more varieties of closed questions were used. However, with structured and closed questions comes some degree of disadvantages. McGuirk and O’Neill (2021) explained that the researcher must be cautious because the respondents are presented by a list of various questions with limited options which can leave out information that the respondents might think is important to include but are unable to fill it in as their answer to that question. To compensate this issue, this study used McGuirk and O’Neill (2021) suggestion and added an extra option, called “annat” (other), wherever it was suitable and possible to do in Google Forms.

The second section covered the participant's travel behaviour. This part of the questionnaire consisted of one multiple-choice question and focused on the participant's choice of transportation mode or modes when leaving their residence.

The third section covered the participant's attitudes and perceptions towards the grass track and their belief regarding environmental and sustainable strategies within the transportation sector. Three open-ended questions was used in this section, to allow the participants to freely express their thoughts and opinion without being restricted to pre-determine options.

Finally, the questionnaire ended with an open-ended question where the participants could leave a comment they want to share, or think is important to mention. This question is optional to answer, compared to the previous questions that required them to answer or fill in the options.

Additionally, the questionnaire did not provide information about the positive nor the negative significant impacts of having green tramways, as it has been purposely excluded in previous studies. For instance, Sikorski et al (2018) explained that, by revealing this information to the participants, their attitude will naturally connect green tramway to the new knowledge they have received. Resulting with them answering the questions with a controlled and unconscious mindset, caused by the action of the researcher. This is an undesirable situation which hinder the research to collect information that strive to reflect the participants' true personal and individual perception and belief. Therefore, the questionnaire has been carefully structure and formulated to avoid any type of influential factors that could be directed towards a biased answer.

### **6.1.3 Distribution of the survey**

The survey was sent out to the participants through two private Facebook groups during a period of three weeks, between 7-26<sup>th</sup> March. The survey was sent out with an introduction letter which included a description about the researcher, the purpose of the survey, the amount of time needed to complete the questionnaire, the ethical consideration of anonymity participation and what kind of questions the respondents are expecting to answer. Information about the requirements to participate was also added in the introduction letter to make sure that the survey only targets residents near Båtbyggargatan. The data would be invaluable if the respondents consisted of residents who live far from the Båtbyggargatan and doesn't use the tram stations there. Furthermore, a notification to remind the participants to complete the questionnaire was sent out 1 week prior to the last day (26<sup>th</sup> of March) of collecting empirical data.

Note of caution, distributing surveys through Facebook are known to produce over- or under representative responses from specific age- and gender groups due to the reality

that not everyone has a Facebook account. It is common that people don't use or log in to their account daily, while some people might log in but don't look or notice their group notifications.

## **6.2 Interviews**

The second research question of this study was:

- How does the grass track contribute to the noise concerns, traffic safety, and financial resource management in the Spårväg Syd project?

To answer this question, this study has conducted interviews with municipality and county workers from Lund, Norrköping and Stockholm. Interviews was used because according to Dunn (2021), interviews a suitable method to gather information from people about their opinions, experience and feelings for a deeper understanding with allows for discussions that involves details and explore hidden meanings. Additionally, interviews can also be used to shed light to voices from different groups of people with various background, ideology, expertise and interest.

### **6.2.1 The procedure of contacting participants**

The purpose of the interviews was to hear opinions and thoughts about the usage of grass tracks from Swedish cities that are experienced with grass tracks on different levels in terms of years and existing green tracks. For that reason, apart from Stockholm, this study has included municipality workers from Lund and Norrköping (the location of Lund, Norrköping, and Stockholm are shown in appendix 2). Norrköping were selected because they were the first Swedish city to implement grass track and thus, it is believed that they have better knowledge and understanding about green tracks on an extensive level compared to Stockholm. On the other hand, Lund is the most recent Swedish city to implement grass track and is therefore viewed as the most modern example of grass track in Sweden so far. Using two examples that represent the oldest and latest implementation are believed to leave interesting input that could benefit future tram project.

This study used the official website of Lund and Norrköping's municipality and Region Stockholm website and sent an e-mail with an introductory letter to the contact email address that was provided on the respective website. The introductory letter included information about the researcher's identity and occupation, the purpose of the study, the reason for contacting the department or person in question, a request for permission for conducting an interview, and a draft of topics for which the interview was planned to cover.

At the end of the procedure to find potential participants, a total of nine people agreed to participate in the interviews. The following people were a noise strategist, sustainable strategist, rail traffic strategist, operation manager, traffic planner, project manager and two track engineers.

## **6.2.2 Performing the interviews**

An important factor that affected how the interviews was performed was that not all of the participants were located in Stockholm, which were the city in which the author is stationed. Consequently, this led to different types of interviews was conducted to adapt to the geographical distance, as well as their availability. Hence, this study used three types of interviews: video, telephone, and face-to-face combined with walking interview.

Furthermore, another important factor that affected the construction of the interview questions where that the study has reached out to cities which are in different stages in terms of the experience of using green tracks, as well as people with different expertise and limited knowledge. The interview questions in this study could therefore not use the same structured questions for everyone since it was deemed more suitable to adapt the questions depending on who was being interviewed.

All interviews were conducted in Swedish, and the participants were all informed about the researcher's identity and the topic of the study. Furthermore, the researcher asked all participants for their permission to record the conversation before the interview begun.

The following sections describe how each of the different interviews were performed.

### *Face-to-face combined with walking interview*

One face-to-face interview was conducted. The advantage with face-to-face interviews is the opportunity to make use of the body language and the surrounding environment to create a comfortable environment for both the interviewee and the interviewer. Face-to-face interviews can take place in closed off and public areas (Saarijärvi and Bratt, 2021). The face-to-face interview in this study took place in a restaurant in Hammarby Sjöstad and was later changed to a walking interview along the nearby grass track. According to King and Woodroffe (2017) is a walking interview is a way of conducting an interview that require flexibility and mobility, since the interviewer either walks, ride-along or accompanies the interviewee in public areas that have a connection to the research's topic. This approach allowed the interviewer and interviewee to use the environment to refer to specific topic in their conversation.

For this interview, the study used semi-structured interviews as the approach to interview the participants. According to Dunn (2021) interviews of semi-structured

characteristics usually consist of a list of questions or topics in which the researcher uses as a guide to track down the subjects or types of questions that needs to be covered during the interview. The advantage of semi-structured interviews is that it allows the researcher to be more flexible and adaptable to what the participant can contribute to the interview.

#### *Video interview*

A total of 4 video interviews was conducted with 6 participants. 2 individual interviews and two group interviews which had 2 participants in each group. The average time duration for all video interviews was around 43 minutes.

The advantage of video interview is that it allows the possibility to conduct interviews with people that are located far from the researcher. It saves travel time and commuting expenses compared to face-to-face interviews (Saarijärvi and Bratt, 2021).

The most common video platform was Zoom because it had an available function to record video meetings and directly convert it to audio and video files after the meeting has ended. However, one of the group interviews was conducted via Teams, which is another video platform, due to the interviewee's wishes. The program version of Teams in which the interviewee used didn't have an inbuilt function for recording meeting, and so, the audio from the interview was recorded via a mobile phone that was placed next to the computer.

The interview questions with the noise and sustainable strategist focused on the grass track's acoustic ability. The interview with the track engineers and the operation manager focused more on questions regarding the traffic safety, installation, and maintenance. Whereas the interview with the traffic planner focused on more general aspect of using grass track regarding the structure of the city and the development of using grass track over the years.

However, two question that was kept consisted throughout the video interviews was the ending questions. The two ending questions was about the participants opinion on what Stockholm should consider before implementing grass tracks, as well as what they consider as the major challenges based on their background and expertise (Appendix 3)

The recorded audio file from the video interview was transferred to a Word document through the "transcription" function. Afterward, the author edited, fixed error and corrected misspellings from the digital transferred transcription by listening to the audio file while reviewing the transcript.

### *Telephone interview*

One interview was held via telephone as an alternative to video interview. The length of the telephone interview was around 10-15 minutes and covered 2-3 questions. The interview was transcribed by hand.

## **6.3 Thematic analysis**

The result from the online survey and the interview was analyzed based on themes. According to Cope (2021) is thematic analysis code one of many distinctive ways to analyse and make meanings of qualitative data. It focuses on the thematic and the theoretically based pattern that the researcher is interested in and in which the study or the project is embedded. The thematic analysis does so by going deeper into the context of phrases and actions of the studied individual/s. For this case, this study will use this code to identify patterns in the respondents' answers by looking for specific types of keywords and expressions that occur frequently and is seen to connect with the theoretical framework of this study. More specifically, identify keywords and phrases that can be related to factors that affect the individual's behaviour, as well as identify those expressions that can be used to indicate biospheric-, altruistic- and egoistic values.

After some initial patterns have been identified, I shall use the interpretive code which Cope (2021) defines as the process where the information from the interviews is analysed and interpreted together with the theories used in the study or the project.

Once the interpretation of the data is finished, I shall categorize and organize a list of keywords and expressions that are shown repeatedly. Beginning with the most obvious to the least obvious. These will later be presented in a descriptive way, similarly to Sikorski et al (2018).

However, this way of analyzing data come with certain implications. The first and most recognized problem is the risk of presenting misleading information. As mentioned in the methodology chapter, the researcher must follow the designed terms and conditions that comes from using qualitative research methods in one's study, especially when in this case, the subjective data being taken from a small portion of a larger population.

The second is that with qualitative data, it is more difficult to simplify the rich information from open-ended questions and in-depth interviews and so, the presented result is missing out the complexity of the original text, especially in the interviews for this study (McGuirk & O'Neill, 2021).

## **6.4 Limitations**

Distributing the survey via a private group in Facebook limit the potential number of respondents due to several reasons. The first reason is that not every resident has a Facebook account and if they have an account, it is also uncertain if all of them are members of the group in which the survey was posted. The second reason is that people tend to log in to Facebook or any other social media frequently or unfrequently depending on their age group, occupation, and gender. Meaning that there could be potential respondents that missed the survey during the 4 weeks the survey was posted online.

To avoid receiving respondents that do not belong to the study's target group, a short text was provided in the beginning of the Facebook post and in the introduction section of the online survey, which informed that the survey is meant for residents along the grass track on Båtbyggargatan in Hammarby Sjöstad. Furthermore, to compensate the limitation regarding infrequent Facebook users, the researcher notified the Facebook group to fill out the survey one time after the second week and one time in the last week before closing the survey.

Additionally, since this research were using different type of interviews methods in different cities with different participants of expertise and knowledge, it could impose a risk for ending up with noncomparable result. However, this study dealt with this issue by focusing on and highlighting the uniqueness from each city and the personal viewpoint from each participant.

Translating the answers and comments from the survey respondents and the interview participants from Swedish to English can affect to the accuracy of the message since English are written and grammatically formulated differently from the Swedish language. Therefore, more attention was on being as transparent as possible when presenting the result.

## **6.5 Ethical consideration**

The method of this research included the contact of people and gathering personal information from each individuals through survey and interviews. The confidentiality of the information that the participants give out must be presented in ways that make it incomprehensible to identify them. Presenting their job title instead of their first and last name. Furthermore, the role of the researcher must not affect nor direct the interview process by their own personal ideas and interest, and shall only act as the non-biased actor that collects the information in an objective way as much as possible (Catungal & Dowling, 2021).

## 7. Result

The first research question of this study was to investigate how the residents of perceived the grass track in Hammarby Sjöstad. Thus, the following sections presents the findings of the survey that was sent out.

### 7.1 The residents' perception of grass tracks in Hammarby Sjöstad

The online survey received a total of 31 respondents, of which 18 were females and 13 were males (Appendix 4).

17 respondent had positive experiences of living near grass tracks and gave comments that referred to the grass track's appearance ("*Nice*", "*Colorful*", "*Aesthetically appealing*", "*Beautiful*"), the residents received feelings and connected to the grass track ("*Cozy*", "*Relaxing*", "*Calming*", "*Different but cool*", "*Exhilarating*"), and the grass tracks environmental performance ("*Noise dampening*", "*More insects is positive. Slightly cooler because the grass does not get as hot as the asphalt*"). Only one respondent was negative in this case and wrote a comment that said that it was "*Nice but not necessary*". The remaining 10 respondents that didn't express an opinion left blank answers.

Furthermore, most of the respondents (39%) associated grass tracks as an environmentally beneficial initiative. The indicators from the respondents were that they mentioned the environmental focus, biodiversity, infiltration of rainwater, fewer hard surfaces, less noise, and more greenery.

10 respondents perceived the grass track as an esthetical purpose, whereas a 2 respondents saw it as a modern and innovative city planning, other 2 saw it as a method towards sustainability, meanwhile 2 other respondents perceived it as a traffic safety measure. Only one respondent mentioned that they feel a sense of identity connected to Hammarby Sjöstad, and another one mentioned the health benefits connected to a less stressful environment.

Below is the translation of the most notable comments that were given during the last part of the questionnaire that was meant for optional comments about the grass track.

"During drought, there is a high risk of fire, and the grass is more brown"  
(Male, 56-65 years old).

“Quite common for people to walk their dogs or letting children play there. Can certainly be good because it gets more uses, but not necessarily from a traffic safety perspective” (Female, 26-35 years old)

"Good that it is being tested in Stockholm. Many European cities have had it for a long time." (Female, 66 years or older).

## **7.2 Lund, Norrköping and Stockholm’s experience with grass tracks**

The second research question of this study was to investigate in what way grass tracks could contribute to noise concerns, traffic safety, and financial resource management in tram project like Spårväg Syd. The following sections present the result from the interviews.

### **7.2.1 Noise**

Whether grass tracks can be used as a primary method to decrease the noise level is a question that has proven to be doubtful among the interviewers, because although grass has a noise-dampening effect, the real noise differences are not much (Traffic planner, personal communication, 13 April; Operation manager, personal communication, 12 April). The noise investigation that was conducted in Norrköping in 2005 was also questioned because of the grass track’s noise-absorbing qualities with the physical condition of the rails. The friction between the rail and the tram wheel is the main source of the unwanted noise that people experience which was considered more important to focus on than covering parts of the track with grass (Noise Strategist, personal communication, 30 Mars). One of the comments about Norrköping’s noise investigation was as follows:

“... there they [Norrköping] have not ruled out the effects of rail wear affecting noise. If it is a rail that is very rough, very worn, it will sound more than a rail that is smooth and fine” (Noise Strategist, translated personal communication, 30 Mars).

Grass track by itself was not considered as the best solution to reduce the noise level as there were much more effective measures such as new techniques to mitigate the noise directly from the source that is the rails and measures that don’t interfere or interact with the components of the tram tracks (Noise strategist, personal communication, 30 Mars).

During the interviews it was revealed that insufficient evidence was the main reason for disregarding grass track as a noise measure. For example, it cannot be technically confirmed that grass track can have a significant role as a noise measure due to the lack of scientific based evidence (Operation manager 12 April; Sustainable strategist and Noise strategist, personal communication, 30 Mars). This was especially concerning regarding Stockholm Stad municipality because the city is more of an expertise in the metro than on the tram train (Noise strategist, personal communication, 30 Mars).

However, despite the lack of evidence, one interviewee was more positive towards grass tracks and shared the following comment based on their experience from the grass tracks in Lund.

“I’m actually a big advocate of grass tracks... The noise has been reduced, and it's nothing I can prove. I just know that's how it is in all the other places where you have grass tracks instead of other materials” (Operation manager, translated personal communication, 12 April).

Furthermore, two other interviewees had also a more optimistic view of the grass track and commented that the noise difference can be heard and experienced if the person is walking or standing near the grass track since the track is embedded in the grass (Traffic Planner, personal communication, 13 April; Rail traffic strategist, personal communication, 21 April). The following comment is one of the interviewee’s opinions.

“ I think that if you just walk by and listen to the tram on the grass track or where it is concrete, then you can hear it... yes, I think that [the sound] is quite clear. ” (Rail traffic strategist, translated personal communication, 21 April).

### **7.2.2 The traffic safety**

During the interviews, it was shown that traffic safety is an important issue that must always be considered when grass tracks are going to be used in rail traffic. The most notable aspect was that grass tracks attract cars and pedestrians to the restricted tram area, aggravating the maintenance work during the autumn and could create dangerous situations for the trams during the winter.

#### *Unintentionally inviting cars and pedestrians into the grass track*

Grass tracks were said to be used as a tool to enhance the visual presentation of which area belongs to tram traffic, and respective car traffic. The purpose of this safety

concept has been used in Hammarby Sjöstad, Norrköping and Lund, and much of it lies in the flexibility of using grass tracks as a self-explanatory traffic safety measure. This means that the urban structure should be easy for people to distinguish and understand what is dangerous and what is safe. Grass tracks were referred as traffic areas that should be avoided, because there is a risk of being hit by trams if one is not cautious (Rail traffic strategist, personal communication, 21 April). For example, the grass tracks in Lund were not only used for water infiltration purposes and to decrease the amount of hard surface areas. It was also used as a natural and open feature without the need to use fences and other physical barriers (Project manager, personal communication, 20 April).

However, the safety concept is not always the most prioritized topic in the planning of new public transportation. For example, there were discussions where some groups of planners found it necessary to make the grass track in Hammarby Sjöstad adaptable for cars to cross over the tracks. One of the interviewers showed a dissatisfied reaction toward this suggestion. Mostly because once a car passage has been built, cyclists and pedestrians will then take the opportunity and cross the track as well, which can be considered problematic for the tram drivers that relies on visibility (Rail traffic strategist, personal communication, 21 April).

“... as tram drivers [perspective], are pedestrians slow, and they must not collide with them. Cars can be pretty darn fast, but they still sit in a shell. Cyclists are both unprotected and quite fast, so they are kind of scary.” (Rail traffic strategist, translated personal communication, 21 April).

Cutting the path of trams and allowing other vehicles and travellers to use parts of the same area leads to a higher safety risk that tram drivers. Nevertheless, the recurring issue with trams were mentioned to be that it is a public transport mode with multiple features. It can be used on separate rail tracks as a metro train, as well as in mixed traffic and operate similarly to buses (Rail traffic strategist, personal communication, 21 April).

On top of that, using grass tracks has shown to be challenging to ensure a safe and clear driving lane for trams. Technically, people are forbidden to cross tram tracks on other areas that are not the specified crossing point, due to order and safety reasons. However, people were described to not be physically restrained to stay in one spot forever, and can move freely around and do whatever they want, whether it is legal or not. This has led some groups of people to take advantage of the open green areas (Rail traffic strategist, personal communication, 21 April). Ideally, the vision of grass tracks is that it come with no fences and other high and obscure obstacles. Unfortunately, this makes it easier for people to believe that they can cross over, especially for those who believe

that they can do whatever they want and takes the opportunity to make a quick shortcut (Traffic planner, personal communication, 13 April).

A common problem has been the occurrence of unauthorized intruders on grass tracks. In Norrköping, for example, there have been situations where cars have driven over the grass track, despite the signs that inform the public that it is prohibited to cross the tram track (Track engineer 2, personal communication, 14 April).

Furthermore, there have been safety issues regarding pedestrians. When Lund, for example, opened their first ever tramway in 2020, it was discovered soon after that some people were spotted walking on the grass tracks (Operation manager, personal communication, 12 April).

“Mostly people who are out walking the dog and also the occasional jogger, but that has stopped now. But it was more in the beginning as the track was there for two years” (Operation manager, translated personal communication, 12 April).

The reason Lund have encounter fewer people on the track was that it was believed that people’s knowledge and self-awareness of the potential danger of being in the way of the tramway has steadily increased after a few years. Nevertheless, it was clear that Lund still see trespassing as a negative aspect of having grass track, because the attractiveness of the grass track will always invite people, in one way or another (Operation manager, personal communication, 12 April).

On the other hand, Norrköping has had its grass tracks since 1999 and learned that the location of the grass track is important to consider because it can influence how people perceive and choose to act in front of a grass track. This is why different areas are more suitable for grass tracks depending on if you ask an anxious parent with kids or a person that takes a stroll on the sidewalk (Traffic planner, personal communication, 13 April).

... when you establish a new track somewhere and it is in grass and maybe there is a playground next to it or a park or something like that. Then it is often perceived as ‘yes, but here is a nice grass out there, you can run across without having to watch where you go’ (Traffic planner, translated personal communication, 13 April).

The most common solution was to build fences around the grass track, but then it were said to restricts the mobility in the “free” city, as cities should be accessible to everyone (Track engineer 1, personal communication, 14 April).

Nevertheless, the safety issue regarding trespassers is an issue which was noticed as a negative part of having a grass track during the interview with Lund and Norrköping. In addition to that, one of those interviewees gave the following comment.

Sometimes, I think the better solution is not to have grass, but when you avoid the fence, then you just build a barrier. Of course, it looks nice with the grass, but yes, such trade-offs. How much do you invite people to be on the [tram] track, even though they shouldn't? (Traffic planner, translated personal communication, 13 April).

#### *Slippery rails and brake malfunctions*

In comparison to the early summer when the maintenance of the grass track is the easiest, the rainy season of autumn were considered the most difficult season to do maintenance on grass tracks (Operation manager, personal communication, 12 April; Track engineer 1, personal communication, 14 April). The reason behind it was explained that the weather gets colder and wetter, and more leaves fall from the trees, it contributes to more difficult situations where the maintenance must handle issues regarding slippery track due to frost and muddy tracks (Track engineer 1, personal communication, 14 April). Furthermore, the autumn leaves were said to pose dangerous situation where it makes it more difficult for the tram driver to control the brakes due to the rails being filled with small bits of residue plant parts from mowing activities and fallen leaves (Sustainable strategist, personal communication, 31 Mars; Track engineer 1, personal communication, 14 April).

During the interviews, two participants believed that tram tracks in general, whether it is grass track or not, encounter problems with slippery rails caused by the autumn leaves (Operation manager, personal communication 12 April; Traffic planner, personal communication, 13 April). For example, Lund were said to faced fewer problems with slippery rails on grass tracks than on asphalted tracks because the grass track is usually more elevated than the surrounding area with hard surfaces. Which leads most of the leaves away from accumulating on top of the rails in contrast to rails embedded in asphalt (Operation manager, personal communication 12 April). On the other hand, Norrköping has experienced more problems with its grass tracks. The reason is that Norrköping has these cultural and historical tree alleys in the city centre called Norra Promenaderna. The grass tracks were implemented on existing tram tracks to enhance and complement the historical value of the tree alleys (Traffic Planner, personal communication, 13 April). Which were revealed to require ... resulted in them needing to enter the track area for anti-slippery control with special vehicles, cutting the grass where needed and removing leaves from the tracks, while at the same time having to be mindful of leaving no marks behind on the grass track so as not to damage the grass surface (Track engineer 1, personal communication, 14 April).

#### *The potential danger of frozen soil in grass tracks*

Another challenge that comes with grass tracks is the safety issue regarding the seasonal temperature changes in the soil. This was said to be especially important during the transition between autumn and winter when the temperature fluctuates near the freezing point (0 °C). This is one of the major safety issues because, during the autumn, the amount of water that is restored in the grass track receives a lot of rain and the. Norrköping has, for example, had issues with grass tracks where areas with high soil moisture have resulted in an expansion of the grass track's surface when the temperature hits the freezing point. This could bring a dangerous situation for the passenger, the conductor, and the tram driver on-board the tram, because the grass track now acts as an obstacle on the tramway instead of an aesthetical and environmental complement (Track engineer 1, personal communication, 14 April). The following comment shows one of the participant's opinions about the frozen soil situation in Norrköping.

For the past 2 years we have had huge problems because this frozen soil or the humidity causes it to freeze and then the ground pushes up that it starts to take in the tram trains. Then it starts to become a safety risk and then we had to go there and shave/remove this crust. (Track engineer 2, translated personal communication, 14 April).

### **7.2.3 Increase requirements for investment and resources**

Lastly, the result from the interviews also showed that upcoming tram project like Spårväg Syd needs to be financially prepared to spend more of their budget on additional resources if they were to implement grass tracks, because the expenses for grass tracks are higher than macadam tracks. This has to do with the extra work efforts and resources that are required for the installation and maintenance.

#### *Installation*

The decision of when and where to install grass track depends on the condition of the existing tram track. Grass track is usually installed when existing and old tram tracks needs to be removed or changed. In fact, it is unlikely that grass tracks are implemented whenever and wherever the municipality wants it (Traffic planner, personal communication, 13 April). Moreover, if Stockholm municipality decide to build a new tramway with grass track, then the total cost of constructing a new tram line must be considered. The average cost of the Tvärbanan in Stockholm was said to be approximately 200 million kronor/km, while the tramway in Lund cost significantly less, around 147 million kronor/km. Cities have different conditions for building tramways and it was cheaper to build the green tramway in Lund because they used a bus lane that was already there from the beginning. On the other hand, Stockholm tends

to have higher requirements compared to Norrköping for instance. A lot of it has to do that Stockholm tends to consider car's accessibility in the city, the distribution of bike lanes, the possibility of having lanes for replacement buses, as well as working towards Stockholm's vision and ideals (Rail traffic strategist, personal communication, 21 April).

The implementation of grass tracks requires a geotextile blanket and a layer of rich soil, that is suitable for the regional climate and soil condition before the grass can be laid on top (Operation manager, personal communication, 12 April). It is noted that the installation often demands to be quick, as well as ensure a stable sub-foundation for the grass to grow with an abundant amount of soil between the tracks. An example of such a stable sub-foundation is longitudinal concrete beams. This ballast-free sub-foundation makes it possible to add more soil and create a better base for the grass to grow and look healthy (Track Engineer 2, personal communication, 14 April). A sub-foundation where grass track is built upon concrete beams is said to be more durable and require less maintenance than macadam tracks (Track engineer 1, personal communication, 14 April). The grass track in Lund, for example, used concrete beams instead of macadam tracks after taking inspiration from the Danish grass track (Operation manager, personal communication, 12 April).

Aside from the importance of having a stable track foundation, it is also crucial for a tramway project to know which types of grass track they plan to use and how they want to maintain it in the future. The choice of grass track determines the approximate amount of resources and the financial requirements for the maintenance (Track Engineer 2, personal communication, 14 April). The most common type of grass track is rolled-out grass lawn and it is being used in Lund (Operation manager, personal communication, 12 April), Norrköping (Track Engineer 2, personal communication, 14, April) and Hammarby Sjöstad (Rail traffic strategist, personal communication, 21 April). Rolled-out grass is beneficial in one aspect, as it allows for faster installation and a higher chance of receiving the end-result one desire, compared to manually cultivated grass seeds, which take longer time (Track engineer 1, personal communication, 14 April). However, it is important to consider that rolled-out grass still requires additional costs and resources even though it arrives pre-cultivated and ready to be applied. One of the interviewees shared the following comment regarding rolled-out grass.

“It's nice and neat, but it costs a penny. It is more expensive purchase price, plus we had to water for 10-15 days/2 weeks for it to get into it the soil and all that, so just that costs”. (Track engineer 1, translated personal communication, 14 April).

### *Maintenance*

When it comes to the maintenance of grass tracks, there is mainly one important challenge and that is to keep the aesthetic value of the grass and prevent it from

changing or being damaged in any way that could negatively affect the grass's appearance (Traffic planner, personal communication, 13 April). The following comment shares one of the interviewee's biggest concerns regarding the maintenance of the grass track in Norrköping.

It [Grass track] is like the garden at home. It's not very easy to get a good lawn and it's the same in the tram track area, so some of our grass tracks are more weeds than grass and so on... But most of the public is generally positive about grass. Yes, so the challenges are mostly on the side of how do I get the grass track to look nice, to stay nice. (Traffic planner, translated personal communication, 13 April).

In regard to the quotation above, one of the participants informed that unlike macadam tracks which are the cheapest and simplest form of tram track, the maintenance of grass tracks requires an additional workforce of mowing and irrigation (Track Engineer 2, personal communication, 14 April). Fortunately, the amount of mowing and irrigation can be adjusted in the early stage of instalment to minimize the cost of resources by investing in rolled-out grass. For example, Lund uses a special mix of grass species which are said to be tolerant to drought and grows slower than normal fast-growing grass species (Project manager, personal communication, 12 April). The advantage of slow-growing grass tracks is that mowing does not need to take place on a predetermined tight schedule, that is every week but is done based on the weather conditions. The grass track in Lund is cut every 7-8 weeks, however, the watering can vary depending on how much it has rained and not rained (Operation manager, personal communication, 12 April).

The weather condition plays a significant role in irrigation management and the location of a city determines how much irrigation is needed. For example, Lund does not have problems with irrigation and rarely needs to water the grass tracks because Lund uses a special grass mixture and receives a lot of rain from the west coast (Operation manager, personal communication, 12 April). In comparison to Norrköping which is located on the east coast, has had problems with drought during the more recent years when there have been periods of heatwaves without sufficient precipitation (Traffic planner, personal communication, 13 April). The cite below shows the thought and opinions regarding the drought situation in Norrköping.

First it becomes yellow and then it becomes brown and then it becomes sand... It is little therefore we also had begun to question. Should we continue to build so much grass track when it's just drying out anyway? And so far, no one has really had the energy and money to rebuild with a better solution or spend money for irrigation or want to try to maintain what we have. (Traffic planner, translated personal communication, 13 April).

Another issue that contributes to additional maintenance costs is the restoration work that needs to be done after the grass has been damaged by for example cars that have intentionally and unintentionally driven over grass track. Furthermore, if the grass track is built upon macadam tracks, then inspections need to be performed to look out for potential wear, loose parts, damages, and repairs. The grass tracks prevent the track inspectors and repairmen and thus the grass needs to be partly removed for them to perform their job (Track engineer 1, personal communication, 14 April). One of the interviewers shared their comment and opinion about the issue of doing track inspection which involves grass tracks, and it is read like this.

We can go in and retrace on grass tracks, but it's never done well and historically it always come back incorrectly. We haven't been able to access the rails and being able to do it properly because there is usually an acute lack of time. It must be done as quickly as possible, and it must cost as little as possible... (Track engineer 1, translated personal communication, 14 April).

Lastly, since it is Stockholm Stad municipality that owns the streets, and SL that operates the public transport traffic, there will always be some kind of clashes between the city's vision and the rail traffic's practical capability. As well as their responsibility to meet other goals that are equally as important (Rail traffic strategist, personal communication, 21 April; Sustainability strategist, personal communication, 30 Mars).

In one of the last moments of the interviews, it was also stated that even though the sustainable aspect were highlighted as the strongest driver within the infrastructure, as well as how grass tracks are seen as one of the options (Track engineer 1, personal communication, 14 April). The environmental and sustainable vision will eventually clash with the city's financial capability, especially if the city is not prepared for the additional expenses that will arrive once the grass track is installed (Track engineer 1, personal communication, 14 April).

Furthermore, one interviewee believed that it is more likely that Stockholm could build more grass tracks in the future due to how Stockholm's ideals and viewpoints have changed over the years since the planning of Tvärbanan (Rail traffic strategist, personal communication, 21 April).

Coincidentally, one of the interviewees informed that Stockholm Stad municipality has attempted to adopt more grass tracks on several occasions, but due to the lack of knowledge about the maintenance and the investment costs, the proposals have not gone through (Noise strategist, personal communication, 30 Mars). This was seen as an understandable and agreeable reason because the implementation of a new concept or

idea in a system that has been used for a long time requires a great amount of effort and persuasion (Sustainability strategist, personal communication, 30 Mars). The following citation is a shared comment of an example of how the situation might look like if grass tracks were brought up as a new potential investment in Stockholm.

You want to do what you've always done and then it's like stone, sleepers, and rails and that's it. "We know how to do it, this is how it is done, don't come here with lots of troublesome new stuff". So that's a bit of the attitude that exists and that's why I think it must be motivated quite a lot in order to achieve this type of solution (Sustainability strategist, translated personal communication, 30 Mars).

## 8. Analysis

It is understood that grass tracks alone are not sufficient to reduce the noise level in the Spårväg Syd project's high-risk areas such as residential areas and nature reserve. At least not in a way that would lead to a significant technical difference from the noise caused by the trams. However, grass track seems to receive a positive impression based on social interaction and interpretation. The appearance of grass track and the influence from other cities with grass track can affect how the grass track's effectiveness to reduce the noise level is interpreted on an individual level. Nonetheless, the chances of the Spårväg Syd project succeeding at maintaining a noise level at a maximum of 70 dBA with grass tracks are interpreted as not likely, at least from a technical perspective.

Moreover, it is understood that the Spårväg Syd project will face similar problems with pedestrians and cars who cross over the grass track. Mostly because it seems to be an occurrence that happens from time to time in both Norrköping and Lund, regardless of if the grass track has been there for a few years or more than a decade. Furthermore, it is interpreted that if the planned grass track in the Spårväg Syd project poses a high risk that involves people getting injured or killed on the tramway, then safety measures must urgently be added, similar to what has happened in Norrköping.

Geographically, since Stockholm is located north of Norrköping, it is understood that once the Spårväg Syd project is in the operation phase, it could face similar problems with frozen soil during the winter like Norrköping. However, it is uncertain if the current grass track in Stockholm faced similar problems since the issue with seasonal temperature changes was only mentioned in Norrköping in the result.

Furthermore, it is understood that grass tracks are seen as a costly but attractive track design with multiple ecological features, since the recurring issue regarding the additional costs for the installation and the maintenance makes most of the interview participants to question the usage of grass track. Both the surveys with residents from Hammarby Sjöstad and the interviews with municipality workers and county workers from Lund, Norrköping and Stockholm imply that the aesthetic feature of grass tracks plays an important role in prioritizing the maintenance of grass track. Thus, it is interpreted that grass tracks would place higher demands on the effort and the investment, as well as affect the budget of the Spårväg Syd project to keep the grass track green, since grass tracks seems to be considered costly in the long run without proper preparations.

## 9. Discussion

The key findings of this study showed that the positive impression of grass track's ability to reduce noise tends to be based on experience rather than on technical measurements. The grass track is seen as a positive and attractive feature in the urban environment due to its aesthetic features and environmental benefits, which also tends to attract unauthorized people to the tramway. Furthermore, the results indicates that grass tracks have higher installation and maintenance cost compared to the conventional ballast track, The cost of maintain grass tracks depend on the seasonal temperature changes in the region, which affect the need for complementary maintenance work.

### 6.1 Driving factors that makes grass tracks popular

First, it was not an unexpected discovery that grass tracks are considered an attractive track design, as most of the survey respondents and some significant interview participants had positive objections to grass tracks, which were similarly to previous studies such as Sikorski et al. (2018), Kappis and Schreiter (2016) and Jakubcová and Horváthová (2020).

In addition, it can be pointed out that this study supports the results of Grüngleisnetzwerk (n.d.) report regarding the noise reducing properties of the grass track, since this study includes findings that agrees that grass tracks are overestimated. As well as indicators that shows that the only positive impression of the noise level was related to the social and psychological perception and symbolism of having green vegetation in an urban context. In other words, it can be argued that grass tracks can be used as a placebo effect for noise. Whether future tram project choose to use this approach intentional or unintentional depends on the ideal of who oversees the project.

However, this study differs from Fontaine et al. (2016) regarding the safety perception of using grass tracks with fences. Although Fontaine et al. (2016) viewed grass track as a strategy to ensure a traffic safe environment in urban areas, this study found that not all cities share the same idea that grass track's purpose is to be used as a traffic safety measure. In fact, as a response to Fontaine et al. (2016) viewpoint, this study argues that each individual city has different vision of how their city should be perceived and represented compared to nearby and global cities. All of this depends on who is in charge for the urban planning of a city during the time, since it is important to remember that people have different ideas about what grass tracks should be used for and what is is associated with.

Furthermore, Sweden may not have the best and ideal climate for using grass tracks, at least in the colder and dry parts of the country as exemplified in the result. Due to the fact that Stockholm is located at higher latitudes than its European counterparts, Stockholm must deal with both snow and rain in both minus and plus degrees. Thus, this study supports the Steckler et al. (2012) study by exemplifying another European country that has encountered difficulties using grass tracks in colder climates as well as drought.

## **6.2 Factors that make cities question the usage of grass tracks**

There seems to be a current dilemma on whether a city should become green or follow the old and safe path in which a cheaper option is chosen. In a sense, one could say that there is a desire to become more attractive as global urban trends and goals plays an important role in the urban planning process. There is a clear pattern that the financial concern and investment of additional maintenance cost block or hinder the development of grass tracks in new tram project. However, this doesn't apply to all cities, since cities such as Lund and Portland is one of the latest cities to install grass track. Anyhow, the financial concern regarding the maintenance is a trend that has been noticed throughout the research, which suggest that there is clash between the environment and the state's budget.

The study has used the Spårväg Syd project as an example of situations where there are greater opportunities to build grass tracks, since it is considered easier to introduce new concepts compared when starting from existing track facilities. The study shows examples of how cities who want to start using grass track in the future tram projects must consider and prepare a lot more investment and resources. Mainly because the knowledge about grass track and its usage and implication have increased compared to the 1980-1990's when the interest to use grass track had just re-emerged. Thus, it is implied that this study can be viewed as an example that support Steckler et al. (2012) statement about the downward trend in grass track in cities with newly established tram network after 2010's.

From an economic perspective, it is stated that the results from this study support Khoury and Grönskog (2015) on the note that grass tracks are more expensive to install and maintain than ballast tracks. However, it is important to point out that unlike Khoury and Grönskog (2015) who presented their results based on numerical calculations, this study has focused more on personal information that is based on the experience of individuals who work with grass tracks and tramway tracks. For that reason, this study can also be seen as a complement to Khoury and Grönskog's (2015) study, rather than a challenging study. Since this study contributes to valuable insights about the consequences of using grass tracks in relation to ballast tracks. As well as

personal insights that can have a significant impact on how grass tracks can be improved. For example, in aspects or topics that Khoury and Grönskog (2015) might not have considered in their study.

However, this result cannot be generalized to all residents who live along the grass track in Hammarby Sjöstad because the number of respondents is smaller than the actual number of homes in the area. In comparison to Sikorski et al. (2018) who received a larger number of respondents from their regional based study, it is important to consider that the survey findings in this research can be seen as a local example of the social perception of grass tracks. Which is a positive merit since no other previously mentioned studies have looked at a specifically local scale like this study.

This study is aware from previous studies that the grass track's strongest argument lies in its ecological and environmental benefits. However, it's important to not only focus on the positive aspect but to also focus on the lesser-known issues or rather consequences. Thus, in relation to previous studies, this research shed light to the social interpretation and experience of individuals with different expertise and knowledge who all have a significant role in the planning of future grass track.

In the end, when it comes to the implementation of grass tracks in future tram project, it has been highlighted both in this study and in previous studies that it depends on the current situation of the city but also who gets to make the final decision. Grass tracks might be suitable in nature areas and in urban areas, but it all depends on who is being asked and what background that person might have. Indeed, it is undeniable that after doing this research, grass tracks do in fact have several factors that can be linked to being a green infrastructure measure, such as connecting the human activity with nature, being multifunctional that offers diverse variations of green design and are integrated well in the grey infrastructure. As well as having the common challenge of continuity or post-monitoring and maintenance. Nonetheless, one thing is important and that is that even though grass tracks have its bits and marks which makes it troublesome for some people. One cannot deny that grass track is an appreciated and beautiful feature in the mundane urban landscape which shares resemblance with the aesthetic of lawns in gardens. Which in the end argues to why so many cities still have grass tracks.

## 10. Conclusion

As mentioned in the beginning of this thesis, the aim for this study was to explore the importance of green tracks for urban planners and strategists in future tram projects and grass tracks' role as a green infrastructure strategy within Stockholm's public transport sector.

This study has contributed to new knowledge about the performance and the consequences of using grass tracks in Sweden with a qualitative based study. The study has achieved its aim by shedding light on individuals with different backgrounds and expertise by including the perception and opinion from local residents, traffic planner, project manager, operation manager, noise strategist, sustainability strategist, rail traffic strategist, and track engineers.

Moreover, this research has also opened discussions for more reflection on what and how one shall consider before deciding to implement grass tracks in future tram projects. As this research covered both previous and new discoveries. Furthermore, this research has highlighted the aesthetical importance of using grass tracks, as well as its following consequences. As well as established a new starting point for further research in the Swedish academic field of study, regarding grass tracks in relation to green infrastructure strategies and the public transport sector.

This research could have been performed differently. For example, one could use another method to reach out and receive more respondents when gathering information about the residents' perception of the grass tracks in Hammarby Sjöstad. Since the number of respondents in this study cannot be generalized to the total amount of residents that live along that grass track.

Suggestions for further research would be to include other grass track cities that weren't included in the research. For example, Gothenburg was shortly mentioned as an example of other Swedish cities with grass tracks but was not included since the main focus was on Norrköping and Lund. Nevertheless, it is important to not exclude potential these cities because they could add useful information that could expand and develop this research topic even further with examples that couldn't or haven't been covered in this study.

Other suggestions would be to interview representatives from Stockholm's municipality and Huddinge about their position regarding grass tracks and see how they can solve the financial concerns with installation and maintenance.

# 11. References

- Amsler, Y., & Hoogendoorn, C. (2010). *D0602. Final Consolidated Report – Chapter 3* (FP6-31312).  
[https://trimis.ec.europa.eu/sites/default/files/project/documents/20120607\\_120731\\_18830\\_D0602\\_M48\\_UITP\\_SP3.pdf](https://trimis.ec.europa.eu/sites/default/files/project/documents/20120607_120731_18830_D0602_M48_UITP_SP3.pdf)
- Anable, J., Lane, B., & Kelay, T. (2006). *An evidence base review of public attitudes to climate change and transport behaviour* (PPRO 004/006/006). The Department for Transport.  
<https://webarchive.nationalarchives.gov.uk/ukgwa+/http://www.dft.gov.uk/pgr/sustainable/climatechange/iewofpublicattitudestoc15730.pdf>
- Ashman, H., and Sollerhed, C. (2013). *Grönytor för en klimatanpassad stad – En fallstudie av Göteborg och Malmö*. [Degree project, Blekinge Tekniska Högskola] DiVa: <https://www.diva-portal.org/smash/get/diva2:830218/FULLTEXT01.pdf>
- Broberg, M. (2022, January 5). Nu kan du tycka till om Spårväg Syd. *Mitti i*.  
<https://www.mitti.se/nyheter/nu-kan-du-tycka-till-om-sparvag-syd-6.27.32475.8dc7f05cc2>
- Burns, M. (2005). *Public transport & urban design*.  
<https://www.crow.nl/downloads/documents/13360>
- Catungal, J. P., & Dowling, R. (2021). Power, Subjectivity, and Ethics in Qualitative Research. In I. Hay & M. Cope (Eds.), *Qualitative Research Methods in Human Geography* (5 edition., p. 18-39). Oxford University Press.
- Cope, M. (2021). Organizing, Coding, and Analyzing Qualitative Data. In I. Hay & M. Cope (Eds.), *Qualitative Research Methods in Human Geography* (5 edition., p. 355-375). Oxford University Press.
- Cope, M., & Hay, I. (2021). Where Are We Now? Qualitative Research in Human Geography. In I. Hay & M. Cope (Eds.), *Qualitative Research Methods in Human Geography* (5 edition., p. 3-17). Oxford University Press.
- Dunn, K. (2021). Engaging Interviews. In I. Hay & M. Cope (Eds.), *Qualitative Research Methods in Human Geography* (5 edition., p. 148-185). Oxford University Press.

- European Commission. (2016). *Green Infrastructure and the Transport sector*.  
[https://trinomics.eu/wp-content/uploads/2016/04/GI-and-Green-Infrastructure-in-the-Transport-sector\\_proof3.pdf](https://trinomics.eu/wp-content/uploads/2016/04/GI-and-Green-Infrastructure-in-the-Transport-sector_proof3.pdf)
- Fontaine, L., Novales, M., Bertrand, D., & Teixeira, M. (2016). Safety and operation of tramways in interaction with public space. *Transportation Research Procedia* 14. 1114-1123. Doi: 10.2478/sab-2020-0012
- Grüngleisnetzwerk. (n.d.). *Effect and Function of Green Tracks*.  
<http://www.gruengleisnetzwerk.de/images/downloads/effects.pdf>
- Hedström, R. (2004). *Attraktiv och effektiv spårvägstrafik* (Eds.). (VTI rapport 504).  
<https://www.diva-portal.org/smash/get/diva2:675246/FULLTEXT01.pdf>
- Jakubcová, E., & Horváthová, E. (2020). Costs and benefits of green tramway tracks. *Scientia agriculturae bohemica*, 51(4), 99–106. Doi: 10.2478/sab-2020-0012
- Kappis, C., & Schreiter, H. (2016). Benefits and Effects of Green Track. In Grüngleisnetzwerk (Ed.), *Handbook Track Greening*. (p. 200). Eurail press
- King, A. C., & Woodroffe, J. (2017). Walking interview. *Handbook of Research Methods in Health Social Sciences*. 1-22. Doi: 10.1007/978-981-10-2779-6\_28-1
- Khoury, P., & Grönskog, N. (2015). *Framtidens spårväg – Är spårvägar med ytskikt av gräs ett bra alternativ?*. [Degree project, KTH]. DiVA <http://www.diva-portal.org/smash/record.jsf?pid=diva2%3A857909&dswid=9389>
- Langert, D. (2018, September 3). *De gamla spårvagnarna gick upp i rök*.  
<https://www.svt.se/nyheter/lokalt/stockholm/se-stockholms-gamla-sparvagnar-rulla-sin-sista-dag-1967>
- Lindholm, G. (2017). The Implementation of Green Infrastructure: Relating a General Concept to Context and Site. *Sustainability*, 9, 610. Doi:10.3390/su9040610
- Lunds kommun. (2023, May 4). *Spårväg Lund C till ESS*.  
<https://lund.se/stadsutveckling-och-trafik/kollektivtrafik/sparvag-lund-c-till-ess>
- Mason, J. (2018). *Qualitative Researching* (Third edition). SAGE Publication.

- McGuirk, P. M., & O'Neill, P. (2021). Using Questionnaires in Qualitative Human Geography. In I. Hay & M. Cope (Eds.), *Qualitative Research Methods in Human Geography* (5 edition., p. 244-270). Oxford University Press.
- Monteiro, R., Ferreira, J. C., & Antunes, P. (2020). Green Infrastructure Planning Principles: An Integrated Literature Review. *Land*, 9(525), 1-19. Doi: doi:10.3390/land9120525
- Naturskyddsföreningen. (2022). *Yttrande över Förslag till nationell plan för transportinfrastrukturen 2022–2033*, (TRV 2021/79143).  
<https://www.regeringen.se/contentassets/5337b6007b714c0ea7f889018b515e56/naturskyddsforeningen-i-stockholms-lan.pdf>
- Naturvårdsverket. (n.d.). *Varför är det viktigt med grön infrastruktur?*.  
<https://www.naturvardsverket.se/amnesomraden/mark-och-vattenanvandning/gron-infrastruktur/varfor-ar-det-viktigt-med-gron-infrastruktur/>
- Novales, M., & Conles, E. (2012). Turf (grass) track for light rail systems. *Transportation Research Record*, 2275(1), 1–11. Doi: 10.3141/2275-01
- Peel, M. C., McMahon, T., & Finlayson, B. L. (2007). Updated World Map of the Köppen-Geiger Climate Classification. *Hydrology and Earth System Sciences* 11, 1633-1644. Doi: 10.5194/hess-11-1633-2007
- Pfautsch, S., & Howe, V. (2018). *Green Track for Parramatta Light Rail: A Review*. Western Sydney University. Doi: 10.26183/5c05fc021efb3
- Ramböll. (2008). *Mätning av buller och vibrationer från olika spårvagnstyper vid Norrköping kommun, Tekniska kontoret: Norrköpings spårvägar*. (Rapport 612907 25368:1).  
<https://norrkoping.se/download/18.5ff942e1184b3f255e229dbb/1624350799078/svanen-6-buller-och-vibrationer-fr%C3%A5n-sp%C3%A5rvagnar.pdf>
- Region Stockholm. (2017). *Regionalt trafikförsörjningsprogram för Stockholms län*.  
<https://www.regionstockholm.se/globalassets/2.-kollektivtrafik/regionalt-trafikforsorjningsprogram/regionalt-trafikforsorjningsprogram-2017.pdf>
- Region Stockholm. (n.d.a.). *Spårväg Syd*. <https://www.regionstockholm.se/sparvagsyd>
- Region Stockholm. (n.d.b). *Trafikförvaltningen*.  
<https://www.regionstockholm.se/trafikforvaltningen>

- Saarijärvi, M. & Bratt, E.-L. (2021). When face-to-face interviews are not possible: tips and tricks for video, telephone, online chat, and email interviews in qualitative research. *European Journal of Cardiovascular Nursing*. Doi: 10.1093/eurjcn/zvab038
- Secor, J. (2010). Social surveys, interviews, and focus groups. In B. Gomez & J. P. Jones III (Eds.), *Research Methods in Geography* (p. 194–205). West Sussex, Blackwell Publishing.
- Sikorski, P., Wińska-Krysiak, M., Chormański, J., Krauze, K., Kubacka, K., & Sikorska, D. (2018). Low-maintenance green tram tracks as a socially acceptable solution to greening a city. *Urban Forestry & Urban Greening* 35, 148-164. Doi: 10.1016/j.ufug.2018.08.017
- SL. (2017, September 29). *Tvärbanan startar för trafik*. <https://www.mynewsdesk.com/se/sl/pressreleases/tvaerbanan-startar-foer-trafik-2184304>
- SMHI. (2018, Augusti 20). *Gröna banvallar för spårvagnar ger många miljövinster, fördjupning*. <https://www.smhi.se/klimat/klimatanpassa-samhallet/exempel-pa-klimatanpassning/grona-banvallar-for-sparvagnar-ger-manga-miljovinster-fordjupning-1.118132>
- Spårvagnsstäderna. (n.d.). *Den moderna spårvägens historia*. <https://www.sparvagnsstaderna.se/sites/default/files/2020-02/historia.pdf>
- Spårvägssällskapet. (1998). *Stockholm*. [https://www.sparvagssallskapet.se/files/download\\_files.php?p=h&atlas\\_id=8](https://www.sparvagssallskapet.se/files/download_files.php?p=h&atlas_id=8)
- Spårvägssällskapet. (1999a). *Ramlösa*. [https://www.sparvagssallskapet.se/files/download\\_files.php?p=e&atlas\\_id=20](https://www.sparvagssallskapet.se/files/download_files.php?p=e&atlas_id=20)
- Spårvägssällskapet. (1999b). *Stockholm*. [https://www.sparvagssallskapet.se/files/download\\_files.php?p=h&atlas\\_id=11](https://www.sparvagssallskapet.se/files/download_files.php?p=h&atlas_id=11)
- Spårvägssällskapet. (2013). *Stockholm*. [https://www.sparvagssallskapet.se/files/download\\_files.php?p=h&atlas\\_id=10](https://www.sparvagssallskapet.se/files/download_files.php?p=h&atlas_id=10)
- Spårvägssällskapet. (2021). *Stockholm*. [https://www.sparvagssallskapet.se/files/download\\_files.php?p=a&atlas\\_id=62](https://www.sparvagssallskapet.se/files/download_files.php?p=a&atlas_id=62)

Spårvägssällskapet. (n.d.). *Atlas*.

<https://www.sparvagssallskapet.se/atlas/atlas.php?land=se&typ=&ling=se&pos=0>

Steckler, P., Klug, B., Gasser, F., & Wehr, W. (2012). Green Track – Environmental Performance Evaluation for “Green” Tramway Superstructure. *CETRA 2012 2<sup>nd</sup> International Conference on Road and Rail Infrastructure*.

[https://publik.tuwien.ac.at/files/PubDat\\_215400.pdf](https://publik.tuwien.ac.at/files/PubDat_215400.pdf)

Stockholms stad. (2022a). *Grässpår – Gröna spårvagnsgator*.

<https://miljobarometern.stockholm.se/natur/ekosystemtjanster/grasspar-grona-sparvagnsgator/>

Stockholms stad. (2022b). *Hammarby Sjöstad*.

<https://vaxer.stockholm/omraden/stadsutvecklingsomrade-hammarby-sjostad/>

Stockholmskällan. (2022a). *Bilar*. <https://stockholmskallan.stockholm.se/teman/trafik-i-stockholm/bilar/>

Stockholmskällan. (2022b). *Bussar*. <https://stockholmskallan.stockholm.se/teman/trafik-i-stockholm/bussar/>

Stockholmskällan. (2022c). *Spårvagnar*.

<https://stockholmskallan.stockholm.se/teman/trafik-i-stockholm/sparvagn/>

Stockholmskällan. (2022d). *Tunnelbanan*.

<https://stockholmskallan.stockholm.se/teman/trafik-i-stockholm/tunnelbanan/>

Trafikförvaltningen. (2015a). *Gestaltningssavsikter*.

<https://www.regionstockholm.se/globalassets/2.-kollektivtrafik/aktuella-projekt/sparvag-syd/gestaltningssavsikter-sparvag-syd.pdf>

Trafikförvaltningen. (2015b). *Miljökonsekvensbeskrivning*.

<https://www.regionstockholm.se/globalassets/2.-kollektivtrafik/aktuella-projekt/sparvag-syd/miljokonsekvensbeskrivning-sparvag-syd-del-1-2015-11-09.pdf>

Trafikförvaltningen. (2015c). *Miljökonsekvensbeskrivning*.

<https://www.regionstockholm.se/globalassets/2.-kollektivtrafik/aktuella-projekt/sparvag-syd/miljokonsekvensbeskrivning-sparvag-syd-del-3-2015-11-09.pdf>

VäxtEko. (n.d.). *Gräsarmering*. <https://www.vaxteko.nu/grasarmering/>

# Appendix

## Appendix 1

Demographic questions:

1. Gender\*
  - Female
  - Male
  - Other: \_\_\_\_ (please specify)
2. Age group\*
  - 18–25 year
  - 26–35 year
  - 36–45 year
  - 46–55 year
  - 56–65 year
  - 66 year and older
3. Highest finished education\*
  - High school
  - Higher vocational
  - Bachelor
  - Master/magister
  - Other: \_\_\_\_ (please specify)
4. Employment status\*
  - Full-time
  - Half-time
  - Student
  - Retired

Behavior question (Multiple choice question):

5. What/which types of transport do you usually use when travel from your home in the last 3 months?\*
- Tvärbanan (tram)
  - Bus
  - Car
  - Bicycle
  - Walk
  - Other: \_\_\_\_ (please specify)

Attitude & belief questions (Open-ended questions):

6. What is an environmental and sustainable public transport in your opinion?\*

7. What do you associate grass track with?\*
8. What are your general impression and feelings of living near a grass track?\*

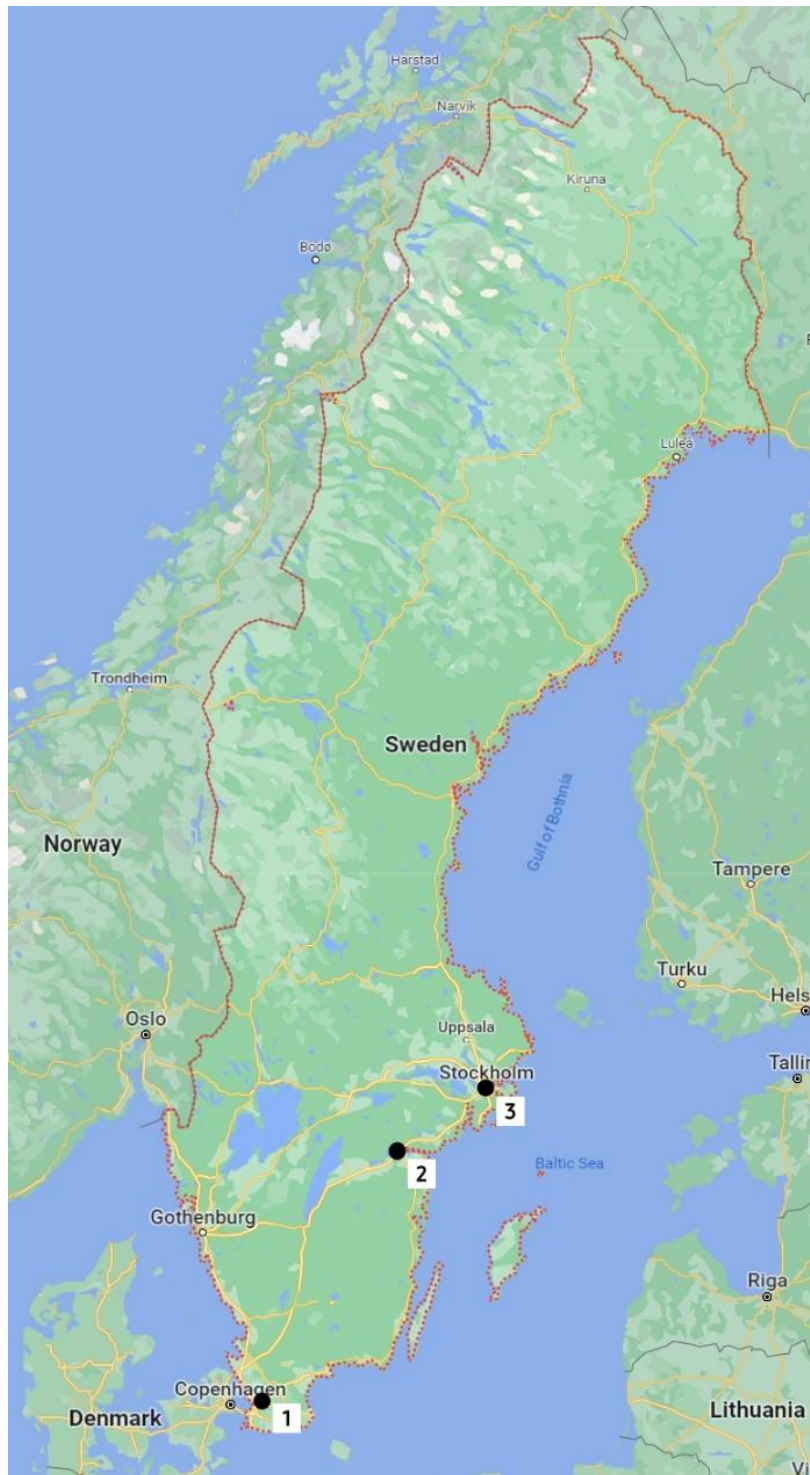
Ending question (Open-ended question):

9. Do you have other opinions or views that you would like to share about grass track, or specifically about the grass track in Hammarby Sjöstad? (optional)

Questions marked with the asterisk symbol (\*) at the end indicate that the question require an answer.

## Appendix 2

Map with the location of Lund (1), Norrköping (2), and Stockholm (3). Source: Google Maps (edited)



## Appendix 3.

The questions which was asked during every video interview:

- Vad tycker du att Stockholm (som är nybörjare inom grässpår) bör tänka på innan de bestämmer sig att använda grässpår i olika bebyggelseområden?
- Vilken är den största utmaningen med att använda grässpår?

## Appendix 4

Table 1. Demographic information

<b>The demographic information of the respondents</b>			
<b>Gender:</b>		<b>Education:</b>	
Female	18	High school	4
Male	13	Higher vocational	4
<b>Age Group:</b>		Bachelor	17
		Master/Magister	5
		Other	1
		<b>Employment:</b>	
		Full-time	22
18-25	5	Half-time	3
26-35	7	Student	5
36-45	4	Retired	4
46-55	3		
56-65	8		
66 years and older	4		

Table 2. Question 5

<b>The resident's travel habit</b>	
Tvärbanan (tram)	30
Buss	20
Walking	15
Car	5
Bicycle	5

Table 3. Question 6

<b>The general perception of what the respondents classifies an environmental-friendly and sustainable public transport</b>	
	<i>Proportion of (n=31)</i>
Operates with renewable fuel	12
Rail-bound traffic	6
Efficient and accessible	6
Little negative environmental impact	5
Affordable	2
Quiet	2
Other	3

Table 4a. Question 7

<b>The residents association of grass tracks</b>	
	<i>Proportion of (n=31)</i>
Environmental benefits*	17
Aesthetic	10
Sustainability	2
Modern and innovative	2
Traffic safety	2
Identity	1
Health benefits	1

Table 4b. Question 7

<b>(*) Indicators for environmental benefits</b>	
	<i>Proportion of (n=31)</i>
Infiltration of rainwater	17
Less hard surfaces	10
Reduce noise level	2
Biodiversity	2
More green areas	2

Table 5. Question 8

<b>Residents experience of living near grass tracks</b>	
	<i>Proportion of (n=31)</i>
Positive	17
Air feels cooler	1
Less noise	1
Colorful	1
Unnecessary	1
Neutral/no answer	6