

Susanna Hsu Hals

# A new design for Elgeseter Street with focus on improving social aspects and walkability

Case Elgeseter Street

Master's thesis in Civil and Environmental Engineering - Master

Supervisor: Alenka Temeljotov Salaj

Co-supervisor: Mahgol Afshari

June 2023



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Norwegian University of Science and Technology  
Faculty of Engineering  
Department of Civil and Environmental Engineering



Norwegian University of  
Science and Technology



# Abstract

The urban development of Trondheim has initiated a city expansion and the upgrading process of the city's main roads, one of them being Elgeseter Street. The Elgeseter district is largely populated as it consists of many apartment buildings, as well as Studentersamfundet, Gløshaugen campus, and Handelshøyskolen. With a zero-growth goal working towards reducing the number of private cars, it is fitting for Elgeseter to have a street design more focused on prioritizing pedestrians in the area.

This paper will be a continuation of a feasibility study the student started working on during the autumn of 2022 as a pre-study. The student has previously collected data and presented alternatives for solutions that can help create a street design for Elgeseter Street with a focus on pedestrians, placemaking and social neighbourhoods. The master thesis has focused on creating a more concrete and detailed solution for Elgeseter Street, with an aim to answer the research question: *What is a realistic and fitting solution for Elgeseter Street considering social aspects and walkability?*

By utilizing literature reviews, document study, legal document study, observational research, and interviews, the student has gathered information in search of changes and additions that can help create a street design with pedestrians at the top of the prioritization pyramid. Removing existing parking spaces along Elgeseter Street will leave significantly more room for sidewalks where social businesses, seating and greenery can be implemented. Adding ramps for wheelchairs, colours on facades, elevated green dividers and pocket parks will also help improve accessibility, attractiveness, safety, and comfort on Elgeseter Street. One of the main inconveniences for pedestrians is the large amount of traffic causing both noise and air pollution. However, this can be reduced by lowering the speed limit, removing parking, and adding curvature to the street to make the road less attractive for private cars. To make the final detailed suggestion for a pedestrian focused street design, the student has utilized Computer Assisted Drawing to create technical drawings and a 3D-model.

# Sammendrag

Den urbane utviklingen i Trondheim har satt i gang prosessen rundt oppgradering av byens hovedveier, der en av dem er Elgeseter Gate. Elgeseter-området er svært befolket ettersom mange har bosatt seg i området, i tillegg preges det av Studentersamfundet, Gløshaugen og Handelshøyskolen. Med et nullutslippsmål som jobber mot å redusere antall private biler, er det passende for Elgeseter Gate å få en vegutforming med fokus på å prioritere fotgjengere i området.

Denne masteroppgaven er en fortsettelse av en mulighetsstudie studenten utførte høsten 2022 som et forprosjekt. Studenten har tidligere samlet inn data og utformet alternativer for løsninger som kan hjelpe å designe en vegutforming for Elgeseter Gate med fokus på fotgjengere, områdeforvaltning og sosiale nabolag. Masteroppgaven fokusert på å utarbeide en mer detaljert løsning for Elgeseter Gate, med et mål om å svare på problemstillingen: *Hva er en realistisk og passende løsning for Elgeseter Gate med tanke på sosiale tilbud og gangvennlighet?*

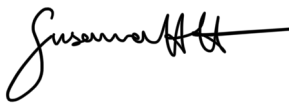
Ved å utnytte litteraturgjennomgang, dokumentstudier, juridisk dokumentstudie, observasjonsforskning og intervjuer har studenten samlet informasjon i håp om å finne endringer og tillegg som kan bidra til en vegutforming med fotgjengere på toppen av prioriteringspyramiden. Det å fjerne eksisterende parkeringsplasser langs Elgeseter Gate vil gi betydelig mer rom for fortau der sosiale virksomheter, sitteplasser og grøntområder kan bli implementert. Det å legge til ramper for rullestolbrukere, farger på fasader, hevede grønne skiller og «pocket parks» vil også bidra til å forbedre tilgjengelighet, attraktivitet, trygghet og komfort på Elgeseter Gate. En av hovedproblemer for fotgjengere er den store mengden trafikk som både forårsaker luft- og lydforurensing. Dette kan reduseres ved å senke fartsgrensen, fjerne parkeringsplasser og legge til kurvatur i veien for å gjøre den mindre tiltrekkende for private biler. For å utforme det endelige forslaget til vegutforming for fotgjengere, har studenten brukt digitale tegneverktøy til å lage tekniske tegninger og en 3D-modell.

# Preface

The master's thesis is written by a student during the spring of 2023 at the Norwegian University of Science and Technology (NTNU) in Trondheim. The student's interest in urban development and city planning has been the background for the pre-study in 2022 and now this master's thesis. It is about time Elgeseter Street is upgraded to accommodate metro buses, and the city should take this opportunity to work towards the zero-growth goal and prioritize pedestrians more. There is a lot of potential and room for creativity in the process of designing a more social and walkable Elgeseter Street.

I want to take this opportunity and thank my supervisor, Alenka Temeljotov Salaj, for introducing me to Elgeseter Street and encouraging me to use my creativity and design a suggestion. There have been regular meetings and follow-ups with good advice and helpful guidance. I also want to thank my co-supervisor, Mahgol Afshari from Trøndelag Fylkeskommune, who has taken the time to meet with me both during status update meetings and privately. Her suggestions during the search for interviewees were very helpful and her experience with Elgeseter Street has been helpful for insight. Lastly, I want to thank all engineers and architects who accepted my request for interviews, as their perspectives and suggestions have helped form my final design for Elgeseter Street.

Trondheim, 07.06.23

A handwritten signature in black ink, appearing to read 'Susanna Hsu Hals', with a long horizontal flourish extending to the right.

Susanna Hsu Hals

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# Abbreviations and Symbols

NTNU	The Norwegian University of Science and Technology
SDG	Sustainable Development Goals
CAD	Computer-Aided Drawing
3D	Three-Dimensional
GS	Google Scholar
WoS	Web of Science

# 1 Introduction

## 1.1 Background

With the expected continual population growth in Trondheim, the city centre is expanding to accommodate new residents (Trondheim Kommune, 2019). A city with roads that used to be dominated by cars has already started a transformation reflecting the new prioritization of sustainability, innovation, and the environment. The cars are being pushed out of the city centre and encouraged to use highways and tunnels, while the roads within Trondheim are redesigned to welcome more sustainable forms of travel like public transport, cycling, and walking.

Elgeseter Street remains a busy main road in Trondheim, with most of the area dedicated to traffic lanes and parking. The street is lined with office and apartment buildings that do not contribute much to the social aspect. Many of the older buildings are run-down and the street's surface is rough and worn. However, Elgeseter Street has the potential to become more socially attractive and walkable, which can improve the experience for all types of travellers. The space can be utilized to transform Elgeseter from a traffic-centric road into a lively city street.

## 1.2 Case study description

Elgeseter Street stretches for about 1 km from Elgeseter Bridge in the north to Holtemanns Veg in the south, see Figure 1-1. The street has a speed limit of 50 km/h and is divided into four lanes – two lanes in each direction, with right-hand lanes being reserved for public transport. As one of the primary roads for traffic in Trondheim, Elgeseter Street sees an average of 20 000 vehicles per day. The only way for travellers to cross the street is by traffic light-regulated crosswalks and an underground crossing by Elgeseter Bridge. The sidewalks are quite narrow and the waiting time for crossings is quite long. The significant traffic flow on Elgeseter Street emits substantial noise and air pollution, making it one of the most polluted streets in Europe (MDG Trondheim, n.d.). The tall buildings lining the street make a canyon that keeps the pollution trapped, reducing the neighbourhood's quality of living.

### **1.2.1 Important areas along Elgeseter Street**

There are several important areas along Elgeseter Street that should be taken into consideration when creating a new design. The furthest north is Studentersamfundet, a major social meeting place for students and surrounded by three metro bus stops. Further southwest is St. Olav's Hospital, which must be easily accessible for everyone, especially emergency vehicles. Furthest south we can find NTNU's biggest campus, Gløshaugen, which is currently part of a campus expansion project (NTNU, 2022). The surrounding campus park is also an important green area for socializing during the warmer parts of the year.

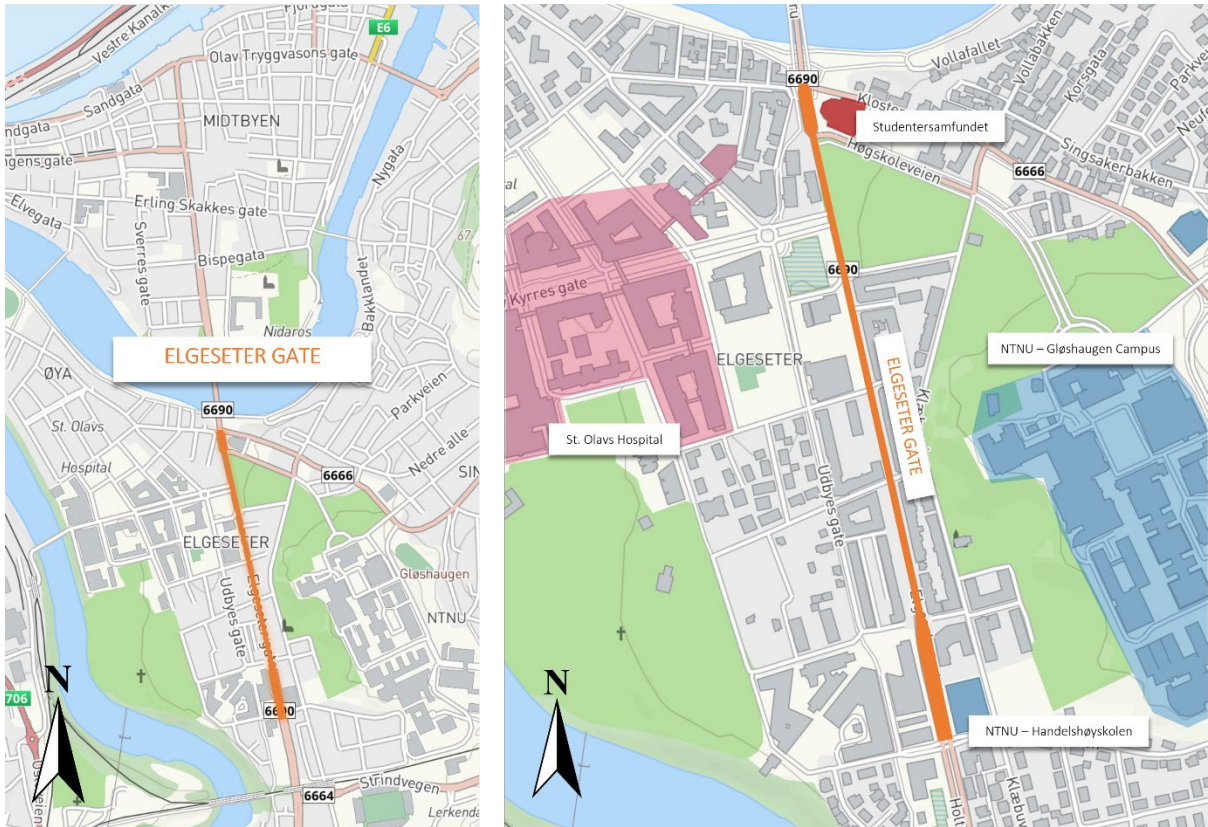


Figure 1-1: Map showing Elgeseter Street's location in the city of Trondheim, with important facilities in the area highlighted. (Made by: Susanna Hsu Hals using map from kommunekart.no)

### 1.2.2 Buildings of antiquarian value

The municipality in Trondheim has also created a map showing buildings and areas with antiquarian value (Trondheim Kommune, 2022), see Figure 1-2. These buildings and areas are of cultural heritage which means that there are restrictions against certain renovations and changes.

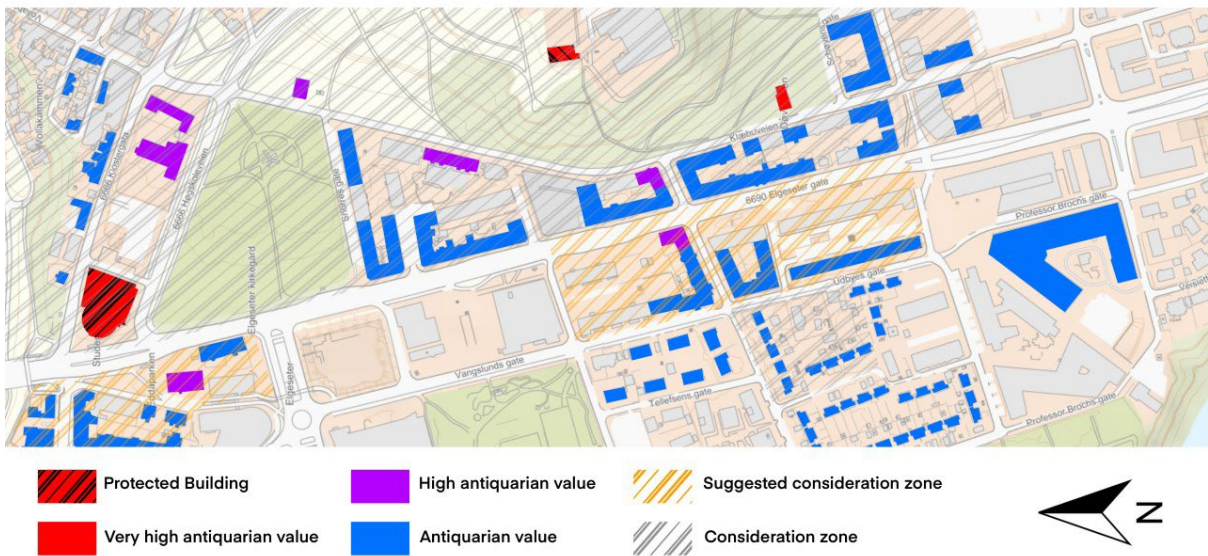


Figure 1-2: Simplified version of Trondheim municipality's cultural heritage map, concentrated on Elgeseter Street. (Made by: Susanna Hsu Hals)



### 1.3 Purpose of study

The master's thesis will be a continuation of a feasibility pre-study the student started working on during the autumn of 2022. It is written for the Department of Civil and Environmental Engineering at the Norwegian University of Science and Technology in Trondheim. The student has previously collected data and presented alternatives to create a street design for Elgeseter Street that prioritizes pedestrians, placemaking and social neighbourhoods. The master thesis will focus on creating a more concrete and detailed solution for Elgeseter Street, based on evaluations of collected data and suggested alternatives. Certain chapters and figures in Theoretical background, Methodology, Document study results, Legal document study results, and Observational research are brought over from the pre-study while the rest is further research.

The final design will focus on the improvement of Elgeseter Street's social aspects and walkability, while reflecting the chosen prioritization pyramid of travellers, see Figure 1-3. There is an overall goal to be mindful of accessibility and the environment while creating a realistic design that also considers the importance of existing elements like metro buses, emergency vehicles, surrounding facilities, and historical buildings. With the goals in mind, the student has formulated the following research question and two sub-questions:

RQ: "What is a realistic and fitting solution for Elgeseter Street considering social aspects and walkability?"

SQ1: "What implementations can make Elgeseter Street more social?"

SQ2: "What implementations can make Elgeseter Street more walkable?"

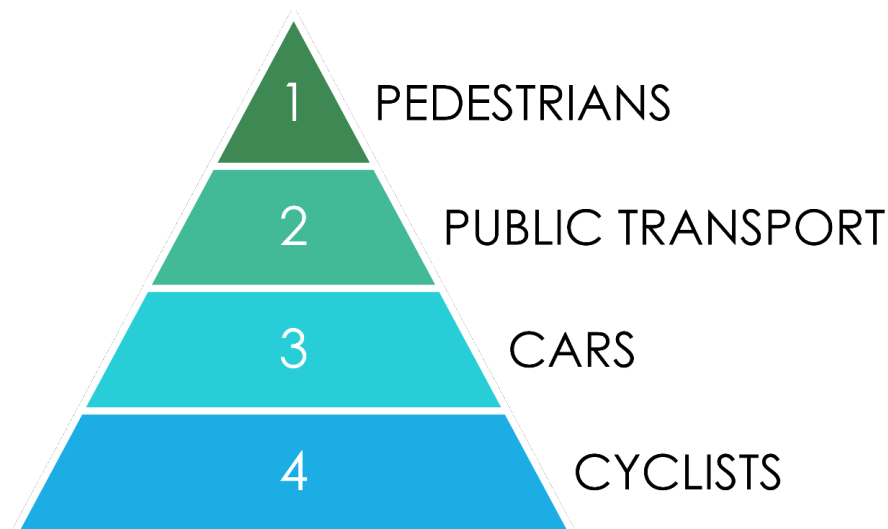


Figure 1-3: Prioritization pyramid for travellers. (Made by: Susanna Hsu Hals)

## 1.4 Structure

The master's thesis has taken the IMRaD-Structure from NTNU as a starting point, see Table 1-1. The discussion will lead to a detailed street design as a suggested solution for Elgeseter Street.

*Table 1-1: An overview and description of the IMRaD-Structure used for the master's thesis.*

<b>Introduction</b>	Presenting background for the chosen topic and stating the research question and sub-questions, in addition to diving a description of the case study.
<b>Theoretical background</b>	Providing relevant theory that supports the investigation of the chosen topic.
<b>Methodology</b>	Describing the various methods used for data collection and pointing out their strengths and weaknesses, in addition to explaining how the methods were used.
<b>Results</b>	<p>The collected data about Elgeseter Street, and social and walkable street designs are presented in the following chapters categorized by methods:</p> <p>Chapter 4: Literature review Chapter 5: Document study Chapter 6: Legal document study Chapter 7: Observational research Chapter 8: Interviews</p>
<b>Discussion</b>	The findings are discussed with a focus on answering the research question and sub-questions.
<b>Conclusion</b>	A summary of the thesis' main results.

## 2 Theoretical background

### 2.1 UN Sustainability Goals

The United Nations created the 2030 Agenda for Sustainable Development as a plan to achieve peace and prosperity for people and the planet (United Nations, 2015). It encourages countries and stakeholders to collaboratively eradicate poverty and heal the planet by working on the UN's 17 Sustainable Development Goals (SDG), see Figure 2-1. These ambitious goals and targets were supposed to encourage people in 2015 to take more action over the next 15 years and implement a global partnership that works towards the greater good. This study about Elgeseter Street works towards achieving the following SDGs: 3 Good Health and Well-Being, 11 Sustainable Cities and Communities, 13 Climate action, and 15 Life on Land.



Figure 2-1: The United Nations' Sustainable Development Goals. (United Nations, 2022)

### 2.2 The Urban Development of Trondheim

*This chapter is brought over from the student's pre-study written autumn 2022: Elgeseter Gate – A feasibility study with prioritization of pedestrians, placemaking and social neighbourhood (Hals, 2022).*

The city of Trondheim has had significant population growth in the last 20 years, and it is expected to increase by 55 000 people by 2050 (Trondheim Kommune, 2019). With this growth comes the need for more qualities and functions, which means that the city centre will need to expand. Many different stakeholders must work together to create a city fit for living while prioritizing sustainability, the environment, city life, and historical preservation.

#### 2.2.1 Miljøpakken

Trondheim introduced "Miljøpakken" in 2008, which is a collaboration to improve travel, reduce emissions, and lower the amount of traffic in the city (Miljøpakken, 2019). This collaboration builds roads, bridges, bike lanes, and sidewalks while considering accessibility, safety, and the reduction of cars. It also supports the "zero growth goal", which works toward stopping the increase of private cars by promoting public transport, cycling, and walking (Miljødirektoratet, n.d.).

### 2.2.2 Metro bus Project

The Metrobus Project was initiated in 2019 as a contribution to reach the “zero growth goal” (Statens vegvesen, 2021). The metro buses are electrical or use biofuel, making them more environmentally friendly. They are also bigger and drive more frequently than the previous public transport arrangement. A lot of bus stops in Trondheim city centre have been upgraded to accommodate the project, and there are bigger projects regarding the main roads of use for the metro buses (Miljøpakken, n.d.). The large streets that need an upgrade are Kongens Gate, Olav Tryggvasons Gate, Innherredsveien, and Elgeseter Street. These streets will be designed with public transport prioritized, and they will have good conditions for bicycling and walking.

### 2.2.3 Trondheim palette

In addition to the sustainable urban development of Trondheim, there has been created awareness around colour choice regarding building facades (Owren, 2021). The city is known for its colourful buildings and neighbourhoods along the coast from the 1930s, but most colours have been replaced by black, grey, and white over the years. Therefore, the city planning office in Trondheim decided to sample the remaining colours of Trondheim, hoping to restore the former aesthetic. A lecturer at NTNU in Trondheim, Kine Angelo, has also created the “Trondheim palette”, with the intent to encourage the use of these colours when renovating or building new projects. Below in Figure 2-2 and Figure 2-3 are the “Trondheim palette” and an example of the city’s colourful facades. These photos contain the colours of the city with both historical and cultural significance.

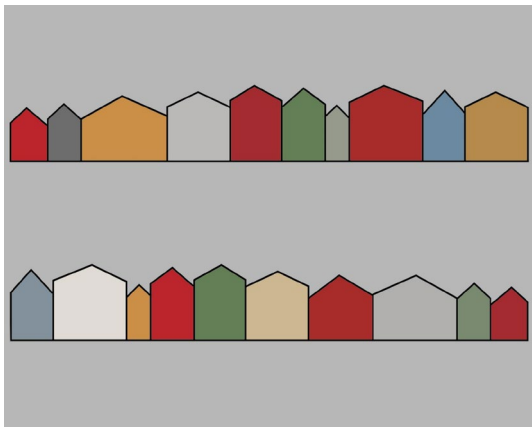


Figure 2-2: The "Trondheim Palette" made by Kine Angelo. (Angelo, 2022)



Figure 2-3: A photo of Baklandet in Trondheim with colourful facades. (Angelo, 2022)

### 2.2.4 Placemaking

With the population growth in Trondheim, it will be necessary to expand the city centre and create more interesting city spaces (Trondheim Kommune, 2019). The municipality aims to maintain the city's history and culture while wishing to develop a city for the people. They've described their goal to make a city on eye level, by creating social meeting places outdoors and indoors and implementing more blue-green structures for placemaking. Adding more local centres and improving connections between these can boost the walking experience and enjoyment in a city.

## 3 Methodology

This chapter provides information about the chosen methods used for gathering information in this study. The student has chosen to review literature and legal documents, as well as observational research and interviewing professionals. To illustrate the final design, the student has used digital sketching, technical drawing and 3D-modelling. The following chapters will describe each method and how they were used for this study.

*Parts of this chapter is brought from the student's pre-study written autumn 2022: Elgeseter Gate – A feasibility study with prioritization of pedestrians, placemaking and social neighbourhood (Hals, 2022).*

### 3.1 Literature review

Literature review counts as both a quantitative and a qualitative research method (Snyder, 2019). Quantitative literature reviews are used for gathering and systemizing data that will be analysed afterwards. Qualitative literature reviews involve getting a broader understanding of a topic and obtaining more knowledge. Literature reviews are used to evaluate existing research on a topic, and then identifying research gaps that your paper can fill in (The Univeristy of Edinburgh, 2022).

For this thesis there has been reviewed literature about how placemaking contributes to social interactions, as well as how walkability in an area can be improved. These reviews have helped the understanding of how a space can be upgraded for pedestrians and people living there, by listing specific goals and measures that can be used in the development. The following subchapters will show the process of the systematic search done to gather literature for this study.

Even though the purpose of this study is to find information that can improve the specific case of Elgeseter Street, it is necessary to examine existing research and map out improvements for social aspects and walkability that may be fitting. However, there are a few disadvantages to using literature review as a method. Reviewing literature can be quite time-consuming, and finding the right literature for a specific case can prolong the time even more. Additionally, the literature should be reliable and valid, which is not always easy to confirm. When reading many articles, some paper might be skimmed through, and important information can be overlooked. It is therefore important to evaluate an articles relevance and properly examine the research.

#### **3.1.1 Systematic search**

When collecting research for thesis literature review, the student has used three databases: Google Scholar, Web of Science and Scopus. The search has been limited to articles from the last 5 years. The initial searches were formulated to find information about social aspects and walkability in urban street design. The different searches and search results in each database are listed in Table 3-1. To narrow the search down, the student included "placemaking", as it was one of the topics of focus in the pre-study. Since Trondheim municipality defines walkability as a good combination of accessibility, attractiveness, safety, and comfort (Paulsen, et al., 2020), the student decided to replace "walkability" with these words to narrow it down even more.

Table 3-1: Overview of searches for literature review and the number of search results.

RESEARCH	RESULTS			
	GS	WoS	Scopus	Total
Urban AND Design AND Street AND Social	14 900	2 282	668	<b>17 850</b>
Urban AND Design AND Street AND Walkability	1 620	328	216	<b>2 164</b>
Urban AND Design AND Street AND Social AND Walkability	12 400	104	56	<b>12 560</b>
Urban AND Design AND Street AND Social AND Walkability AND Placemaking	443	2	0	<b>445</b>
Urban AND Design AND Street AND Social AND Attractiveness AND Accessibility AND Safety AND Comfort AND Placemaking	157	0	0	<b>157</b>

After getting 157 results from Google Scholar, the student went through all the articles titles to evaluate relevance. All titles with no relevance to this thesis' research question were dismissed, and after this process, 109 articles were removed, and 48 articles remained. Afterwards, the student read the abstract of the remaining articles to get a better idea of their relevance to the project. Finally, 22 of the articles were filtered out, leaving 26 articles to be reviewed. An overview of the framework for this search process is presented in Table 3-2 below.

Table 3-2: Framework for scoping study.

Research question:	
<i>What is a realistic and fitting solution for Elgeseter Street considering social aspects and walkability?</i>	
Search string:	
Urban AND Design AND Street AND Social AND Attractiveness AND Accessibility AND Safety AND Comfort AND Placemaking	
Search criteria and databases:	
Years	2018-2023
Language	English
Databases	Google Scholar, Web of Science, Scopus
Literature	Articles

### 3.1.2 Research procedure

When planning for scoping literature, the student first formulated the research question after deciding what the prioritizations for a new Elgeseter street design should be. The student thereafter found relevant keywords that could be used to narrow down the search results. After trial and error, the student ended up with the databases: GS, WoS, and Scopus, and limiting the searches to articles from the last 5 years. Steps of the scoping review are shown in Figure 3-1 below.

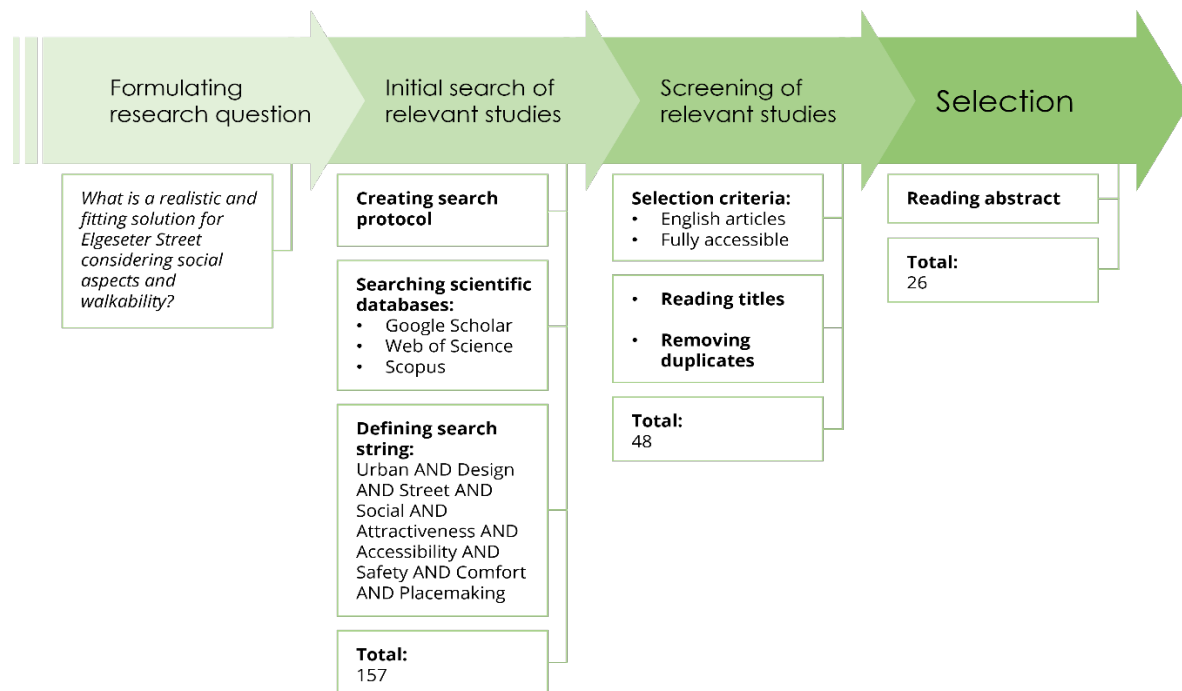


Figure 3-1: Process of the scoping review done for this study.

### 3.2 Document study

A document study is a structured method that is used to gather information about a certain topic using existing documents that are available (Bowne, 2009). It is a qualitative research method that requires documents, both printed and electronic, to be examined and interpreted so that one can gain understanding. This research method is often combined with other qualitative research methods to study a specific topic. Multiple methods will help draw conclusions from several sources of evidence.

For this paper, the student has focused on finding documents relevant to the urban development of Elgeseter Street and placemaking. Literature about the urban development of Trondheim has been studied to get a bigger picture, in addition to understanding the function of Elgeseter Street and its connection to the city. There are also several guidelines given by the municipality, suggesting what needs to be prioritized and what they wish for the upgraded Elgeseter Street design. There has also been gathered documents with information about the preservation or demolition of a few buildings, in addition to information about certain elements that can help improve Elgeseter's street design.

The documents studied for this paper has been collected using different methods. Early on, the supervisor sent several relevant documents from the municipality of Trondheim and other

organizations like NTNU, SINTEF, St. Olav's Hospital, and Trøndelag Fylkeskommune. Some of the other articles have been found using Oria and Google Scholar as search engines, to increase validity and reliability by narrowing down the result to approved professional articles. The municipality plans have also had several case documents attached that are relevant to this subject.

Document study is a fitting method for this study as there is a lot of relevant documents about the municipality's goals and plans for urban development of Trondheim and Elgeseter Street. The interview process also resulted in the findings of new improvements that have been further researched through document studies. This method has allowed the student to gather existing information about relevant topics and use other people's earlier work to produce new ideas fitted for this specific study. However, a downside to using this method is how time-consuming finding and studying documents can be. Deciding what documents are relevant can also be difficult, and in the search for articles some might be overlooked. When documents are found, it is also important to make sure all relevant information has been collected and that no important points are being neglected.

### 3.3 Legal document study

The purpose of a legal document study is to examine which legal documents are relevant to the case, and then make sure the solution meets the requirements (Ironclad, n.d.). There are legal obligations that should be fulfilled, and it is important that relevant legal documents are collected, examined, reviewed, and analysed. Keyword lists can be used to filter the useful information however, it is essential that you critically review all documents with a level of relevance.

For this study, the student has collected regulation plans and municipality plans for Trondheim and Elgeseter Street. There has also been used Norwegian manuals and handbooks for street design, to find the proper measurements the different lanes should have. In general, the legal document study has helped create the legal framework to make sure the final design is reasonable and realistic.

For this study it is important to gather the legal documents that set the framework for the final design that will be produced. Ensuring a realistic design will increase the usefulness of this study and make it easier for Trøndelag Fylkeskommune and Trondheim municipality to take inspiration. Another benefit of studying legal documents is the ensured validity and liability of them, however this method can be quite time consuming. Some legal documents and handbooks cover a lot of information that might not be relevant and filtering the information out properly can take time. Additionally, when filtering so much information it is possible to overlook certain parts that are important to the study.

### 3.4 Observational research

Collecting information for a study purely based on the researcher's observation is called observational research or an observational study (George, 2023). This type of study is usually a qualitative method, and it is commonly used for explanatory and exploratory research. Different types of observational research practised in this study include covert observation, qualitative observation, and archival research. Covert observation means to research the behaviour of participants who do not know they are being observed, for example by observing public spaces.



Qualitative observation is about using our five senses to collect data, such as observing colours and sounds. Finally, archival research is investigating a research question by utilizing archives. These could be sources from libraries or data online.

The student has conducted observational research to collect data about Elgeseter Street's conditions today. Covert observation has been used to gather information about people's behaviour in Elgeseter Street to find out which areas people gather for social purposes and how accessible the street design is today. The qualitative observation was used to evaluate the aesthetics and pedestrians' experience in the street, in addition to collecting examples of colourful facades in Trondheim. Finally, archival research has involved using maps to determine the area restriction for a new street design, as well as mapping out the toll system and sun-diagram in Trondheim.

Observational research can be a great way to get inspiration for the final design of Elgeseter Street. When figuring out a solution prioritizing people, it can be relevant to experience the area as a pedestrian and notice benefits and problem areas that might not be mentioned in literature. The disadvantages of this method, however, include the fact that some things should be observed over time and some things can not be observed at all. Observational research is therefore be combined with other methods to gather relevant information, and the student has kept in mind that some observation might be biased as well.

### 3.5 Interview

Conducting interviews is a qualitative research method where people are asked questions to collect data (George, 2022). It is a great research tool that allows you to gather rich information about a topic. However, there can be challenges that come with interviews and it is important to conduct them properly. It is essential to not accidentally ask leading questions, and one should effectively spend the agreed time and make sure all questions are asked.

For this study, the student decided to conduct qualitative semi-structured interviews with professionals to ask their opinion on alternatives created as a pre-study. There were additionally made two interview guides, one for professionals working with area planning and one for people who work with traffic and roads. The interviews were conducted both in person and digitally, and they were all voice recorded to make sure all relevant information is transcribed. All interviewees have signed a consent form for the voice recordings.

Most of the interviewees are employed in Trøndelag Fylkeskommune who own Elgeseter Street, which means that they already are familiar with the project and its challenges. Others were from Trondheim municipality and Asplan Viak – who has worked with St. Olav's Hospital's outdoor area. Within road and traffic, the interviewees consisted of senior advisors and engineers, and they were interviewed about placements of public transport lanes, reduction of traffic, different types of travellers and different types of crossings. The people working with area planning were landscape architects and city architect. They were interviewed about the amount of greenery that should be added, as well as different ways to make a street more comfortable and interesting. They were also asked about social additions and ways to improve aesthetics in street design.

Interviewing experienced professionals within the fields that work with urban development and street design is very helpful in the case of this study. The interviewees all work in the Trondheim region and have experience with Elgeseter street already. The qualitative interviews help gather information about professionals' work process, priorities and experienced challenges with creating a new road design. It is an effective way to get relevant reliable theory without having to search through a lot of theory, however, the information might be biased. When interviewing a fewer people, it is possible to get biased opinions that might not reflect the majority's opinion in the field. Additionally, when conducting interviews, it is possible to accidentally ask leading questions, and the student should therefore practice and research interviews methods beforehand.

### 3.6 Digital sketching

In initial stages of a project, it can be effective to use digital sketching as a tool to encourage creative thinking and communicate visions and ideas (Lieu & Sorby, 2015). This method is often used in construction projects to create visualizations for consultations with clients (Bouchlaghem, et al., 2005). In planning stages of a project it is helpful to bridge the gap between professionals and clients by communicating with visualizations. Sketching both by hand and digitally is therefore a helpful method used to explain potential and visions to people who might not understand the professional language used by experts (Bouchlaghem, et al., 2005).

For this paper, the student has used digital sketching to create visualizations that help create overviews of the current conditions in Elgeseter Street, as well as new concepts and ideas. Most of the drawing and photo-editing has been done using the app Procreate on an iPad, and the rest has been made using Microsoft PowerPoint. Some explanatory maps and visualizations of alternatives have been brought over from the pre-study done autumn 2022 (Hals, 2022). For this master's thesis there has been created more visualizations and maps to create overview and explain the student's suggestions for Elgeseter Street's new design.

The purpose of the study is to create a new design and visualizations can be an effective tool to illustrate the streets potential and how changes and new additions can look. Explanatory maps and figures can also help create an overview and forward the points made in writing. The downside to this method is the potential for lack of accuracy. The information explanatory figures are based on might not be accurate or enough. Photo editing can help visualize Elgeseter Street's potential; however, the editing skills determine the realism. If the editing is not done properly, it might create false expectations for readers.

### 3.7 Technical drawing

When a project has gotten to the point where ideas need to be communicated to clients, new drawings must be made as a media that can be presented (Kilmer & Kilmer, 2003). Creating technical construction drawings requires time and attention to detail, thereby making the drawings quite valuable and about 50% of a project fee. With the recent development of technology construction drawings are now usually made with computers. Computer-Aided Drawing (CAD) is a tool that has been integrated in the construction world, and technical drawings are today sent digitally to the different stakeholders.

The technical drawings in this study have been made using Graphisoft ArchiCAD 26. The student created a model for Elgeseter Street with the existing buildings in place, and then implemented all changes and additions that can help improve the walkability and increase social activity. The 2D drawing of the street has been used to produce plan-drawings of both the entire street and smaller sections. There has also been generated drawings of important cross-sections that help describe the new design of Elgeseter Street. The program has allowed the student to create drawings of high quality and accuracy, with smaller details like outdoor furniture, greenery, lamps and more. All technical drawings can be found in Appendix 5 with description of the final design.

Using CAD to create detailed plan- and section-drawings of the new design is a very effective way to show the final suggested design of Elgeseter Street. With ArchiCAD the details can be drawn with millimetre accuracy, which allows for the design to be quite realistic and useful. The disadvantage of producing such a detailed suggestion is the lack of call for further brainstorming. When presented with something concrete, it can be difficult to imagine other design ideas and implementations that could be fitting. Creating technical drawings can also be very time-consuming, which makes it necessary to make a detailed plan for the time that will be spent on a project.

### 3.8 3D-Modelling

Computer-modelling is used to create 3D-visualization that communicate information that 2D-drawings can't do effectively (Lieu & Sorby, 2015). Not all people have the 3D spatial skills that allows them to visualize things in 3D, and it is therefore very useful to have 3D modelling tools and renderings that are more descriptive. These tools allow us to create visualizations that describe a design with a high level of complexity, and some renderings can be quite detailed and realistic (Ganah, et al., 2001).

The student has used Graphisoft ArchiCAD 26 to create technical construction drawings that also generate a 3D-model of the project. The model has been used to render realistic photos of different areas along the new design for Elgeseter Street with prioritization of pedestrians. The renders are used throughout the paper as descriptive images that visualize what changes and additions to Elgeseter Street would look like. A collection of rendered images can also be found in Appendix 5 showing the final design.

Adding images from a 3D-model is an effective way to show what the final design in this study looks like. Pictures can show a lot more than words can and should therefore be incorporated in the study for visual representation of the work. The downside to including 3D-modelling in a project is the large amount of time it takes to create an accurate model. Creating a model also requires some experience with a CAD-program as it directly influences the time that will be spent on modelling. There should be made a detailed schedule for the entire project, and if possible, the student should create the model early and prepare the groundwork.

## 4 Literature review

This chapter is divided into two parts where the first subchapter will present an analysis of the literature reviewed for this study. The second subchapter is an overview of the findings divided into findings about social aspects, accessibility, attractiveness, safety, and comfort.

### 4.1 Analysis

Looking at the number of publications each year since 2018, see Figure 4-1, it is notable that there was a larger increase of publications from 2021 to 2023 compared to the years before. According to research done by (Papastergiou, et al., 2023), the spike of interest in social activity and walkability might have been caused by the COVID-19 pandemic, as going outside was one of the only getaways that had lower risks of getting infected.

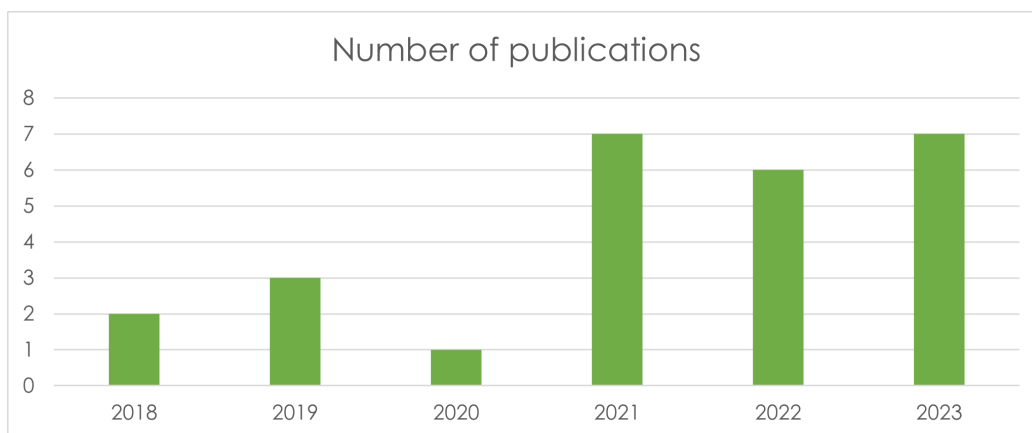


Figure 4-1: Diagram showing number of publications from 2018-2023.

### 4.2 Findings from literature

In order to identify changes and additions that can help improve Elgeseter Street for pedestrians, the student has reviewed existing literature and categorized the findings. The coming chapters include information about social activity walkability, where walkability is divided into accessibility, attractiveness, safety, and comfort.

#### 4.2.1 Social aspects

When wanting to increase social activity, it is important to know what attract people and what effect social spaces can have for people. The social dimension together with the visual, aesthetic, and spiritual dimension have an impact on creating affective atmospheres (Abusaada & Elshater, 2021). Abusaada and Elshater (2021) also describe how pedestrians evaluate the interaction between building blocks and observe how it can highlight social spaces and seating on the sidewalk. After the invention of cars, the streets have been taken over by vehicles while pedestrians, cyclists and public spaces have been de-prioritized (Yang, et al., 2019). According to Rui and Othengrafen (2023), there has been an increase of competition between traffic and pedestrians for street space, however, there should be a way to let streets serve both a transportational and social purpose. Researchers have now been made aware of the importance of social life, and cities have started to take action trying to “humanize the street environment” (Yang, et al., 2019).

A well-functioning urban structure should have centres of activities located at a walking distance, which both creates social vibrancy and economic value (Jabbari, et al., 2023). Increasing social cohesion at a neighbourhood level is often associated with having easy access to destinations and good walking conditions (Mouratidis, 2021). According to Shields, et al. (2021), the benefits of walking include the increase of community contact, in addition to several health benefits. They also mention the importance of considering social walkability when wanting to encourage more walking in an area. The implementation of public spaces can improve both the physical environment and psychological dimensions (Moulay, et al., 2018), as the role of social spaces is to encourage social activity and improve physical health (Yang, et al., 2019). Mouratidis (2021) state that activities like meeting people, visiting shops, accessing recreational and cultural facilities all contributes to people achieving eudaimonia, which contributes to their well-being. Studies show that cities and societies where social relationships are strong, are associated with high level of happiness (Mouratidis, 2021). Recreational amenities are also beneficial for the health of elderly living nearby, as they encourage everyday travel (Graham, et al., 2019).

Social interactions and daily activities that include culture, history and community, can help boost people's sense of place (Latip, et al., 2023). Urban space should include social infrastructure like housing, educational centres, shops, and sport areas (Yang, et al., 2019). According to Afshari, et al. (2022), the lack of recreational amenities in the Elgeseter district might be the cause of people's inactivity. Streets should be designed with wide sidewalks, different types of squares, markets, vendors, street furniture and more (Yang, et al., 2019), as residents in an area perceive social quality of life through aesthetic, cultural and social factors (Elsemary, 2019). The position of activities can encourage communication, tranquillity, and comfort between pedestrians, in addition to increasing their joy (Abusaada & Elshater, 2021). Pedestrians also tend to value markets, art, shaded areas, food, and beverages (Elsemary, 2019). In a street, the social dimension affects the daily living experiences of people living in the area. A positive experience can be created by adding local activities, places to sit and eat, and a separation of movement between pedestrians and vehicles (Abusaada & Elshater, 2021).

There are several elements important when creating a pedestrian realm, including landscape, suitable areas for leisurely strolling, greenery, street enmities, and control of traffic to reduce noise and air pollution (Yaseen, 2021). Having taller buildings along a narrower street can help create the sense of space, and having narrower vehicle lanes can encourage pedestrians to visit all attractions on both sides of the street. When designing a street, it is important that urban planners evaluate if parking spaces really are necessary, as they take a lot of space that could be used for pedestrian infrastructure (Jabbari, et al., 2023). A wider sidewalk can allow for the implementation of benches and railing, which can help encourage social interaction (Rui & Othengrafen, 2023). There should also be added seating allowing for people to sit together, and shade, shelter, and greenery is important as well. According to Moulay, et al. (2018), the addition of inclusive and responsive parks tends to increase people's place attachment, which will motivate people to spend more time outdoors. Alicia (2021) mentions that green spaces bring something aesthetic to an area while they promote social interactions and physical activity. During COVID-19, green spaces were important for providing space for leisure activities at lower risk of infection (Mouratidis, 2021). It is important to tailor green spaces to specific cases, and community engagement can help urban planners and communities create meaningful green spaces (Alicia, 2021).

### **4.2.2 Accessibility**

To create a human-centred street design, it is important to create an accessible street (Rui & Othengrafen, 2023). Baobeid, et al. (2021) points out the importance of prioritizing accessibility in order to be more inclusive of people suffering from mobility challenges. Pedestrians might have physical impairments that affect their balance, making them more susceptible for falls and collisions (Jabbari, et al., 2023). People with disabilities might also have sensory impairments and limited mobility that affect their capability to navigate in a safe manner. Graham, et al. (2019) mentions how important ensuring accessibility is for elderly and disabled people living in an area, especially since there are many everyday facilities that create the need for daily travelling. Wen, et al. (2018) also talk about the importance of designing outdoor spaces with considerations of accessibility, as elderly prefer to have access to these spaces for socializing and experiencing the outdoors. Elderly like to visit green spaces near where they live, and their activities often revolve around walking to these green spaces (Wen, et al., 2018). It is therefore important to design accessible sidewalks as well as implementing crosswalk markings and signal timings that accommodate elderly and people with disabilities (Jabbari, et al., 2023). Improving the accessibility in an area will also strengthen the social relation and sense of community in the neighbourhood (Orsetti, et al., 2022).

### **4.2.3 Attractiveness**

The visual variables in street designs include architecture, building block, public spaces, and street furniture (Abusaada & Elshater, 2021). According to Rui, et al. (2023), visually appealing elements can help create a sense of community and belonging in an area. Abusaada and Elshater (2021) also mention how visual appropriateness and pleasing appearance on eye-level plays a large role in reducing feeling of stress. A walking environment can be improved by ensuring fresh air, quiet, architecture, flower gardens and trees (Graham, et al., 2019). In the case of Elgeseter Street, the lack of greenery combined with the presence of old buildings makes the street less attractive to travel along (Afshari, et al., 2022).

On a fundamental level, people are attracted to aesthetically pleasing environment, and architecture can therefore shape the walking experience in an area (Brielmann, et al., 2022). Pleasant spaces can slow people down and reduce anxiety as the pedestrians have many interesting elements to look at and experience. According to Abusaada and Elshater (2021), aesthetics and architecture can give value to a public space, as the building facades overlook the street. They also state that a sense of building's magnificence can better a person's mood. Latip, et al. (2023) describe how decoration, colour, landscape, and texture can help create a sense of place, which will further encourage social interaction. Preserving memories of cultural heritage and historical elements can be valuable to people, especially the elderly (Wen, et al., 2018). The preservation of historical buildings with beautiful architecture can help with a sense of place and create a magical atmosphere (Abusaada & Elshater, 2021).

### **4.2.4 Safety**

According to Jabbari, et al. (2023), when connecting the pedestrian network to public transport, it is essential to ensure safety and accessibility, as well as creating an efficient transport system for everybody. It is important to consider vulnerable pedestrians groups, like children, elderly, people with disabilities, and people under the influence of drugs or alcohol. It can also be useful to try

and understand pedestrians' behaviour, in order to implement safety measures. Certain pedestrians might have risk-taking tendencies that should be considering when creating a safe street design (Jabbari, et al., 2023). Having designated areas and lanes for bicycles in addition to avoiding adding street parking spaces, can both help ensure safety in a street (Rui & Othengrafen, 2023). Afshari, et al. (2022) points out how not dividing pedestrians and bicycles in Elgeseter Street can be a safety hazard. Implementing traffic calming measures such as lower speed limits can help inconvenience vehicles and reduce traffic (Jabbari, et al., 2023). Lighting on streets is also important (Rui & Othengrafen, 2023), as poorly lit streets can also be a concern for people's safety (Graham, et al., 2019). It is also pointed out by Graham, et al. that other safety problem areas include damaged pavement, crossing points, traffic density and traffic speed.

#### **4.2.5 Comfort**

In urban planning it is important to ensure sidewalks of good quality to improve walkability and walking behaviour (Afshari, et al., 2022). It is pointed out by Afshari, et al. how the reducing of noise and air pollution in Elgeseter Street can be achieved by encouraging more active mobility and improving the bicycle network. The use of electric vehicles will help lower the emission of noise and polluted air, which can help create a more attractive street environment (Rui & Othengrafen, 2023). Improving street comfort and walkability will better public health and reduce high blood pressure, obesity, and depression (Yaseen, 2021). Fresh air, seeing people and experiencing life is important to encourage everyday travel, which can boost people's health and well-being (Graham, et al., 2019).

To ensure pedestrian safety and comfort, it is beneficial to design streets with as wide sidewalks as possible (Rui & Othengrafen, 2023). The space on the sidewalk can be utilized to add features that help increase pedestrians' comfort. Thermal comfort and air quality is important, and this can be improved by among other things implementing vegetation (Baobeid, et al., 2021). Landscape and vegetation play a large role in comfort on a street, as they both improve aesthetics and have a positive environmental effect (Yaseen, 2021). Orsetti, et al. (2022) also mention that the addition of greenery can provide shade, improve air quality, reduce heat, and improve both mental and physical health. The interest of green spaces in walking distance has had an exponential growth over the last decade and is possible to assume that the spike since 2019 is caused by COVID-19 (Papastergiou, et al., 2023). Many prefer nature-based recreation (Wen, et al., 2018), and during the pandemic, green spaces have served as getaway spots with low risk of infection (Papastergiou, et al., 2023). It can therefore be beneficial to evaluate specific cases and use both theoretical and practical processes to determine the need for green spaces in that area. Focus groups and residents in the specific district can be used to determine demand (Lin & Andersson, 2023).

## 5 Document study results

This chapter presents the documents that are analysed for this study. The results include documents from the municipality with information about strategies for Trondheim and Elgeseter Street. Additionally, there are documents studied to gather more information about how one can plan for walkability and what implementations can help improve it. There has also been found information about accessibility in street design and the benefits of pocket parks, as it is relevant to improving walkability in Elgeseter Street.

### 5.1 Urban development strategy for Trondheim

*This chapter is brought over from the student's pre-study written autumn 2022: Elgeseter Gate – A feasibility study with prioritization of pedestrians, placemaking and social neighbourhood (Hals, 2022).*

In 2019 the municipality of Trondheim made a document planning the city's urban development up till 2050 (Trondheim Kommune, 2019). Below in Figure 5-1 are maps of Trondheim showing the demarcation areas for this urban development strategy. Since the 1960s, the car has been one of the main factors during city development, making several areas of Trondheim characterized by wide roads and heavy traffic. Although it will be difficult, it is a habit that needs to be changed for Trondheim to stay an attractive city for living, socializing, and working. In 2019 the population of Trondheim was 195 000, and it is expected to be around 250 000 people in 2050. Therefore, the municipality will have a chance to develop a city for people of all ages and with different functional impairments.



*Figure 5-1: Maps of Trondheim showing the city's demarcation area for the urban development project till 2050. (Trondheim Kommune, 2019, p. 22)*

One of the important goals for Trondheim's urban development is the "zero-growth goal", which involves taking measures to avoid an increase in passenger-car usage (Trondheim Kommune, 2019). These measures include improving public transport and active mobility practicability. Areas for parking can be removed to make driving less convenient. With the addition of practical public transport and reduction of ticket prices, the traffic can be reduced substantially. An idea for increasing active mobility is to reduce travelling distance. By placing enough daily used facilities in different neighbourhoods, the appeal for cycling or walking may increase. Preferably, the "zero-growth goal" outcome will be a reduction of CO<sub>2</sub> emissions, noise and air pollution, area for car parking, traffic jams, and traffic accidents.



Spatial planners and transport planners have a common goal to create a more diverse and exciting city (Trondheim Kommune, 2019). They want Trondheim to be a city with enjoyable city life and improved quality of city space. To achieve their goals, they've formulated two necessary measures. The first one is to create "a city for the people", which means considering what makes a happy living for people. The second measure is to further develop the city and strengthen the existing city structure.

### **A city for the people - A city on eye level**

It is sustainable to create an attractive city for the people. A city should have practical arrangements for public transport and active mobility (Trondheim Kommune, 2019). To care for every resident, the design of the city should accommodate everyone by working on accessibility for the functionally impaired in the early phases of construction projects. A city can be made exciting for the people, by caring for the quality of streets, squares, social places, blue-green structures, facilities, and building facades.

### **The strengthening of urban structure**

The existing urban structure in the city of Trondheim consists of the city centre, main roads for public transport, paths for walking and cycling, and green areas (Trondheim Kommune, 2019). The plan for urban development involves increasing active mobility, by improving the existing network of public transportation. The municipality also wants to further develop important areas with history, culture, and the essence of Trondheim, to keep the city's strengths during urban development. They also want to prioritize improving connections between local centres by constructing more social areas like squares and parks and implementing interesting facilities along main road connections. One of the objectives forward should be to adapt and further develop existing structures in the city.

## 5.2 Planning for walkability

*This chapter is brought over from the student's pre-study written autumn 2022: Elgeseter Gate – A feasibility study with prioritization of pedestrians, placemaking and social neighbourhood (Hals, 2022).*

The municipality in Trondheim has a goal to make more people travel by walking since it's good for the environment, and health, while it encourages social interactions (Paulsen, et al., 2020). Elgeseter Street has a big potential for walking and increasing the number of pedestrians can make the street more attractive, alive, and safer. Road planning for pedestrians only focuses on traffic safety and accessibility, therefore has the municipality made a Guide for Planning Public Spaces which also prioritizes a road's appeal and safety. The pedestrian lane network can be improved by upgrading the existing connection, creating new effective ones, and creating pleasant surroundings. Therefore, Trondheim municipality has developed four main values for the planning of sidewalks; that it is accessible, safe, comfortable, and attractive.

### **Availability and accessibility**

An available road is a road that physically connects two destinations while it is usable by all people (Paulsen, et al., 2020). That means that there must be enough space and a practical slope. In addition, a road needs to be mentally available in a way that makes it easy to orient in the area. These criteria should be met all year round in all weathers, without any physical obstacles or other problems that can cause time-consuming travel.

Accessibility is about making a road accessible for all people (Paulsen, et al., 2020). sidewalks should have slopes that consider physically impaired people in wheelchairs. Additionally, the sidewalks should be sufficiently wide to accommodate the walking traffic in the area, and the space for snow, seating areas, entrances, and such should be taken into account. The seating areas will benefit children, the elderly, and people who might have difficulty walking long stretches at a time. An accessible sidewalk should also have good lighting to make it more accessible during the darker times of the day.

### **Safety**

A safe road is a road that secures users from traffic accidents, violence, and crime (Paulsen, et al., 2020). These are criteria that don't have specific solutions, and it can be discussed how different cases should be solved. A way to avoid accidents is to separate car lanes from the sidewalks, although that might make the users less observant in dangerous situations. Environments, where there are a lot of people walking, will automatically feel safer. Good lighting conditions and a dense network of walking paths can also contribute to the feeling of security. The safety along trafficked roads is also affected by the speed of cars, especially when crossing. Therefore, the speed and the need for traffic lights should be considered when designing a road.

### **Comfort**

A walk is considered comfortable when the road is protected from certain weather, air pollution, and noise pollution (Paulsen, et al., 2020). There should also be some interesting features along the way, as well as facilities that offer experiences, and seating areas that welcome people to stay. The width and slope of the road can also affect the experience, and it is important that the road has no obstacles along the way. Safety will also have a positive effect on the comfort of a walk.

## Attractiveness

Greenery, aesthetic facades, cultural qualities, and social spaces contribute to the attractiveness of a road (Paulsen, et al., 2020). A dense network of walkways gives pedestrians several choices of paths, which can be attractive in the sense that people can choose what to experience and add some variation. Paths that connect meeting areas like parks, cafés, and squares can be seen as attractive, especially when combined with interesting facilities on the first floors of buildings.

An example of an area with all the conditions above is Bakklandet in Trondheim, which is photographed in Figure 5-2. This area has many times been nominated by the municipality as the most attractive city space in Trondheim. (Paulsen, et al., 2020)



Figure 5-2: A photo of Bakklandet in Trondheim. Photo by EspeN-ikon© (Bakklandet.info, 2011)

### 5.3 Demolition or preservation of Elgeseter Street 4, 6, and 30B

It was decided in 2016 that the four main roads in Trondheim – Elgeseter Street, Innherredsveien, Kongens Gate and Olav Tryggvasons Gate – will be rebuilt to accommodate the implementation of metro buses in the city (Trøndelag Fylkeskommune, 2020). Since then, there has been a great deal of discussion about whether the buildings in Elgeseter Street 4, 6, and 30 B should be demolished or preserved, see Figure 5-3 and Figure 5-4. This will affect the area regulation around Elgeseter Street, which sets the framework for the new street design.



Figure 5-3: Photo of Elgeseter Street 4 and 6.  
(Google Street View, 2022)



Figure 5-4: Photo of Elgeseter Street 30B.  
(Fortidsminneforeningen, 2020)

#### **The antiquarian values of Elgeseter Street 4, 6, and 30B**

The railway in Elgeseter Street was in the 1880s moved to the west of the river (Trøndelag Fylkeskommune, 2020). This allowed the city of Trondheim to expand further south, which initiated the construction of St. Olav's Hospital and NTH (now known as NTNU) Gløshaugen campus. Elgeseter Street 6 was built in 1908 while 4 and 30B were constructed in 1911, right before the tram was added in 1913. These three buildings were all completed in the art nouveau architecture style, which has given them architectural and historical value. Elgeseter Street 4 and 6 are classified in protection class C, while 30B is in protection class B – high antiquarian value.

These three buildings are well preserved and consist of the original elements from their time (Trøndelag Fylkeskommune, 2020). Elgeseter Street 30B has kept the original shape, windows, balconies, and corner details. Right outside 30B, there are two stumbling stones on the sidewalk after Mathilde and Jac Maliniak who lived here before they were deported during the second world war. The history and authenticity are what give Elgeseter Street 30B its high antiquarian value.

#### **The conditions of Elgeseter Street 4, 6, and 30B**

Norconsult went to inspect the buildings in 2018 and evaluated the recent state of Elgeseter Street 4, 6, and 30B (Trøndelag Fylkeskommune, 2020). Their summary states that the buildings have stood cold and empty for a long time, which has caused substantial air humidity indoors and in the basement walls. The lack of maintenance over the last few years is evident and all three buildings are in need of rehabilitation and modernization. From experience, renovations of robust buildings from the pre-war era, like these, should be feasible. Since the placement of the buildings is quite central in the city of Trondheim, the first floors are regulated for businesses while the rest above are for residential use. If the buildings were demolished, the excess space by Elgeseter Street 30B won't have much potential (Trøndelag Fylkeskommune, 2020). However, the space by Elgeseter Street 4 and 6 can be utilized for more greenery and outdoor social areas.

## 5.4 Carsharing in the Trondheim region

Carsharing has become increasingly popular in both Norway and other countries (Norconsult, 2023). The purpose of implementing car sharing is to reduce the number of personally owned cars and thereby cut down the need for parking spaces. Another benefit is the reduction of people driving cars in general. Trøndelag Fylkeskommune has encouraged Norconsult to map out and describe how carsharing in the Trondheim region can work and find out how one can reduce the number of cars in households.

Norconsult has provided input on carsharing and concluded that it is an implementation that promotes innovation and technology with many benefits (Norconsult, 2023). It is a new market that has not been widespread yet, which means that it might take time for people to get used to carsharing and for it to have a positive impact on traffic and the environment. Carsharing would have to work differently in different areas depending on how dense the traffic is and how many people in the area own cars.

It is favourable to have two-way-carsharing, which means picking up and deliver the car in the same spot (Norconsult, 2023). This way the cars won't interfere much with public transport and it is overall cheaper than letting people drive the cars more freely. It is possible to explore other alternatives, but it is important to evaluate the economic risk and the amount of interference with public transport. Two-way-carsharing is however not practical for getting to and from work, as the car has to be delivered to the same spot it was taken from. If people were driving these cars home, personnel would have to go get them back to an area with higher demand. Two-way-carsharing is the standard way of implementing carsharing, and other alternatives have often been decommissioned because of low profitability.

With fewer parking areas in the city centre, less people will have the opportunity to own cars (Norconsult, 2023). This can lead to people moving out of the city when they feel the need to get a car, which can lower the attractiveness of living in the city. Implementing more carsharing parking spots in the city centre can have an effect on the welfare and avoid people getting pushed out of the city. It might also create more diversity in residents as families can live more centrally and still have access to cars.

Carsharing can also be beneficial for the environment by having electrical cars (Norconsult, 2023). Some people might have chosen to drive petrol cars because of the lack of charging stations in their apartment complexes. Making people switch over to carsharing with electrical cars will therefore help reduce emissions as well. As cars used for carsharing will have shorter life span than personal cars, they will more frequently be switched out for the newer and better environmentally friendly models. This is another reason for betting on the implementation of carsharing.

In Trondheim it is possible for their public transport corporation – AtB – to coordinate and promote the addition of carsharing (Norconsult, 2023). They can add it as an option in their travel planner, as well as manage the cost. Making carsharing more accessible will help make people more familiar with the concept and thereby use it more.

## 5.5 Accessibility in street design

When working on new road and street designs, it is important for Statens Vegvesen to make them accessible for all people no matter what functional ability (Statens Vegvesen, u.d.). On their websites, they have gathered good examples of accessibility in street designs.

### Streets, parks and city areas

One way to create an accessible street is to clearly separate sidewalks from cars and mark areas of danger with contrast (Statens Vegvesen, u.d.). Figure 5-5 to Figure 5-8 below show a street in Andenes where they've used darker materials of quality for vehicle lanes and sidewalks with a lighter-coloured curb to signal the separation. This sidewalk also has lighter lines across driveways where cars need to cross the sidewalk. It is important for these visual markings to be of high contrast as they should be clearly visible to have an effect. The street also has dividers with greenery like grass and trees to soften up the street and increase its quality. Some crossings are designed with ramps in the vehicle lane, bringing the road up to sidewalk level, see Figure 5-8. This will help wheelchair user cross, as well as people travelling with strollers or other wheeled objects.

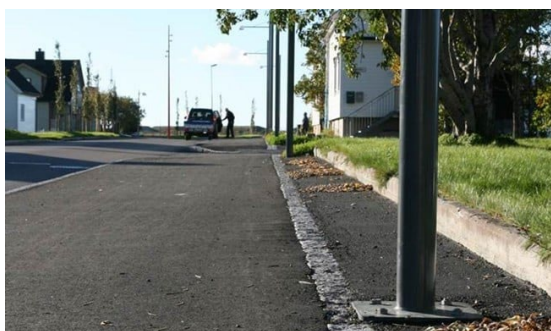


Figure 5-5: First photo of street in Andenes showing the contrast between asphalt and lighter curbs. (Statens Vegvesen, u.d.)



Figure 5-6: Second photo of street in Andenes showing green dividers and smooth transition. (Statens Vegvesen, u.d.)



Figure 5-7: Third photo of street in Andenes showing lighter lines across sidewalks to mark driveways. (Statens Vegvesen, u.d.)



Figure 5-8: Fourth photo of street in Andenes showing ramps up to sidewalk-level by crosswalks. (Statens Vegvesen, u.d.)

Another street in Hamar does also have some good examples of accessibility in street design, see Figure 5-9 to Figure 5-12 (Statens Vegvesen, u.d.). The sidewalks have textured markings in darker colours, to help the visually impaired navigate on the sidewalk and across the street. At dark there is sufficient lighting, and in some areas, the sidewalks are completely separated from the road. Outdoor seating areas are placed near the street, and bus stations are constructed with cover to shelter from the weather. By entrances that are elevated, there are ramps to make them accessible for wheelchair users.



Figure 5-9: First photo of street in Hamar showing markings on sidewalks for the visually impaired. (Statens Vegvesen, u.d.)



Figure 5-10: Second photo of street in Hamar showing nearby seating areas. (Statens Vegvesen, u.d.)



Figure 5-11: Third photo of street in Hamar showing sheltered bus stop. (Statens Vegvesen, u.d.)



Figure 5-12: Fourth photo of street in Hamar showing ramps by elevated entrances. (Statens Vegvesen, u.d.)

## Bus stops

There are several implementations that can help make a bus stop more accessible (Statens Vegvesen, u.d.). There should always be shelter for people who are waiting, and if there is bicycle parking nearby then that can be sheltered as well, see Figure 5-13. You can also add markings on the ground that help the visually impaired recognize where the curb by the bus stop is and where the doors on the bus usually end up, see Figure 5-14.



Figure 5-13: Photo of sheltered bus station and bicycle parking. (Statens Vegvesen, u.d.)

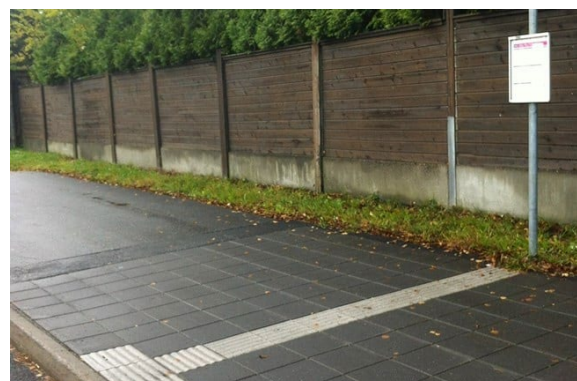


Figure 5-14: Photo of markings by bus stations for the visually impaired. (Statens Vegvesen, u.d.)

## 5.6 Pocket parks for people

In an attempt to gather information about how pocket parks should be designed, students from Oslo University College were shown 74 pictures of urban parks and asked to assess their value (Nordh & Østby, 2013). The students were asked which parks they felt they could rest in and why, in addition to what activities they could imagine doing in the park and what elements made them think of the activities. The photos showed seventy-four different Scandinavian parks smaller than 3000 m<sup>2</sup>, with different amounts of vegetation and hard surfaces, see examples of photos in Figure 5-15 below. There were 58 students around the age of 29, where 89% of them were women.



*Figure 5-15: Example of photos of urban parks used in the study. (Nordh & Østby, 2013)*

The participants were asked to imagine going for a walk and needing rest, then they meant to rate the different photos based on that one scenario. The students were also asked to describe the components that contributed to a better rating, and these were grouped into 16 categories. The results are presented in a table in Figure 5-16.



The categories that contributed the most to high ratings on restoration likelihood. In the table the categories are presented in four sub groups: nature, design, surrounding and management.

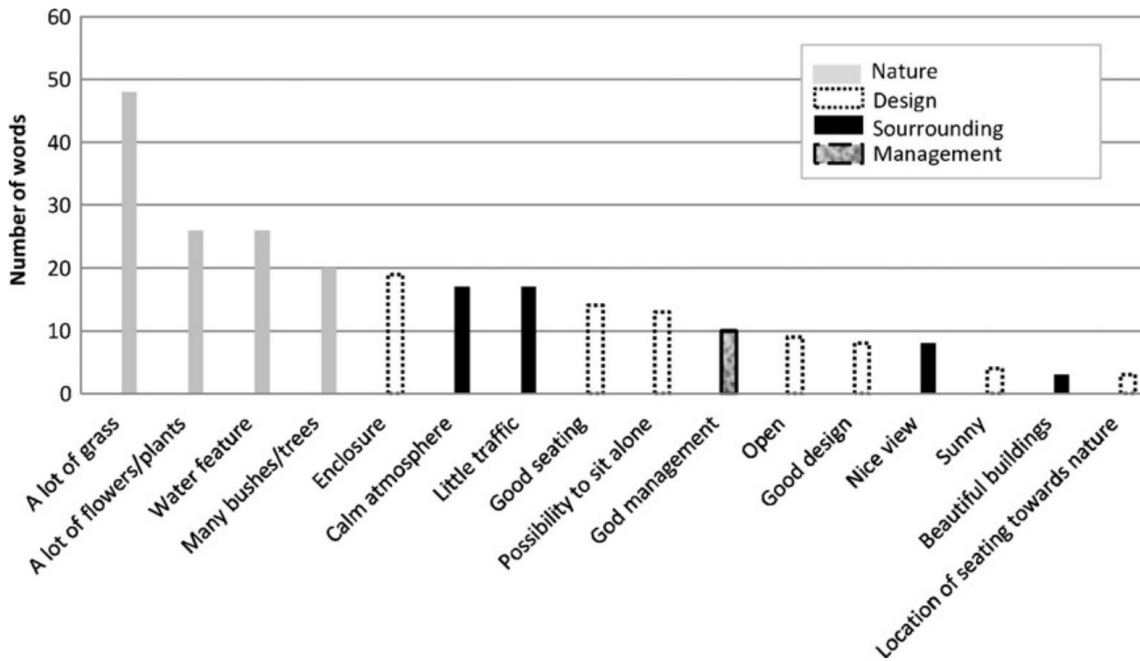


Figure 5-16: Results from asking students about what elements in parks were important for them to give a good rating base on the potential for relaxation in the park. (Nordh & Østby, 2013)

Out of the activities the students could imagine being performed in urban parks, the most mentioned were relaxing/philosophizing, reading/writing, and eating/drinking (Nordh & Østby, 2013). A few also mentioned activities like play, physical activity, socializing, sunbathing and listening to music.

The study concludes that vegetation such as grass, trees, bushes, and flowers are highly valuable qualities in a pocket park (Nordh & Østby, 2013). Additionally, it has become clear how surroundings and enclosure can improve the experience in the park. The results show the importance of urban parks and how they can offer restoration, seating, and a number of social activities. It is essential that planners and landscape architects incorporate pocket parks in the expansion of cities.

## 5.7 Findings from commuters on Elgeseter Street

In spring 2022, Mahgol Afshari from the Department of Civil and Environmental Engineering at NTNU set up a stand with 8 photos and asked commuters in Elgeseter Street what photos they liked the most (Afshari, 2022). The photos were depicting several types of parks and stores that were incorporated into street designs. Each person was asked to point out their two favourites, and the three most popular photos are shown in Figure 5-17, Figure 5-18 and Figure 5-19.

The results show that people would prefer to have businesses like restaurants, cafés, and stores on street level along Elgeseter Street. Furthermore, they would prefer to have the sidewalks separated and pushed back from the road, with the addition of greenery and outdoor seating options. The commuters were also positive about adding pocket parks placed a little further away from the road, with different types of seating, vegetation, and possibilities for activities.



Figure 5-17: First photo that was voted forward by commuters in Elgeseter Street. (Afshari, 2022)



Figure 5-18: Second photo that was voted forward by commuters in Elgeseter Street. (Afshari, 2022)



Figure 5-19: Third photo that was voted forward by commuters in Elgeseter Street. (Afshari, 2022)

## 6 Legal document study results

### 6.1 Planning Document for Elgeseter Street – 2018

*This chapter is brought over from the student's pre-study written autumn 2022: Elgeseter Gate – A feasibility study with prioritization of pedestrians, placemaking and social neighbourhood (Hals, 2022).*

Based on the "City environment agreement" from February 2<sup>nd</sup>, 2016, Elgeseter Street will be transformed to accommodate the new metro-busses in Trondheim (Trondheim Kommune, 2018). In 2018, it was decided that there should be planned detailed regulations for a centred bus lane, sided bus lanes and bus lanes moved to a parallel street westward. It was also mentioned that the street should be designed with facilities for bicycling, walking, city life, and shopping while keeping the historically significant elements along the street.

Premises from the municipality's planning document relevant to this study are:

- Elgeseter Street should be one of Trondheim's main streets of public transport.
- St. Olav's Hospital should be easily accessible, and the accessibility for emergency vehicles should be prioritized.
- Elgeseter Street should be an attractive road for walking, with safe crossings and practical connections between important destinations.
- The new design should be safe for all users of the road.

Social goals and effect goals relevant to this study are presented in Table 5-1 below.

*Table 6-1: Overview of the societal and effect goals relevant to the feasibility study.*

#### **SOCIETAL GOALS**

- The street project should strive to create an urban street and living environment while contributing to the increase of sustainable travelling.
- The street project should contribute to boosting the attractiveness of the city.
- The street project is an important project for the metro-buses in Trondheim, it should therefore be made good conditions for pedestrians and bicycles along the road.

#### **PROJECT SPECIFIC GOALS**

- Accessibility for emergency vehicles should be secured.
- The street project in Elgeseter Street should contribute to creating an attractive and lively city campus. The street project needs to be coordinated with the campus expansion project, to reach the goals set for the Trondheim city campus.

#### **EFFECT GOALS**

- There should be an improvement in accessibility, availability, and attractiveness for pedestrians, cyclists, and users of public transport.
- Pedestrians, cyclists, and public transport should be prioritized over cars, to help reach the "zero growth goal".
- Preserve the accessibility for public transport, delivery of goods, and emergency vehicles.
- Reduce the road barrier effect between the neighbourhoods on each side.
- Facilitate more life on the street, better living, and a city environment along the road.
- Make sure to keep the historically significant elements along Elgeseter Street and use them as resources.
- Facilitate sustainable travelling methods.
- Improve the street's environmental conditions (noise, dust, surface water, local climate).

## Important issues

The list below contains important issues in the Elgeseter Street project that are relevant to this study (Trondheim Kommune, 2018):

- How to solve the conflicts between goals for city life, living environment, cultural monuments, users of the road, accessibility, and availability.
- How to prioritize between cars, public transport, cyclists, and pedestrians when designing a road in a narrow space.
- How to create more street life, increase safety, and reduce noise.
- The consequences of keeping buildings with cultural value; Elgeseter Street 4, 6, and 30b.
- How to secure accessibility for cars when public transport is prioritized.
- How the space in front of Studentersamfundet can be transformed into an area with metro buses, space for pedestrians, accessibility for emergency vehicles, and accessibility to connecting streets.

## 6.2 N100 Road and Street Design

*This chapter is brought over from the student's pre-study written autumn 2022: Elgeseter Gate – A feasibility study with prioritization of pedestrians, placemaking and social neighbourhood (Hals, 2022).*

The handbook for road and street design in Norway is called N100 and applies to all public roads and streets (Statens vegvesen, 2022). It is written based on the traffic department's regulations in Road Law §13, and the most recent requirements were added on October 31<sup>st</sup>, 2022. Appendix 1 is a summary of all requirements relevant to the Elgeseter Street case, that will be used when working out the final street design. Requirements and suggestions for road bends are not included, as Elgeseter Street is a relatively straight road.

## 6.3 V120 Premises for Geometrical Design of Roads

*This chapter is brought over from the student's pre-study written autumn 2022: Elgeseter Gate – A feasibility study with prioritization of pedestrians, placemaking and social neighbourhood (Hals, 2022).*

The handbook with premises for the geometric design of roads is called V120 and applies to all public roads and streets in Norway (Statens Vegsesen, 2019). This handbook is the basis for the sight and alignment criteria in N100 and is used to design the centre line for roads. For this study, it is used to determine the necessary cross-section for Elgeseter Street.

From *Chapter 4: Cross-section* we see that straight road sections shall have a normal crown with straight line camber, and the slope shall be 3% (Statens Vegsesen, 2019, p. 41). In Figure 6-1, Figure 6-2, Figure 6-3, and Figure 6-4, you can see different suggested cross-sections that are suitable for Elgeseter Street, based on the requirements found in N100 and V120. These have a variety of widths depending on the addition of dividing grass lanes and where these can be placed. Since the area around Elgeseter Street varies in size, the road cross-section design can vary along the road.

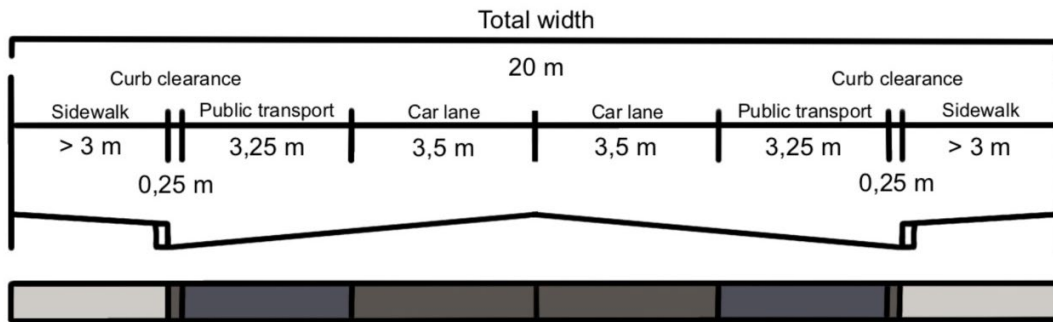


Figure 6-1: A suggested cross-section for Elgeseter Street, with car lanes, public transport lanes, and sidewalks. (Made by: Susanna Hsu Hals)

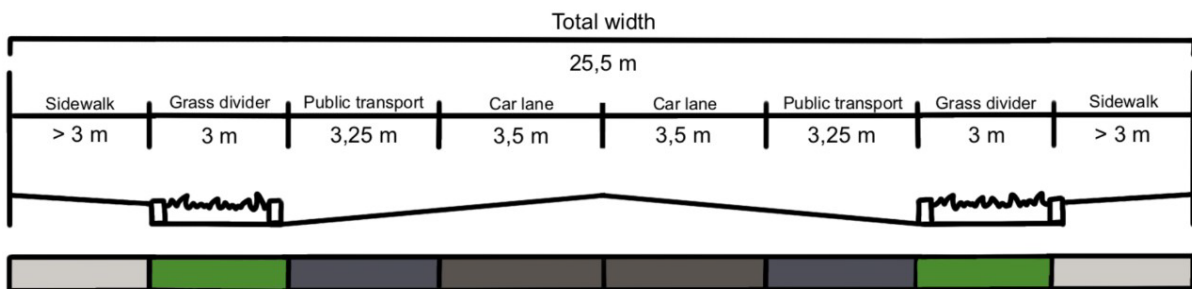


Figure 6-2: A Suggested cross-section for Elgeseter Street, with added grass dividers between the public transport lanes and sidewalks. (Made by: Susanna Hsu Hals)

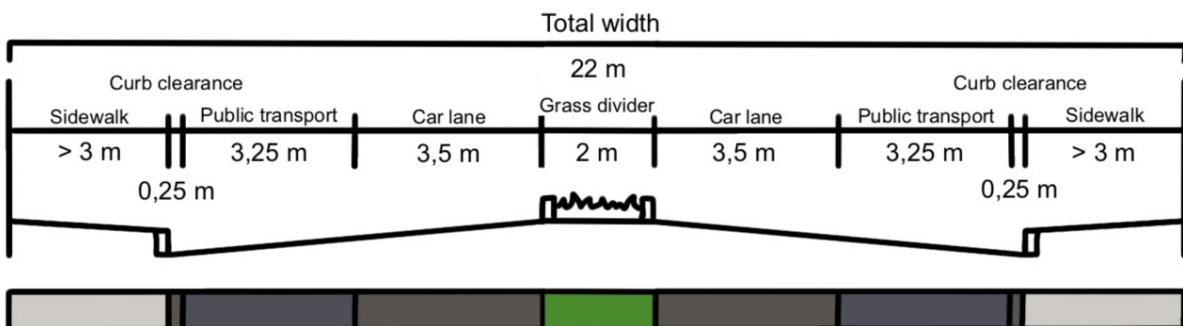


Figure 6-3: A suggested cross-section for Elgeseter Street, with a grass divider in the middle dividing the car lanes. (Made by: Susanna Hsu Hals)

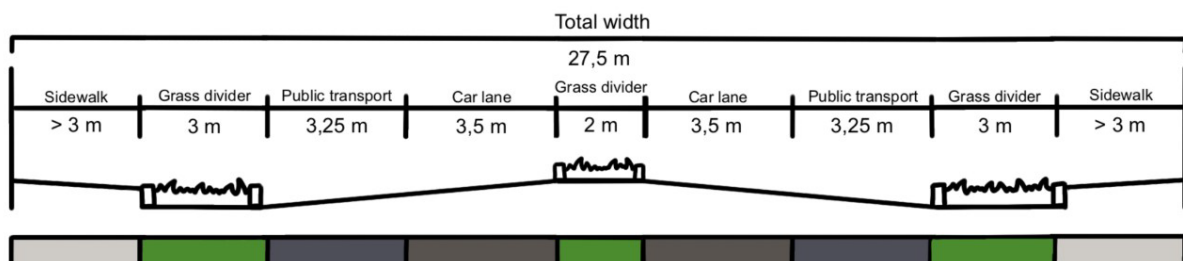


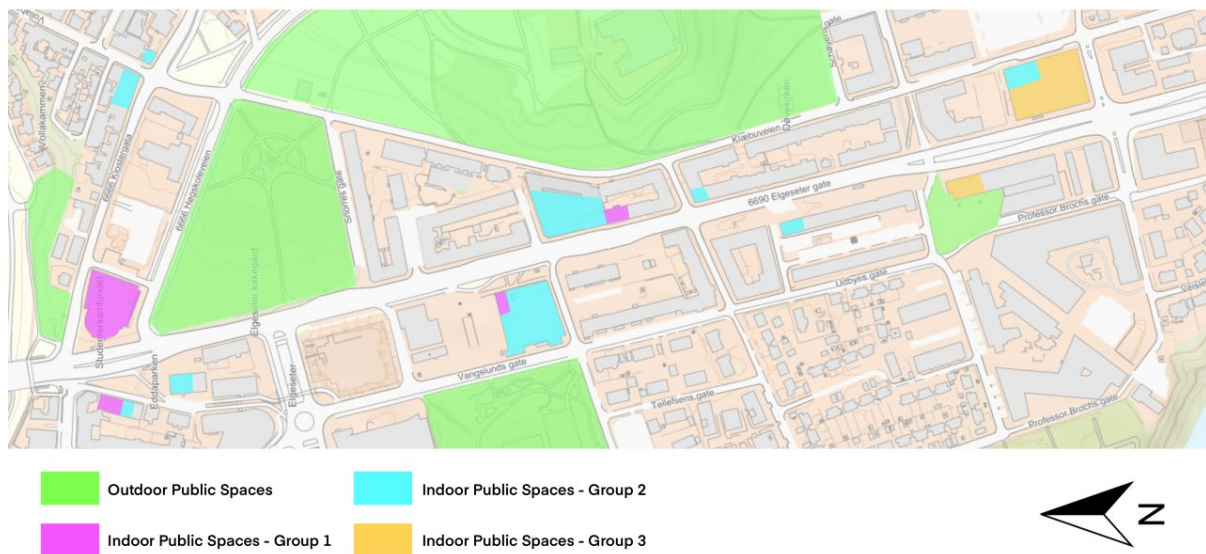
Figure 6-4: A suggested cross-section for Elgeseter Street, with grass dividers in the middle and separating sidewalks from traffic. (Made by: Susanna Hsu Hals)

# 7 Observational research

## 7.1 Social places on Elgeseter Street

*This chapter is brought over from the student's pre-study written autumn 2022: Elgeseter Gate – A feasibility study with prioritization of pedestrians, placemaking and social neighbourhood (Hals, 2022).*

Figure 7-1 below shows the different areas and facilities along Elgeseter Street. The outdoor social areas are highlighted in green, consisting mostly of parks and socially inviting public areas with seating. The social areas indoors are categorized into 3 groups highlighted in three different colours. The first group highlighted in pink represent social facilities where you can sit down and have something to eat or drink, such as cafes, restaurants, cafeterias, bars etc. And the second group of social facilities, highlighted in blue, include different types of stores where people can go shopping or buy themselves a treatment. These include hair salons, grocery stores, clothing shops and more. The last group highlighted in yellow include facilities with seating where people can gather and talk, work, and maybe arrange activities. Examples of facilities in this group are libraries and schools. The rest of the buildings that aren't highlighted represent apartment buildings, office buildings, and other various facilities.



*Figure 7-1: Map of Elgeseter Street highlighting the social spaces nearby. (Made by Susanna Hsu Hals based on maps from August 2022)*

Table 7-1 shows which facilities are within the three groups of indoor public spaces on Elgeseter Street. The table has colour codes that match the map in Figure 7-1.

Table 7-1: Social spaces indoors along Elgeseter Street, divided into three groups.

GROUP 1	GROUP 2		GROUP 3
<b>Studentersamfundet</b> <i>Building with bars, restaurants, cafés, stages, and clubs</i>	<b>Bunnpris Samfundet</b> <i>Grocery store</i>	<b>Elgeseter Mini Marked AS</b> <i>Speciality store</i>	<b>Bøker og Bylab</b> <i>Library</i>
<b>Dromedar</b> <i>Café</i>	<b>Pizzabakeren Nedre Singsaker</b> <i>Takeaway</i>	<b>Extra Elgeseter</b> <i>Grocery store</i>	<b>NTNU Handelshøyskolen</b> <i>School building</i>
<b>Smile Pizza Elgeseter</b> <i>Restaurant and Takeaway</i>	<b>Joker</b> <i>Convenience store</i>	<b>Møbeltapetserer Antonio Arenas AS</b> <i>Speciality store</i>	
<b>Lille Thailand Elgeseter Street</b> <i>Restaurant</i>	<b>7-Eleven</b> <i>Convenience store</i>	<b>Elgeseter Hårdesign AS</b> <i>Hair Salon</i>	
	<b>Bunnpris &amp; Gourmet Elgeseter</b> <i>Grocery store</i>	<b>Rema 1000 Elgeseter</b> <i>Grocery store</i>	

## 7.2 Accessibility in Elgeseter Street

*This chapter is brought over from the student's pre-study written autumn 2022: Elgeseter Gate – A feasibility study with prioritization of pedestrians, placemaking and social neighbourhood (Hals, 2022).*

When evaluating the accessibility of Elgeseter Street, the student focused on seeing if the street is accessible to all users. The road is pretty straight without any significant slopes, which makes it suitable for wheelchair users. However, the sidewalks are narrow and can make it difficult for a wheelchair user to turn and change direction. Many of the buildings along the road have stairs leading up to the main entrance, and without any ramps, it makes the building not fit for wheelchair users. In some areas of the sidewalks, the pavement is cracked and damaged, making the surface rough and uneven. This can make it less comfortable for wheelchair users, people with strollers, and other forms of travel using wheels on sidewalks.

The sidewalk in some areas is sloped downwards toward the car lanes, which leads the surface water away. However, if the slope is too steep, it can be a hazard in the winter when snow and ice are increasing the chance of slipping and falling. The narrow sidewalks combined with cyclists and electrical scooters can reduce space, and even cause accidents. The sidewalks and car lanes are not separated in any way, which makes them less safe for the users, especially the visually



impaired. The lack of contrast in facades combined with noise pollution can also create difficulties for the visually impaired.

### 7.3 Aesthetics in Elgeseter Street

*This chapter is brought over from the student's pre-study written autumn 2022: Elgeseter Gate – A feasibility study with prioritization of pedestrians, placemaking and social neighbourhood (Hals, 2022).*

An aesthetic environment can improve the experience of walking down a street, however, this is not the case for Elgeseter Street. Most of the buildings are old, grey, and run down. The road is wide, filled with traffic, and leaves little room for greenery. The only aesthetic elements are Høyskoleparken, the more colourful buildings around Studentersamfundet, and maybe the more recent buildings depending on taste and preferences. The styles of buildings vary between the old neoclassical architecture and new modern simplistic designs, creating a non-cohesive aesthetic along Elgeseter Street. Figure 7-2 and Figure 7-3 below are taken from Google Street View (August 2022) and show a couple of views of the road.



*Figure 7-2: Photo of Elgeseter Street taken at Elgeseter Street 13 facing south. (Google Streetview 2022)*

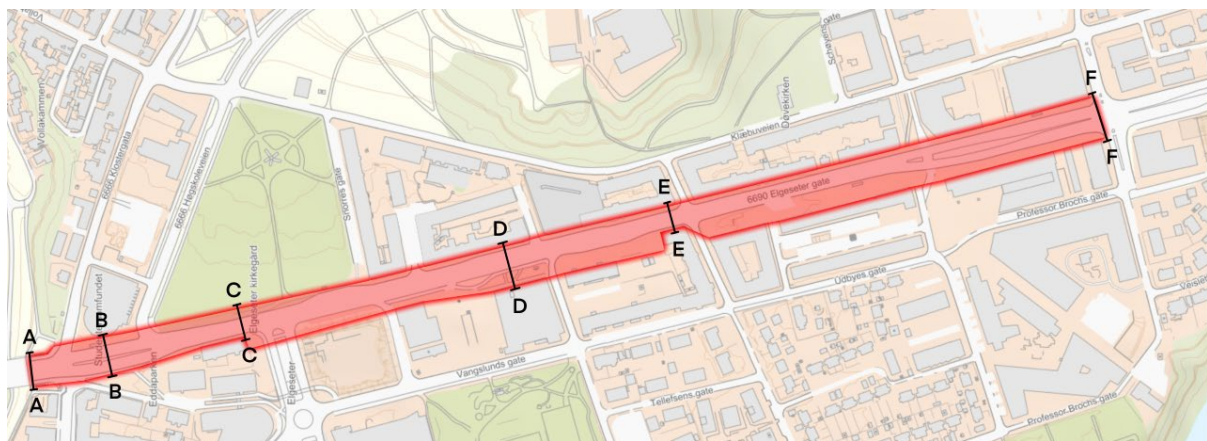


Figure 7-3: Photo of Elgeseter Street taken at Elgeseter Street 51 facing north. (Google Street View 2022)

## 7.4 Area restrictions for Elgeseter's street design

*This chapter is brought over from the student's pre-study written autumn 2022: Elgeseter Gate – A feasibility study with prioritization of pedestrians, placemaking and social neighbourhood (Hals, 2022).*

Elgeseter Street today varies in width, as it mostly has four lanes with a few exceptions where there are added left-turn lanes or a road verge. The area on each side also varies in width, with sidewalks, strips of grass, parking space, and bus stops. When creating a new road design, the usable area will be restricted by surrounding buildings and the edges of Høyskoleparken. Figure 7-4 below shows a map of Elgeseter Street with the area restriction highlighted, and the most wide and narrow widths are marked. These widths are approximately measured in Google Earth.



<b>A - A : 26 m</b>	<b>C - C : 21 m</b>	<b>E - E : 19 m</b>
<b>B - B : 31 m</b>	<b>D - D : 34 m</b>	<b>F - F : 33 m</b>



Figure 7-4: A map with area restriction for road design highlighted. The most wide and narrow widths are measured using Google Earth. (Made by Susanna Hsu Hals)

## 7.5 The toll system in the Trondheim region

The placement of tolls for cars in the Trondheim region can help determine which routes would be preferable to drive. The map in Figure 7-5 below shows the placements of tolls which are mostly located near the highway outside of the city centre.

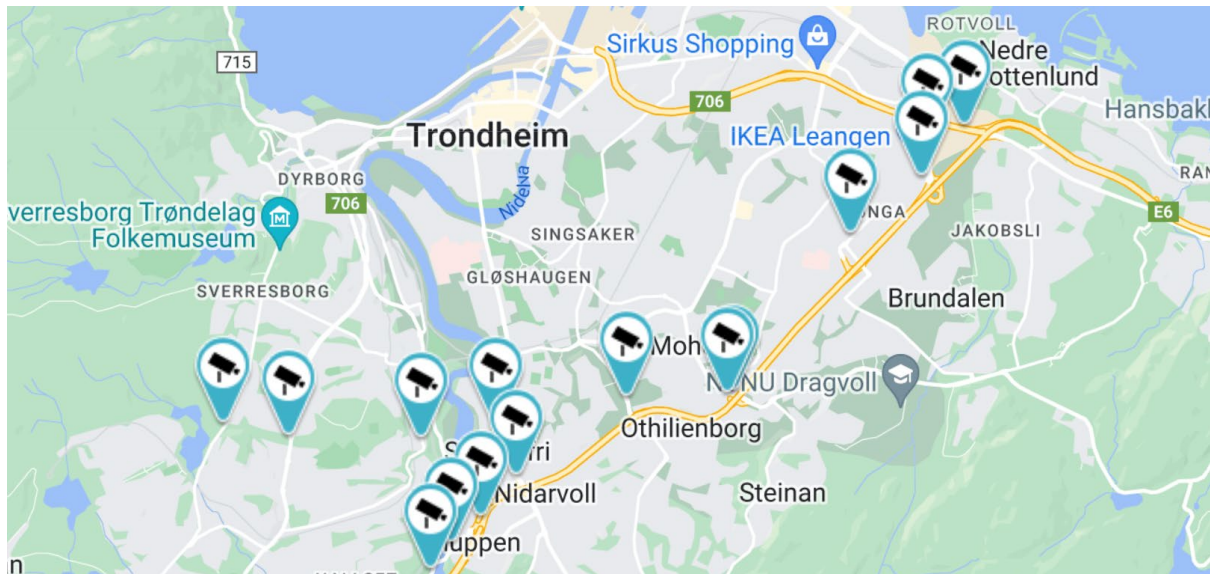


Figure 7-5: Map showing where tolls for cars are placed in the Trondheim region. (Vegamot, 2023)

## 7.6 Sun diagram

The sun diagram in Figure 7-6 below shows the path of Trondheim's sun during April, meaning it will be shorter in winter and longer in summer. Elgeseter Street stretches approximately from north to south, which means the eastern side will be sunny before midday and the western side after.

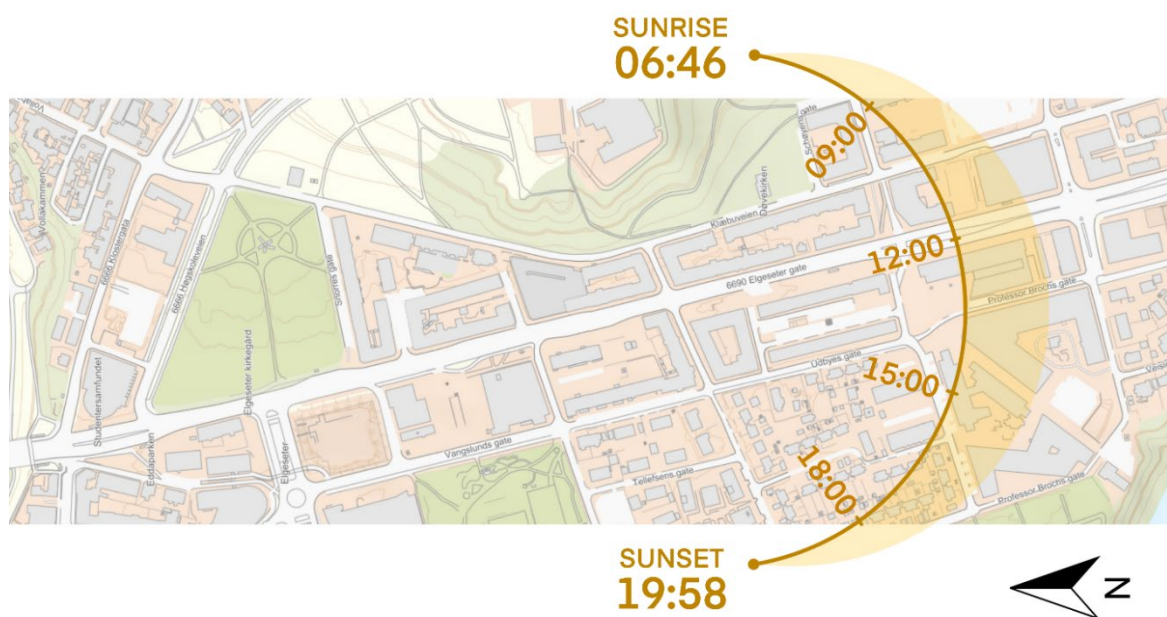


Figure 7-6: Map of Elgeseter Street showing the sun diagram for April. (Made by: Susanna Hsu Hals)

## 7.7 Colourful Facades in Trondheim

The Trondheim Palette was made by Kine Angelo including colours picked from colourful facades the city once was characterized by (Owren, 2021). As of today, several buildings have been restored and many new projects within the architecture and construction industry have started incorporating these colours on facades again. For inspiration, the student has gathered photos of old and new facades in Trondheim, see Figure 7-7 to Figure 7-12 below.



*Figure 7-7: Photo of Baklandet along Nidelven. (Wikimedia Commons, 2006)*



*Figure 7-8: Photo of Lerkendal studentby. (SIT, 2013)*



Figure 7-9: Photo of apartment buildings along Innherredsveien, Trondheim. (Photo by: Susanna Hsu Hals)



Figure 7-10: Photo of an apartment complex by Lademoen, Trondheim. (Photo by: Susanna Hsu Hals)



Figure 7-11: Photo of Trondheim central train station. (Wikimedia Commons, 2009)



*Figure 7-12: Photo of the residential street - Mellomila. (Google Street View, 2022)*

## 8 Interviews

This chapter contains the results from interviews conducted with working professionals within area management, road, and traffic. Interviewees from Trøndelag Fylkeskommune were targeted because of the county municipality's ownership of Elgeseter Street, and employee's familiarity with the Elgeseter case. The people working with landscape and architecture were interviewed for their knowledge of placemaking and socially attractive areas.

### 8.1 List of interviewees

TITLE	CORPORATION	INTERVIEW TOPIC
<b>Senior Advisor</b> Traffic and Mobility	Trøndelag Fylkeskommune	Road and Traffic
<b>Senior Engineer</b> Landscape Architect and Roads	Trøndelag Fylkeskommune	Road and Traffic
<b>Senior Engineer</b> Roads	Trøndelag Fylkeskommune	Road and Traffic
<b>Civil Architect</b> City Architecture	Trondheim Kommune	Area Management
<b>Landscape Architect</b>	Asplan Viak	Area Management

### 8.2 Key findings

#### 8.2.1 Alternatives from pre-study

The following alternatives presented in Figure 8-1 to Figure 8-5 are alternatives the student made in a pre-study for a new design of Elgeseter Street. The first three figures show different amounts of greenery added to the street design, while the last two figures illustrate having public transport lanes on the side and in the middle of the street. These alternatives were presented to the interviewees, and they were asked which alternatives they preferred and what challenges and benefits can come with them. The results from their answers and comments are included in the next chapters with key findings.

### Alternatives showing different amounts of greenery

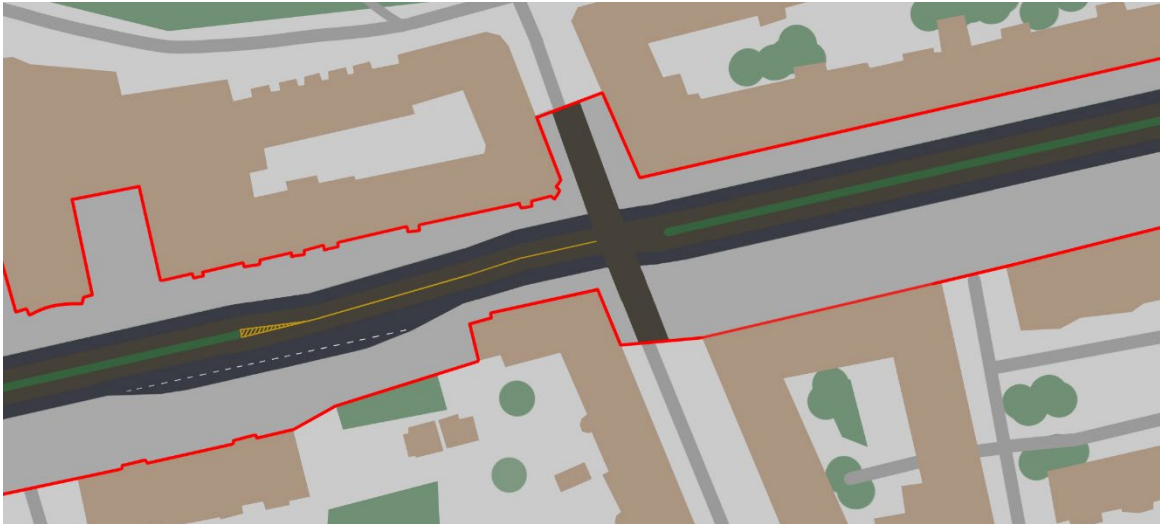


Figure 8-1: Only green dividers in the middle. (Made by: Susanna Hsu Hals)



Figure 8-2: Green dividers in the middle and between the road and sidewalk. (Made by: Susanna Hsu Hals)



Figure 8-3: Green dividers and green areas on the sidewalk. (Made by: Susanna Hsu Hals)



## Alternatives showing placements of public transport lanes



Figure 8-4: Public transport lanes in the middle of the road. (Made by: Susanna Hsu Hals)

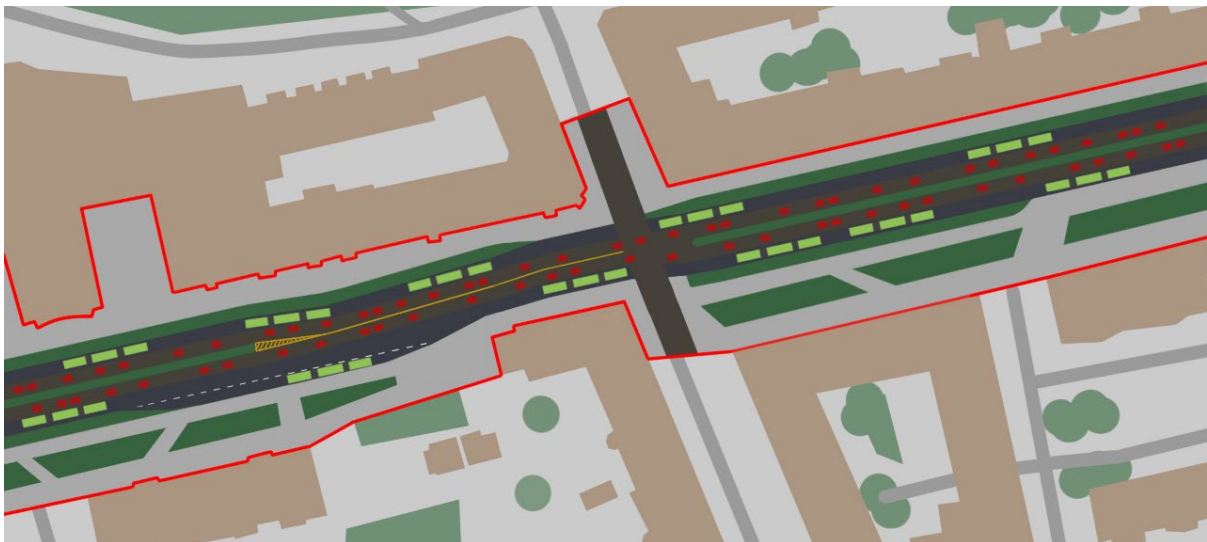


Figure 8-5: Public transport lanes on the sides. (Made by: Susanna Hsu Hals)

### 8.2.2 General priorities in the Elgeseter district

When creating a road design, it is important to prioritize people and elements that are specific to the area. In Elgeseter Street it is necessary to keep in mind St. Olav's Hospital, as it needs to be accessible for all kinds of travellers. One should also think about all the students that come to the area because of NTNU's Gløshaugen campus. There are also residents of all ages in the Elgeseter district, which means that the road design should be made for families, the elderly, students, as well as people working in the area. There is also the goal to transform Elgeseter into an innovation district, which should be kept in mind when creating a new road design.

There should in general be a priority to keep a good balance between accessibility for vehicles along the street and the pedestrians across. The number of crosswalks and their placement should reflect what type of traveller is prioritized in the street. In the case of street design, you often have to choose between the prioritization of public transport or pedestrians.

## **8.2.3 Road and traffic**

### **Placement of bus lanes**

When designing a road with public transport lanes, you can choose to have them centred or on the sides along sidewalks. The different placements provide various benefits for each type of traveller, and the choice of placement will depend on whom you want to prioritize when creating a road design.

Having centred bus lanes is the most beneficial choice if public transport is prioritized. This solution creates an effective travelling path for buses, that doesn't have to consider the roads that connect to Elgeseter Street. Centred bus lanes will therefore be more effective the longer the stretch is, and for this case, starting the centred bus lanes by Sluppen or further south would probably be a big improvement for public transport. Having bus stops placed between vehicle lanes will also create the need for dividers that create a smooth transition before and after the stops. These dividers can be used to add interesting elements and greenery in the street, which can help slow down the traffic as cars tend to drive more carefully when taller elements in the street are close. However, the necessity for dividers will increase the minimum needed width for road design, which can cause problems in areas that are narrow. In Elgeseter Street, several buildings with antiquarian value will have to be removed to make enough room for centred bus lanes. This solution is therefore less likely to be approved by the city antiquarian and might be less realistic for Elgeseter Street. Making people cross a car lane to get to bus stops might slow cars down, however, it will reduce the safety for pedestrians who would suffer the most if a collision happened.

Having bus lanes on the side with bus stops connected to the sidewalks is a safer solution for pedestrians. It is more area efficient and can also create more social activity as people tend to gather at bus stops. This will have a positive impact on the street environment and add more life to the area. The extra space will allow more room for dividers that can separate sidewalks from vehicle lanes. There is a lot of traffic along Elgeseter Street and keeping the traffic in the middle as far away from the pedestrians as possible will improve the pedestrian's safety and feeling of security.

### **Dividers between lanes**

Certain parts of Elgeseter Street are quite wide, and there is therefore enough room to add dividers if appropriate. Dividers can break up the asphalt to make the street more interesting, and wider dividers can even be used to add greenery. Taller dividers can make the vehicle lanes seem narrower, which can help slow traffic down along the street. They can also help to separate pedestrians from vehicles and thereby improve traffic safety. The downside to dividers in this area is the accessibility of emergency vehicles. Elgeseter Street is located near St. Olav's Hospital, which needs to be accessible to everyone. Ambulances prefer having wide streets without dividers, as it allows them to drive more freely and cross whatever lanes they want depending on traffic. If choosing to have dividers along Elgeseter Street, it is therefore important to consider the placement and height. Dividers in the middle of the street are more inconvenient for emergency vehicles compared to dividers along sidewalks. Having lower dividers that can be driven over can also help make the road more accessible for emergency vehicles.

### **Removal of parking areas**

Reducing the number of parking areas along Elgeseter Street will make more room for pedestrians to walk while it also allows the opportunity for businesses along the street to have elements like seating and signs outside. The extra space can also be used to add seating areas outside and pocket parks. Removing parking spaces will make the area less attractive for cars, which is beneficial as there is an environmental goal to reduce the number of private cars. For the people living in the Elgeseter district, a replacement for the removed parking could be larger private parking garages underground. However, as private cars stand unused most of the time, implementing some sort of car-sharing system that use fewer parking spaces could help replace the need for parking.

### **Underground crossings**

Making underground crossings available for pedestrians can help them cross Elgeseter Street will increase their safety and also remove the waiting time people deal with today. However, these crossings will only be effective if the crosswalks on the road are removed. When there are several options for crossing, people tend to choose the fastest and shortest way regardless of safety. Underground crossings force people to use stairs and walk longer, which is most likely less tempting than running across. Removing crosswalks will help traffic flow and eliminate an element that vehicles need to be aware of. This can improve traffic safety but also cause drivers to be less observant. The pedestrian traffic flow across the street is important to prioritize if walking is encouraged, and removing crosswalks means that each one would have to be replaced by an underground crossing. These will take up a lot of space, especially when they have ramps to make them accessible to wheelchair users. There might not be enough room in Elgeseter Street to have all these underground crossings at all.

Having an underground crossing will also have a negative impact on the social life on the street. People are the ones that create life, and they need to be able to move more freely and visibly across the street to maintain a lively atmosphere. As of today, there is only one underground crossing on Elgeseter Street that is located under the bridge by Studentersamfundet. This crossing can be interesting to take a look at and improve, as it is already located in a crowded area with many different types of travellers crossing in all directions.

### **Reduction of noise and air pollution**

There are several measures that can be taken to lower the noise and air pollution on Elgeseter Street, depending on how realistic the street design should be. With no limitations, the most effective solution would be to put the entire road in a tunnel and immediately erase the problem. But when discussing solutions in a more realistic manner, economy and politics are usually deciding the framework for a project. Elgeseter Street is located near a river, which makes it risky to dig far down. If any solutions would need buildings removed, that would both be more expensive and cause political problems, as many buildings along Elgeseter Street should be preserved.

Most of the noise created by traffic is caused by wheels against the asphalt, and fortunately with electric vehicles, this problem is slowly being solved over time. There is also a possibility to lower the vehicle lanes so that the noise can be bounced off the taller dividers, while the source of noise

is also moved further away from the sidewalk. This kind of solution would need special lowered bus stops and crossings on bridges over the road.

Another way to tackle the problem is to reduce the number of cars travelling through Elgeseter Street. The most drastic way to achieve this is to create a car-free city centre that bans private cars from Elgeseter Street. This causes problems with private cars' accessibility to the hospital, which makes it necessary to create effective alternative routes. This might be a more fitting solution in the future when there hopefully are fewer cars. It could however be possible to make Elgeseter Street only available to electric vehicles, as they emit less pollution and since we already have the environmentally friendly metro buses.

Something else that can reduce traffic on Elgeseter Street is to make it less pleasant to drive through. There are effective roads and tunnels outside the city, that can handle a lot more traffic, and making Elgeseter Street less tempting can make people choose alternative routes. The toll system in Trondheim today makes it cheaper for some routes to drive through the city centre via Elgeseter Street than to drive around. If the toll system is changed to make the street more expensive, private cars would probably choose to take alternative routes. It is also possible to lower the speed limit, which would reduce noise pollution and lessen the traffic effectiveness by making the route through the city centre take longer.

There are also simpler measures that can be taken to reduce noise in a street. Noise can be reduced and cancelled out by reflecting off rougher surfaces. The addition of trees and foliage can therefore be helpful even though it cannot remove the noise entirely. Having trees and bushes as dividers can also have a mental effect on people and make them less observant of the cause of noise that they can't see. Rough surfaces can also be introduced in road design by having rugged natural stone dividers and maybe even rougher textures on facades. A creative way to reduce noise can also be to have roads made from materials or slabs that can muffle the noise.

### **Reducing the number of cyclists**

To increase safety for pedestrians it will be beneficial to reduce the number of cyclists biking on the sidewalks. Experienced cyclists in Trondheim should already know about the bicycle lanes on each of the streets parallel to Elgeseter Street, and bikers in general will usually choose to avoid pedestrians as they don't want to be slowed down. Making the bicycle lanes more attractive and accessible can help attract more bikers and making them more visible from Elgeseter Street can show less experienced bikers a better alternative to the sidewalk.

To make bicycle lanes more practical, they need to cover longer stretches and be connected all over the city. Visibility and readability are also important to attract bikers and make sure they use the space dedicated to them. It will be beneficial to clearly mark the bicycle lanes, whether it is using colours, signs, or shapes.

It is also possible for bikers to share the sidewalk on the pedestrians' terms if the sidewalk is wide enough. Different types of travellers often fight for space on streets, and it is important to recognize that cycling on sidewalks might be safer for children compared to cycling next to cars.

## **8.2.4 Area management and social aspects**

### **Increasing social activity**

To make Elgeseter Street seem less empty it is necessary to increase the social activity in the area, and there are several measures that should be taken to achieve that. The number one problem to fix is probably noise pollution, as it makes it less pleasant to walk and socialize along the street. Lowering the speed limit would both help reduce noise and increase the feeling of safety on the sidewalk.

If possible, the width of sidewalks should be increased to make more room for socializing. Sidewalks should in general be wide enough for three people to walk alongside each other and should therefore be wider than the minimum criteria in Trondheim municipality which is 2,5 meters. Wide sidewalks give the opportunity to add more interesting elements that can make the walk feel shorter. The extra space should also be utilized to add outside seating whether it is connected to a pocket park, restaurant, or café. Greenery should also be incorporated as it can help make an area more enjoyable. Big open spaces can make people feel lost and confused, which makes it beneficial to create smaller pockets for socializing along a sidewalk to make it more interesting.

Focusing on making the city pleasant on eye level is important to attract pedestrians to Elgeseter Street. When creating social areas on a smaller scale it is important to choose good materials that help create a pleasant atmosphere. These materials can vary between greenery, stone, wood etc. and prioritizing good quality and aesthetics will help to level up the area and increase value. The material choice is usually limited by economics; however, you can increase the quality quite a lot without using the most expensive materials.

Another way to make sidewalks more interesting and improve walkability is to avoid making them too linear and have varying widths instead. Linear sidewalks can make the walking distance feel longer and more boring. Varying the width will create more variation of visual elements along the street, while it also helps create smaller pockets where seating or greenery can be placed. Changing the centre line of Elgeseter Street and varying the widths of sidewalks along can also allow for more space on the east side of the road, which will get more sunlight throughout the day. It is preferable to walk or stay on the sunnier side of the street, so there should be added social areas along that side. Elgeseter Street is already placed further east, leaving a lot of space on the west side. Moving the centre line westbound will allow for the sidewalk to be wider on both sides and give the opportunity to utilize the sidewalk space more efficiently for pedestrians.

Having some form of town square could also help increase social activity. The area outside Studentersamfundet is crowded with many different types of travellers, which makes it fitting to add more social areas both indoors and outdoors to make people stay in the area.

### **The addition of greenery**

Adding greenery to Elgeseter Street is a good way to make it seem less empty, especially in areas where there is extra space created by buildings being further back. Trees and other green elements can be used to divide the sidewalk into different zones that help make the area more interesting and attractive. The addition of greenery will help clean the air, reduce noise, and add more life to an area. The positive effect is both visual and psychological, and vegetation in street

design is therefore often used to improve the well-being and experience on a street. Trees can also be placed in front of less attractive facades to improve the overall impression of an area.

Adding areas or lanes of grass is not as effective as people might think, and a more fitting solution can be to have greenery elevated with stone borders that people can sit or play on. This type of design can also be used to create dividers and smaller squares along the sidewalk. When choosing what type of greenery to use it is important to consider the rough conditions in the street. There is a lot of air pollution and wind in the street, and in the winter the salt sprinkled in the streets will worsen the condition. It could also be beneficial to consider plants that are green in the winter as well, to make sure the greenery has a positive impact on Elgeseter Street all year around. To help greenery thrive it is also beneficial to have larger volumes of dirt connected instead of smaller beds placed sporadically.

Greenery is often used to improve the visuals in a street, however, there are more benefits that often can be overlooked. Areas and lanes of grass work as natural drainage for rainwater, which helps reduce the amount of water on vehicle lanes and sidewalks. In the winter, the green lanes can be used to store excess snow that is ploughed from the road.

### **Adding pocket parks**

Including pocket parks in street design is an efficient way to add both greenery and social spaces to an area. When designing these parks, it is important to make sure they are inviting and not misunderstood as private areas for people living in the neighbourhood. Pocket parks will need sufficient natural light, as it is important to keep the plants healthy and because people prefer to stay and socialize outside in sunnier areas. Fortunately, as Elgeseter Street stretches from north to south, both sides of the street will get direct sunlight throughout the day.

### **Trees as dividers**

Trees can both add greenery and be used as dividers in street designs. Planting larger trees in a row can create the impression of a dividing wall that can be used to separate lanes in the road or zones on a sidewalk. These kinds of dividers will add colour and life to an area, while also creating a sense of safety when it separates pedestrians from vehicles. They can also make vehicle lanes seem narrow by having taller obstacles close, which can make cars slow down and be more aware of their surroundings.

### **Adding restaurants, cafes, and stores**

When considering adding restaurants, cafes, and stores in an area, it is important to make sure the critical mass is sufficient in the neighbourhood. You need the population base for the businesses to have a purpose and make enough income for the placement to be worth it. Fortunately, because of the large neighbourhood and connection to the Gløshaugen campus, the Elgeseter area should have enough critical mass to suffice for the addition of social businesses on Elgeseter Street. Trondheim is a city that will expand, and the population in the Elgeseter district will only increase over time. It is therefore important to add qualities a street must have to make people want to walk and stay there. There should also be a priority to fight the traffic to make the street less rough and thereby attract more people.

There will probably not be a need for restaurants, cafes, and stores along the entire road, but rather a few here and there to make the road interesting. The few existing stores can be kept, and

some of the premises in the street today can be regulated for social businesses. Expanding social space from the street and into the first floors of buildings will help create an interesting city on eye level. In the case of Elgeseter Street, it is important to maintain the architecture of the buildings where the first floors are changed, especially if the buildings have antiquarian value. It is also beneficial to make the social businesses visible and inviting to the pedestrians, to make sure people know what the street has to offer. The choice of social businesses should also reflect the people who live and travel in the area, which means there should be added something for all ages.

### **Outdoor seating**

If traffic and noise are reduced in Elgeseter Street, the addition of outdoor seating will be fitting to increase the social activity in the area. Outdoor seating could be along the sidewalk, in pocket parks or connected to social businesses like restaurants and cafés. To make them more attractive, it could be beneficial to widen the sidewalk on the east side and place the seating there on the sidewalk that gets the most sun after midday. The sunnier side will be more attractive and should therefore have more interesting features. Outdoor seating areas can also be made into interesting spaces separated by trees and other greenery that is elevated. They should in addition have some type of cover in case there is a need for shadow or shelter.

There are several measures that can be taken to separate outdoor seating from traffic. Greenery can be used as dividers that can both muffle noise and block the view. What people experience as noise can depend on how visible the source is, which means that people often can ignore the traffic noise if the view of cars is obstructed by something nicer. Having seating areas elevated can also help separate pedestrians from vehicles, making them feel safer and further away.

### **Renovations of older buildings**

It is essential to renovate the older buildings along Elgeseter Street to make them less sad and unattractive. A way to initiate renovations is to make the street more socially attractive and convince the owners of the buildings of Elgeseter Street's makeover. Making the street more attractive will also increase the possibility of the first floor being rented out to more interesting businesses. There is a lot of beautiful architecture with great potential, and it would be beneficial to bring the buildings of antiquarian value back to their former glory. The addition of colours would also be very helpful to increase attractiveness, especially when Trondheim municipality already has a palette it wants to incorporate more in the city.

## 9 Discussion

With the urban development of Trondheim, there are plans to upgrade the four main roads for traffic in the city (Trondheim Kommune, 2019). Innherredsveien, Olav Tryggvasons Street, Kongens Street and Elgeseter Street are all being transformed to accommodate the addition of metro buses in Trondheim (Miljøpakken, n.d.). Elgeseter Street is today an old traffic focused street and has a lot of potential for becoming an efficient street with attractive qualities as well. With Trondheim municipality's (2019) zero-growth goal, the city aims to reduce the number of cars and the new design for Elgeseter Street should reflect that. Trondheim municipality wants to encourage more active mobility and attract more people to the area, while creating a design that preserves the elements with historical value as well (Trondheim Kommune, 2018). Even though Elgeseter Street is an important street for traffic, it is important to consider the neighbourhood and pedestrians travelling in the area. The removal of parking spaces along the street would allow for more space that can be utilized for improving the socializing and walking experience in the street. This study is therefore continuing the work from the student's pre-study, by answering the question: *What is a realistic and fitting solution for Elgeseter Street considering the social aspects and walkability?*

A handful of methods have been used to gather information about the city of Trondheim, Elgeseter Street, urban development, and street design. The collection of results has been used to find out *which implementations can make Elgeseter Street more social, and which make it more walkable*. These changes and additions are further discussed in this chapter and there are additionally added descriptive figures showing suggestions for a new street design the student has made using Computer Aided Drawing (CAD) and 3D-modelling. The full description of the final suggested design can be found in Appendix 5.

### 9.1 Changes and additions that will benefit social aspects

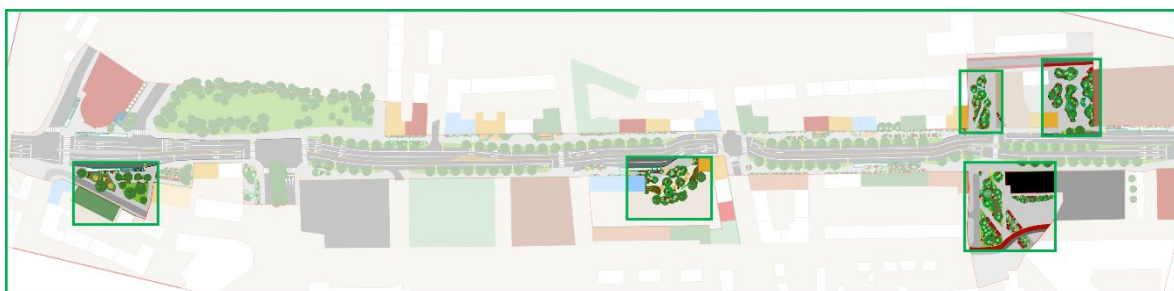
The findings of literature review presented in section 4.2.1 show how important creating a social atmosphere can be for the physical and mental health of both pedestrians and people living in a neighbourhood. According to Jabbari, et al. (2023), a functional urban structure should have centres of activities located at a walking distance. The findings in section 5.1 show that Trondheim Kommune (2019) wants to create a city on eye level that strengthens the urban structure, and this includes Elgeseter Street. Creating a vibrant and attractive social environment on Elgeseter Street is essential to improve the experience for pedestrians. As observed in section 7.1, Elgeseter Street today is traffic oriented and lacks both outdoor and indoor areas dedicated to socializing. From interviews with a city architect and a landscape architect, the student was made aware of the large amount of people in the area that makes the critical mass for social businesses large enough. Social businesses like cafés, restaurants, and stores can be implemented on the first floors of buildings to create a livelier atmosphere along the sidewalk. Improving the walkability and attractiveness of the street is also one of Trondheim Kommune's goals that can help bring people to the area (Paulsen, et al., 2020). There should be a variation of social businesses to cover the neighbourhood's needs, and especially the implementation of cafés and restaurants have the benefit of adding pleasant smells to the street.

Another way to make people want to stay on Elgeseter Street is to add more seating both indoors and outdoors. According to Yang, et al. (2019), streets should be designed with sidewalks, squares,



markets, and street furniture. Restaurants and cafés can offer indoor seating to customers, and where there is enough room on the sidewalk, the businesses can have connected outdoor seating. According to interviews with city and landscape architects, there should also be added areas people can sit without having to buy something, which can be implemented in the form of benches along the street or in pocket parks. According to Jabbari, et al. (2023), it is also important to implement seating allowing groups of people to sit together, and adding shade, shelter and greenery can be fitting as well. When it comes to indoor seating, libraries are an addition that offers areas for studying, and fortunately, there already is one across Handelshøyskolen. Even office buildings can have open lobbies with seating available to both the people working there and the public. The addition of seating along Elgeseter Street will give people places to stay and socialize, as well as make the street more accessible by offering places to rest.

According to the interviewed city architect, when adding outdoor seating it is important to create a design that encourages more socializing. Elgeseter Street is quite trafficked and just placing benches randomly might make them less likely to be used. It is essential to consider the conditions in the area and create smaller spaces where people feel they can socialize in peace. Seating should therefore be placed further away from the road and traffic, and adding barriers between would also help. Vegetation like trees, bushes, and flowers can be used as less harsh barriers, as well as they can help create smaller areas for socializing along the sidewalk. Pocket parks and groups of benches facing each other will create smaller hangout spaces and squares that can help encourage social interaction. In section 5.6 there are several examples of pocket parks that have been voted as people's favourites, and these can be used as inspiration for adding pocket parks in Elgeseter Street. Findings from literature review in section 4.2.5 also show that the interest in adding more green spaces has gone up since the COVID-19 pandemic, as parks can serve as outdoor getaway spots during a time many were forced to stay home. There are several areas with potential for pocket parks along the street, and the final design suggest placing pocket parks in several areas near Handelshøyskolen, by Elgeseter street 30B and by Studentersamfundet. Placements and suggestions for pocket park designs are illustrated in Figure 9-1 to Figure 9-3.



*Figure 9-1: Overview from CAD showing suggested placements of pocket parks in Elgeseter's new street design.  
(Made by: Susanna Hsu Hals)*



Figure 9-2: Render from model showing a suggestion for pocket park design by Handelshøyskolen. (Made by: Susanna Hsu Hals)



Figure 9-3: Render from model showing a suggestion for pocket park design by Elgeseter Street 30B. (Made by: Susanna Hsu Hals)

The sun-diagram for Elgeseter Street is illustrated in section 7.6 and it shows that the west side is sunnier before noon and the east side after. It was mentioned during interviews that when planning for outdoor seating, it can be helpful to consider the position of the sun during the day. It can be assumed that social businesses like cafés and restaurants are visited most after school or work, which means that it is beneficial to place them on the east side of Elgeseter Street. This will benefit outdoor seating connected to the businesses while it also helps bring in customers that have decided to walk on the sunny side of the street. When creating a new road design, the centre line can be moved further west to make more room on the eastern sidewalk. However, even though the east side might be more attractive, it is important to make sure both sides are attractive and offer seating. Figure 9-4 and Figure 9-5 below are rendered from the model of this study's suggested street design, showing how the new centre line and removal of parking spaces has allowed the addition of outdoor seating on the sidewalk.



Figure 9-4: Render from model showing outdoor seating connected to social businesses in Elgeseter Street. (Made by: Susanna Hsu Hals)



Figure 9-5: Render from model showing more outdoor seating by social businesses and seating along green dividers. (Made by Susanna Hsu Hals)

According to many interviewees, another factor to consider when trying to increase social life in Elgeseter Street is the noise pollution from traffic. Outdoor seating won't work if there is too much noise interfering with socializing, and the street would be less pleasant to walk along as well. Noise affects the comfort and walkability of a street, and measures that can be taken to reduce noise are therefore discussed in the next chapter under section 9.2.4.

## 9.2 Changes and additions that will improve walkability

When creating a street design with pedestrians at the top of the priority pyramid, it is essential to make the street walkable. The municipality in Trondheim defines the walkability of a street by accessibility, attractiveness, safety, and comfort, and it is important to have a good combination of these attributes (Paulsen, et al., 2020). Elgeseter Street has deficiencies within all categories and has great potential for improvement. This chapter will discuss what changes and additions can improve walkability both along and across Elgeseter Street.

### 9.2.1 Accessibility

To create an inclusive urban environment, it is important to prioritize accessibility for all travellers (Statens Vegvesen, u.d.). The findings from section 4.2.2 also show the importance of accessibility in street design, especially considering people with disabilities, children and elderly who live in a busy area. There are facilities that encourage everyday travelling, and making sidewalks accessible and enjoyable for everyone is therefore essential. One of the most significant barriers for wheelchair users is the lack of accessibility to buildings with entrances above street level. As observed in section 7.2, there are several elevated doors that can only be accessed by stairs in Elgeseter Street. A new street design creates the opportunity to elevate the sidewalk to match up to entrances or make more space for the addition of ramps or smaller elevators. If social areas are added to the first floor of buildings, it is essential to help people with mobility impairments access them with ease. Adding ramps will also be beneficial for families with strollers living in apartment buildings along Elgeseter Street.

Another obstacle for wheelchair users is an uneven sidewalk (Statens Vegvesen, u.d.). Elgeseter Street is old and run-down, which has affected the quality of the sidewalk and the transitions between the sidewalk and crossings. In some areas, the pavement is sloped with holes and cracks, which can all be solved by laying a new levelled sidewalk with materials of better quality.

When creating an accessible street design, it is important to consider the visually impaired (Statens Vegvesen, u.d.). To help these people navigate the street better, it is essential to add clear signals and markings. This includes colour-coding obstacles to make them more visible, as well as adding tactile markings in important areas like bus stops, crossings, and entrances. Figure 9-6 and Figure 9-7 are rendered from the 3D-model and show suggested bus stop designs for the bus stops; Studentersamfundet and Hesthagen. Both have tactile markings and different sidewalk material to clearly mark the bus stops. These are inspired by bus stops from section 5.5.



Figure 9-6: Render from model showing suggested bus stop design for Studentersamfundet. (Made by: Susanna Hsu Hals)



Figure 9-7: Render from model showing suggested bus stop design for Hesthagen. (Made by: Susanna Hsu Hals)

To further assist people with visual impairments, one can add sounds to traffic lights in order to signal safe crossings. Some interviewees also mentioned that another improvement would be to design the sidewalk with contrasting materials and colours to mark areas for different types of activity. This includes making surfaces that should not be walked on rougher and marking bus stops by using a different material on the ground. This will help people with visual impairments find bus stops or avoid people standing still as obstacles by bus stops.

### 9.2.2 Attractiveness

When judging a street's attractiveness, we look at the amount of greenery, aesthetics, cultural quality, and social spaces (Paulsen, et al., 2020). According to section 4.2.3, when considering aesthetics in street design, architecture and the preservation of older buildings also plays a large part in the visual impression for pedestrians. Elgeseter Street does have a hint of some of these qualities, however, there is a lot of room for improvement. Looking at the amount of greenery, Elgeseter Street is definitely lacking. From observation, the few patches of grass and trees by parking areas are the only vegetation that can be found. Fortunately, the space for the street between the buildings allows for the addition of a lot more. City and landscape architects from the interviews have mentioned that in street design; adding green dividers between lanes is probably the most effective way to add greenery. In Elgeseter Street, green dividers will have the most effect if they are placed between the sidewalks and vehicle lanes. That way the grass and rows of trees can work as a safe separation while they improve the aesthetics and feeling of life. It will also create something more interesting on eye level, which works toward the municipality of Trondheim's goals for urban development (Trondheim Kommune, 2019). The city architect also mentioned that taller vegetation can be used to cover more boring facades and improve the overall look of the street. An example is illustrated in Figure 9-8 and Figure 9-9, where vegetation is improving the facades of Elgeseter Street 38 and 38B.



Figure 9-8: Render from model showing example of how vegetation can improve the facade of Elgeseter Street 38. (Made by: Susanna Hsu Hals)

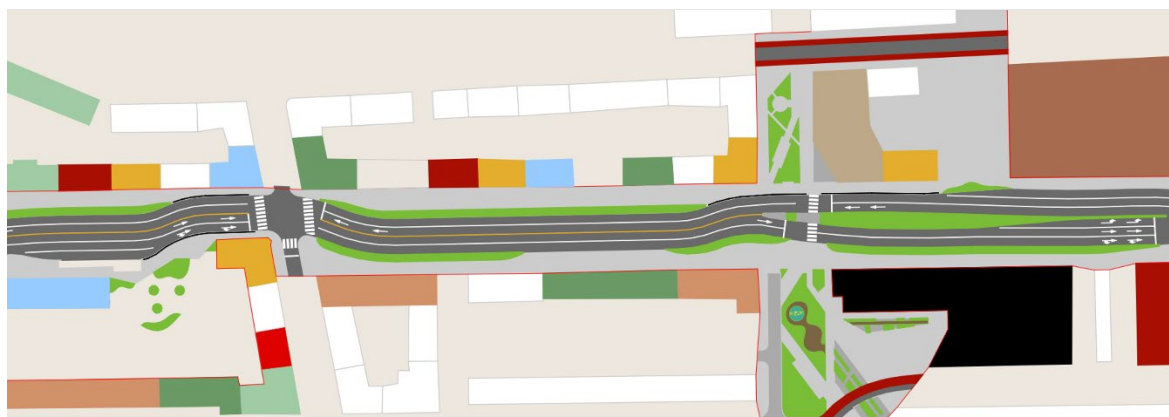


Figure 9-9: Render from model showing vegetation by the facade of Elgeseter Street 38B. (Made by: Susanna Hsu Hals)

From interviews the student gathered that a benefit of having green dividers is the natural drainage the grass can provide. In the winter it would also be beneficial to shovel excess snow onto them. This would make green dividers in the middle of the road a positive addition as well, however in the case of Elgeseter Street it might cause more inconveniences. The engineers and advisors that were interviewed recognized that since St. Olav's Hospital is located near Elgeseter Street, it is important to keep it accessible to emergency vehicles. Trondheim municipality has also mentioned their premise of prioritizing the hospital's accessibility in their planning document for Elgeseter Street (Trondheim Kommune, 2018). Since ambulances tend to take advantage of emptier vehicle lanes regardless of their intended direction, it would be beneficial to not have dividers. Dividers in the middle will also widen the cross-section of the street, which means that pedestrians would have to walk longer to get across the street and maybe even get stuck on the divider. In the case of Elgeseter Street with the prioritization of pedestrians, green dividers should therefore only be placed between sidewalks and vehicle lanes. Figure 9-10 shows the suggested street design for Elgeseter Street with green divider separating the road and sidewalks. The centred green divider by Handelshøyskolen is as it is today with trees planted along it.



NORTH HALF



SOUTH HALF

Figure 9-10: Overview from CAD showing north and south half of the new Elgeseter Street design with green dividers. (Made by: Susanna Hsu Hals)

As mentioned earlier in section 9.1, vegetation like grass, trees, bushes, and flowers can also be used to create social spaces on the sidewalk. This will create more interesting features on eye level as well as it improves the aesthetics for people choosing to stay in the social spaces on Elgeseter Street. During interviews with city and landscape architects there were discussions about improving aesthetics by renovating the facades of the existing buildings, especially the ones with historical value and architecture. The observations in section 7.3 show the poor state of many neoclassical apartment buildings along Elgeseter Street, and the lack of colours is not helping the attractiveness. Renovations can help bring life back into these buildings, and to preserve the antiquarian value it is important to keep the existing architectural elements. The interviews made the student aware of the city antiquarians strict view on changing the architecture of buildings with antiquarian value. If the first floors are changed to implement social businesses, there should be attention paid to keeping the architectural integrity after the changes. Making a few windows larger and changing the floor plan should be enough for businesses to move in. Figure 9-11 and Figure 9-12 are renders from the model showing a suggestion of how social businesses can be implemented on the first floor of buildings with antiquarian value.



Figure 9-11: Render from model showing a café added on the first floor of Elgeseter Street 15. (Made by: Susanna Hsu Hals)



Figure 9-12: Render from model showing a social business added on the first floor of Elgeseter Street 35. (Made by: Susanna Hsu Hals)

During interviews, there was also discussions about improving aesthetics by bringing back colours that have faded over time. Other buildings could benefit from getting new colours from Kine Angelo's Trondheim palette, to bring back the feel and history of the city's colours (Owren, 2021). Since Elgeseter Street is one of the main roads leading into Trondheim, it should represent the city's history and give an impression of Trondheim's qualities. Figure 9-13 below shows the Trondheim palette used for inspiration, as well as the colours of facades today and new suggested colours. The student has chosen to let the newer buildings keep their facades while most of the older ones have been coloured. Figure 9-14 shows a closer look at some of the older facades with existing colours and the new digitally renovated facades. These buildings can be found on Elgeseter Street 31B, 33, 35, 37, and 39.

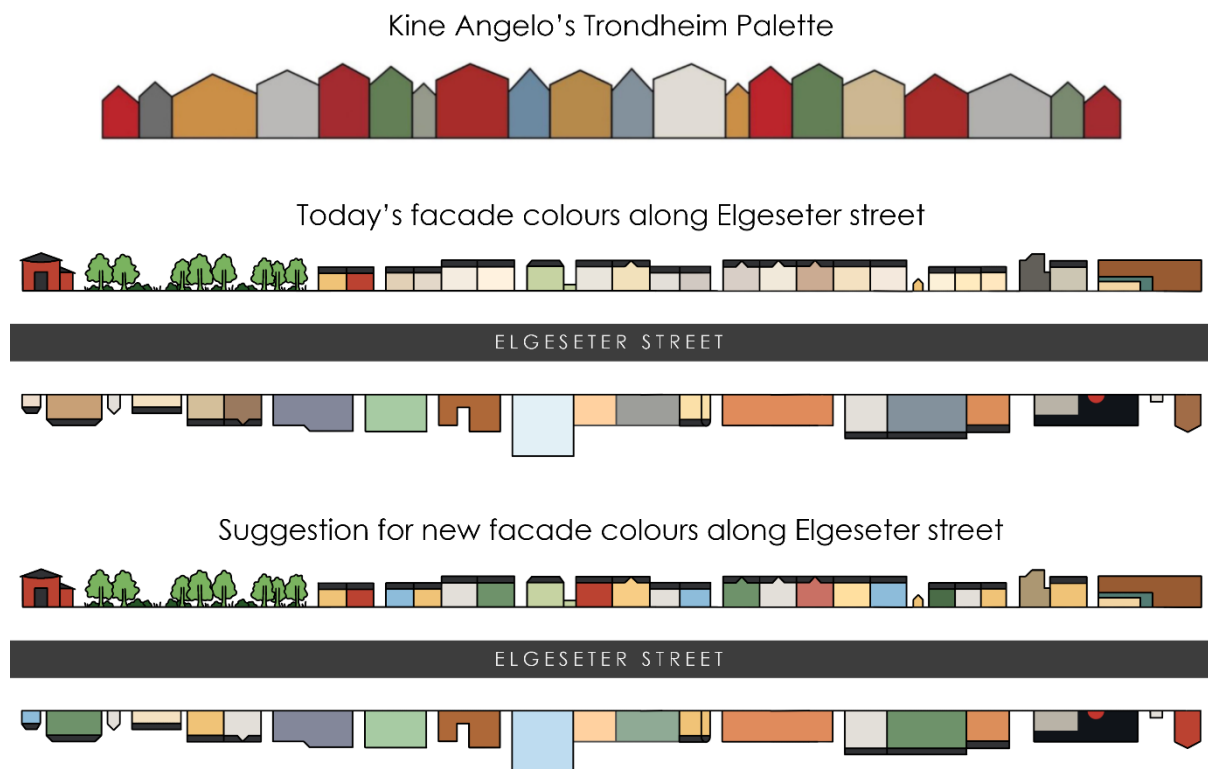


Figure 9-13: Illustration showing Kine Angelo's Trondheim Palette, existing facade colours along Elgeseter Street and the new suggested colours for this project. (Made by: Susanna Hsu Hals)

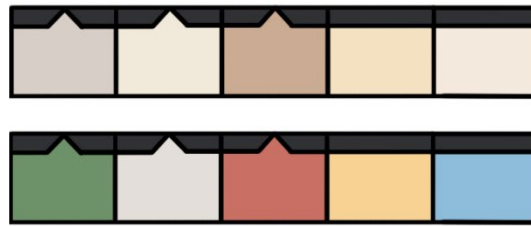


Figure 9-14: Illustration showing a close-up of certain buildings before and after edited with renovations and new colours from the Trondheim Palette. (Made by: Susanna Hsu Hals)

The demolition or preservation of Elgeseter Street 4, 6, and 30B has been discussed for a long time because of their impact on new street designs (Trøndelag Fylkeskommune, 2020). They have stood empty for many years and look run-down and abandoned today. However, their historical and antiquarian value should encourage renovations, especially since it is not too late. Looking at the street design, the buildings would impact the maximum width of the road, see section 7.4. However, there should still be enough space for the minimum requirements of lane widths. Additionally, there would only have to be narrower passageways by these particular buildings, which shouldn't affect the function of the street too much. The worst case is that the lanes would feel a little narrower with no extra separation between sidewalks and vehicle lanes, like Figure 6-1 in section 6.3. By Elgeseter Street 4 and 6 there is the possibility to push the park back a little to make room, and by Elgeseter Street 30B, it is possible to let the pedestrians go through the building where it sticks out on the sidewalk. That would however compromise the antiquarian value and might therefore be hard to get approved. Regardless of the possibility of these changes, the room between the buildings today should be enough for street design by handbooks with minimal deviations. Keeping the buildings would be in the municipality of Trondheim's interest, as they have a goal to keep historically significant elements (Trondheim Kommune, 2018).

Interviewees have pointed out that the amount of social activity in Elgeseter Street will also help determine the attractiveness of the area. As previously discussed in section 9.1, Elgeseter Street has a lot of potential and there are many ways to improve the social aspects. The presence of people walking and staying on the street creates more life and contributes to the street's attractiveness. The more measures taken to increase social activity; the more attractive Elgeseter Street will become (Paulsen, et al., 2020).



### 9.2.3 Safety

An important issue in the Elgeseter Street project involve solving how one can create more street life, increase safety, and reduce noise (Trondheim Kommune, 2018). Several interviewees pointed out that the issue of traffic is a crucial factor in ensuring pedestrian safety on Elgeseter Street. According to Jabbari, et al. (2023), it is important to ensure safety and accessibility when connecting the pedestrian network with public transport. Findings from section 4.2.4 also support adding traffic calming measures to further increase safety in a street. A large number of cars driving with high speed creates a barrier between the east and west sides of Elgeseter. One solution that was discussed during interviews is slowing down the traffic by reducing the speed limit, however interviewees within different fields had different opinions on the matter. An engineer within road and traffic works with prioritizing public transport and pointed out the importance of public transport's accessibility and effectiveness. However, another interviewee mentioned that public transport already drives slower than the speed limit and won't be affected by a reduction. This can be checked out and evaluated before discussing a change of speed limit for Elgeseter Street.

The student also noted during interviews that making the road curve can help slow down traffic, as vehicles tend to speed up on straighter roads. An example of how a new design for Elgeseter Street can have more curves compared to today's design is illustrated in Figure 9-15. Additionally, adding green dividers with trees between sidewalks and vehicle lanes will create a physical barrier as well as it can provide a feeling of safety for pedestrians.

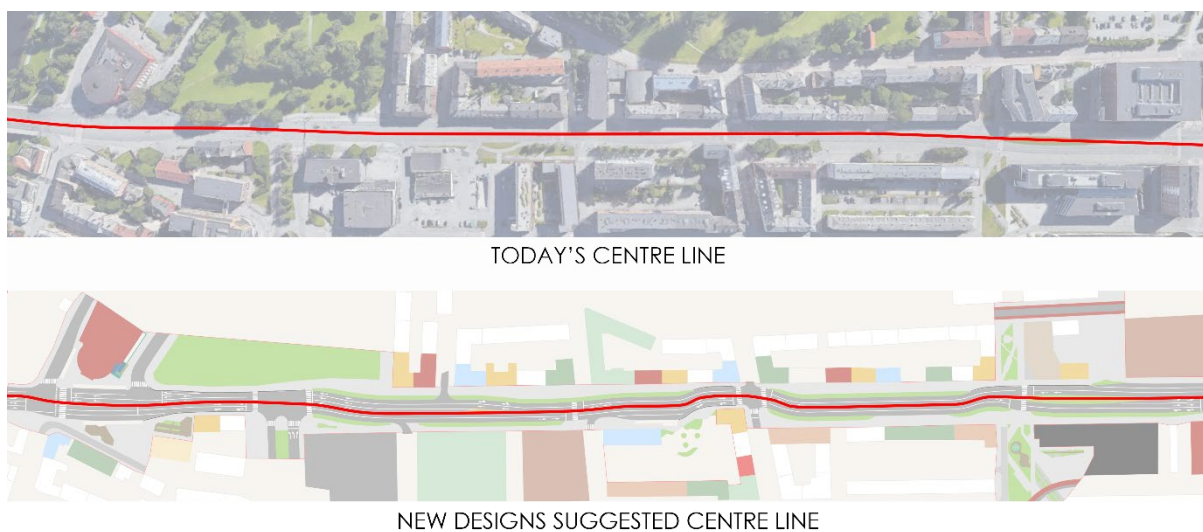


Figure 9-15: Overview of Elgeseter Street's centre line today and the new centre line from this study's street design. (Made by: Susanna Hsu Hals)

Landscape architects from the interviews suggested enhancing this effect by elevating the green dividers to create a more distinct barrier. It will also hinder people from crossing the road where there are no sidewalks. This can help reduce the dangers for both pedestrians and vehicles caused by reckless crossings. However, having a distinct barrier might also make drivers less observant of their surroundings, which can have a negative impact on traffic safety. Fortunately, with taller barriers and curved roads, it is hopeful that drivers will slow down and be aware of their surroundings. Figure 9-16 and Figure 9-17 are rendered from the 3D-model and show two types of barriers between the sidewalk and road. Figure 9-16 shows an example of what an elevated green divider could look like in Elgeseter Street.



Figure 9-16: Render from model showing an example of an elevated green divider. (Made by: Susanna Hsu Hals)

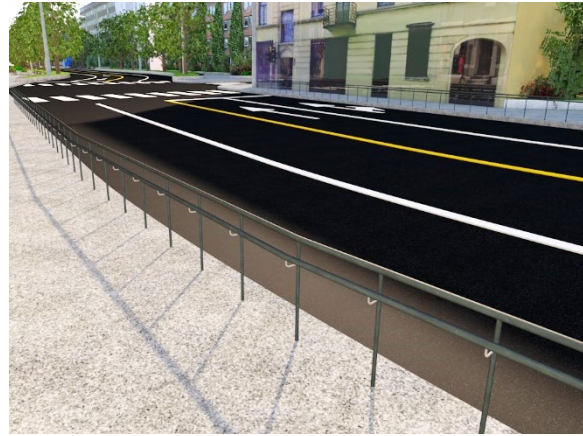


Figure 9-17: Render from model showing fencing as divider between vehicle lanes and sidewalks. (Made by: Susanna Hsu Hals)

Another topic discussed in interviews was the placement of public transport lanes. Even though interviewees who prioritize public transport suggested centred lanes, the majority of interviewees argued that public transport lanes connected to the sidewalk would be a lot safer for pedestrians. The safety would decrease if pedestrians would have to cross vehicle lanes to get to bus stops, and cars would also have one more obstacle to worry about, which could hinder the traffic flow. As stated in section 6.1, Elgeseter Street should be one of the main streets for public transport, however, it is still important to maintain good traffic flow and accessibility for emergency vehicles in the new design (Trondheim Kommune, 2018).

Several interviewees mentioned that sharing the sidewalk with bicycles can make it less safe, and worrying about cyclists and electric scooters will make Elgeseter Street less walkable. Fortunately, there are proper bicycle lanes on both streets parallel to Elgeseter Street – Udbyes Gate and Klæbuveien – which makes them more attractive for cyclists. This will help maintain Trondheim Kommune's (2019) goal of strengthening the urban structure by promoting active mobility in the area. The experienced cyclists in Trondheim would probably choose these streets anyway, however, new bikers can be more clueless and thereby choose the more known Elgeseter Street. It is therefore beneficial to add symbols and markings that inform people about the parallel bicycle lanes. It was discussed in interviews that bicycle parking in Elgeseter Street can be placed closer to the bicycle lanes so people notice them easier. The bicycle lanes in Klæbuveien are already marked red, however, Udbyes gate only has half of the street clearly marked for bicycles. Improving the rest of Udbyes bicycle lanes can help navigate cyclists away from Elgeseter Street and make it safer and more comfortable for pedestrians.

According to section 5.2, ensuring proper lighting along the sidewalk is also important for pedestrians to feel safe, especially after dark. People usually feel safer near other people and tend to walk along trafficked roads in the evening (Paulsen, et al., 2020). It is therefore important to make Elgeseter Street safe by adding enough light sources both along the road and in smaller connecting alleyways. Additionally, attracting more people and increasing social activity will also help boost safety on the street. Figure 9-18 shows a part of the model where extra lighting is added in a pocket park to increase safety.



Figure 9-18: Render from model showing extra lighting placed in a pocket park by Handelshøyskolen. (Made by: Susanna Hsu Hals)

#### 9.2.4 Comfort

To improve the walking experience for pedestrians, it is essential to create a comfortable street design (Paulsen, et al., 2020). According to literature reviewed in section 4.2.5, comfortable street designs can encourage more active mobility and create a more attractive street environment. The increase of active mobility will also have both physical and psychological health benefits. Landscape architects from interviews pointed out that wider sidewalks of high-quality pavement can help make the street more comfortable and accessible for everyone. An idea could be to remove existing parking spaces along Elgeseter Street to make room for wider sidewalks, however, if this change is made there should be some kind of replacement for car users in the area. The zero-growth goal strives to reduce the number of cars (Miljødirektoratet, n.d.), and the removal of parking would make Elgeseter Street less attractive for private cars. However as mentioned in section 5.4, to keep the area attractive for living, it is essential to provide the option of parking private cars. An alternative is to keep some of the parking spaces and reserve them for carsharing. The cars for carsharing can be electric as well, which makes this compensation even more environmentally friendly.

In section 6.1 it is stated that the municipality of Trondheim (2018) has a goal to make Elgeseter Street attractive for walking by among other things having safe crossings with practical connections across the road. Landscape architects from interviews also mentioned that it is important to keep the balance between good traffic flow along and across Elgeseter Street. From observation the student noted that the waiting time for several crossings is quite long, and in some areas the lack of crossings forces the pedestrians to take a detour to get to a destination across. It can therefore be interesting to evaluate the effect of adding a few more crossings, as well as shortening the waiting time for pedestrians. An improvement might reduce the number of people running across, and thereby increasing the safety on Elgeseter Street. Figure 9-19 is a map of this study's new design for Elgeseter Street with suggestions for extra crossings marked.

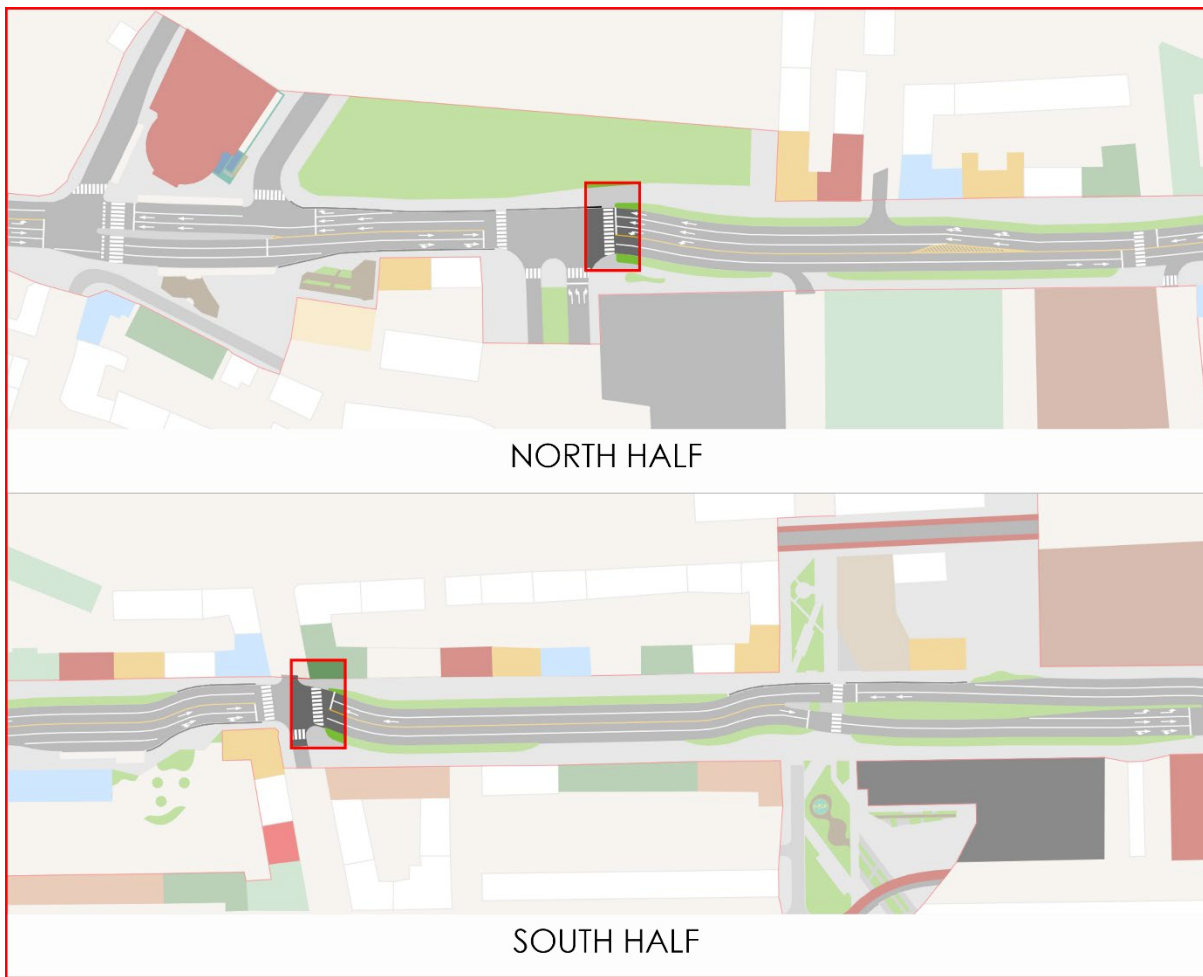


Figure 9-19: Figure showing the north and south part of the new Elgeseter Street design with new cross sections marked. (Made by: Susanna Hsu Hals)

Reducing the noise on Elgeseter Street can also help improve the comfort of pedestrians (Paulsen, et al., 2020). From observation the student realized that the amount of traffic today makes it hard to converse with people when walking or staying outside on the street. Several interviewees pointed out that for the social activity to increase in Elgeseter Street, there should be noise-reducing measures taken. There are many solutions that can help with noise pollution, and some are more drastic than others. A landscape architect suggested rugged elements to the street as one of the simpler noise-reducing measures. Rougher surfaces can help reflect the soundwaves from the noise, and there are a couple of ways to add that to street design. If there is enough room, adding trees and vegetation can both help muffle the noise a little while also blocking the view of traffic, which can have a psychological noise-reducing effect. Since there are a lot of other benefits to adding trees as well, it is a positive addition to street design. Other rough surfaces can be added by changing facades; however, it was pointed out in interviews that a lot of buildings with antiquarian would be difficult to change. Lowering the road or having elevated dividers can also help muffle the traffic noise coming from the tires of cars.

Several interviewees pointed out that lowering the speed limit will reduce noise as well, and as discussed before in section 9.2.3, it is already beneficial for increasing safety on Elgeseter Street. Changing the speed limit from 50 km/h to 40 km/h can have a huge impact on the noise, while it also makes Elgeseter Street less attractive for private cars. The potential downside would be if

public transport was affected negatively, however, from interviews the student has gotten the impression that lowering the speed limit a little won't affect the buses on Elgeseter Street.

A Senior Advisor within road and traffic stated in an interview that making Elgeseter Street less attractive for private cars will reduce the amount of traffic, and thereby reduce noise pollution. When looking at changes that can be made in the Elgeseter district, one way to inconvenience cars is to make Elgeseter Street environmentally friendly and only allow electric vehicles. This will both reduce traffic and noise as electric vehicles are a lot quieter. It also encourages more environmentally friendly travelling, which is working towards the zero-growth goal (Trondheim Kommune, 2019). It additionally supports Trondheim Kommune's goal to keep good conditions for metro buses (Trondheim Kommune, 2018). However, this might be too drastic of a change as a lot of people still own petrol cars. This change could be too sudden and create much chaos on other roads, but it can be something considered smoothly transitioning to.

An even more drastic change could be to only allow public transport on Elgeseter Street. A senior advisor mentioned that there is a goal to only allow metro buses in the city centre and have cars resort to highways around the city and underground. This solution would cause the same difficulties as only allowing electric vehicles, and there have not been made proper alternative routes for cars yet. It was discussed in several interviews how a long-term goal should be to lead the private cars in a tunnel underground and connect it to the Strindheim tunnel that has partially replaced Innherredsveien. Maybe even public transport could be redirected underground and be accommodated by underground bus stops. That way Elgeseter Street could be rid of traffic noise altogether and get much more space for attractive additions to the neighbourhood.

It is possible to make the street less attractive by increasing the attractiveness of alternative routes. As shown in section 7.5, the tolls in Trondheim are mostly located along the E6 highway east of the city centre. This means that in some cases, driving on and off the highway would cost more than driving through the city centre. Even though the traffic in Trondheim city centre is more difficult to navigate through, it is imaginable that people would choose the cheaper route over the fastest one. GPSs in cars can show several alternatives and inform about their costs, which can make driving through the city more enticing. The toll system should therefore make it cheaper and more attractive to utilize the highways to get to their destinations.

## 10 Conclusion

Elgeseter Street has long been a traffic-focused road creating a barrier separating the east and west part of Elgeseter. With the urban development of Trondheim, the main roads are being upgraded to accommodate the environmentally friendly addition to public transport – metro buses (Trondheim Kommune, 2019). The new designs of these streets will reflect the prioritization order of travellers, and to work on the zero-growth goal, it is about time to neglect private cars and focus on the prioritization of pedestrians. The space between the buildings along Elgeseter street has the potential for a street design that is attractive to pedestrians, while accommodating the metro buses and still allowing necessary traffic. The purpose of this thesis is to evaluate what changes and additions can improve the street's social aspects and walkability, in the hopes of attracting more life to Elgeseter Street. There has also been a goal to create a street design within a realistic framework, and a description with technical drawing and images from a 3D-model can be found in Appendix 5.

Findings from this thesis show that Elgeseter Street is lacking social offers for pedestrians and people living in the neighbourhood. A new street design for Elgeseter should strive to support Trondheim Kommune's goal to create a city on eye-level. Since the critical mass in the area is sufficient, it would be beneficial for businesses to move into Elgeseter Street. The first floors of several buildings should be renovated for commercial use, allowing businesses like restaurant, cafés, and stores to set up shop. When more people are attracted to the street, there should also be added extra seating both indoors and outdoors for people to stay in the area. To make room for the outdoor seating, existing parking spaces along Elgeseter Street should be removed. This measure will additionally support the municipality's zero-growth goal by making the area less attractive for private cars. A more pedestrian friendly design should also have more interesting features, wider sidewalk and especially outdoor seating on the east side of Elgeseter Street, as it is the sunnier side in the afternoon.

The municipality's goal to make Elgeseter Street more walkable (2020) should be highly prioritized when creating a street design for pedestrians. Measures should be taken to establish a street with a beneficial combination of accessibility, attractiveness, safety, and comfort. Increasing social activity would already benefit both attractiveness and safety on a street. A space that successfully encourages social activity will start to attract more people and increase life in the area. Having more people around will also reinforce the feeling of safety for pedestrians.

Starting with accessibility, the student observed several problem areas along today's Elgeseter Street. To improve this aspect, the new design should make sure all entrances are accessible for wheelchair users either by raising the sidewalk to the first floor-level or adding ramps and smaller elevators. Smoother sidewalks of better quality would also make travelling by wheelchair more practical, in addition to boosting safety and comfort for all pedestrians. Another helpful measure to improve accessibility in street design is the addition of distinct markings and signals for visually impaired. Bus stops and store fronts should be designed with tactile markings, and larger obstacles can be colour-coded to contrast from the surroundings.

Increasing the attractiveness of Elgeseter Street means to make the area more visually pleasing. The most effective measure in an attractive design is the addition of vegetation. Trees, bushes, and flowers are versatile and can be added in many different ways to improve a street. Vegetation

adds colour, life, and more interesting elements to look at on eye-level. Trees can be added on green dividers as a barrier between lanes, while it also can be utilized to separate smaller social areas on the sidewalk or in parks. Flowers and bushes can be placed around seating to muffle noise and shield from traffic, while improving the visuals of the area. Another way to add colours to Elgeseter Street is to renovate facades and implement the Trondheim Palette, which will support the city planning office's goal to bring Trondheim's colours back (Owren, 2021). Trondheim municipality also has a goal to preserve elements with historical value, which means that demolitions are unwanted and potential renovations should respect the architecture and antiquarian value of some buildings.

When looking to improve safety, it is important to consider all travellers on the street. For pedestrians, reducing the speed limit and number of cars will increase their safety quite significantly when crossing the road. Creating a more curved centre line for Elgeseter Street would also force cars to slow down and pay attention to their surroundings. Dividers should be elevated to create safer barriers between vehicles and pedestrians, while taller elements close to the road also tend to slow down cars. Keeping the public transport lanes on the sides and having bus stops connected to sidewalks will also reduce the number of crossings and thereby increasing the safety. To avoid collisions that can happen when a sidewalk is shared with bicycles, the cyclists should be directed to the parallel streets with bicycle lanes. This can be done by adding clear signs leading them away, and bicycle parking can be placed closer to bicycle lanes as well. The entire street and especially generally shaded areas; there should be added proper lighting to help reduce crime and contribute to safety. A combination of all these additions will make it more likely for people to choose walking along Elgeseter Street.

To make a street more walkable, comfort plays a big part. Removing parking spaces in Elgeseter Street and widening the sidewalk will allow for more space dedicated to pedestrians, and more people will be able to walk together comfortably. Adding more crossings will also help the balance between traffic flow both along and across the street. Less detours will allow pedestrians to comfortably access all attractions on both sides of Elgeseter Street. However, the major change that can help boost comfort is reducing the noise pollution in Elgeseter Street. Findings from this thesis show that there are several measures that can be taken: some manageable and some more drastic. These include adding rougher surfaces to muffle noise, lowering the speed limit, only allowing electrical vehicles on the street, only allowing public transport, and reducing traffic by changing the toll system in Trondheim. For the final design, the student has concluded that the most realistic measures would be adding rough surfaces through vegetation and lowering the speed limit.

Since the student has chosen to focus on creating a realistic design, there are a few additional considerations that have influenced the final design. There has not been added any dividers along the centre line of the road, in order to make the vehicle lanes more accessible for emergency vehicles near St. Olav's hospital. The design is prioritizing pedestrians, however the car- and public transport lanes have not been removed as the municipality of Trondheim wants Elgeseter Street to be one of the main roads for public transport, and because St. Olav's hospital should be accessible to every type of traveller.

## 11 Further work

During the work with this master's thesis, the student has come upon several research methods and new topics that can help give a more accurate answer to the research question. A recommendation for further work is to include the residents and pedestrians in Elgeseter Street in decision making when it comes to changes and additions. This can be done by creating a survey with many visualizations of solutions and documenting their favourites. Additionally, both pedestrians and professionals can be presented with this study's solution and state their opinions to further improve the work.

Writing a thesis and presenting a suggested street design with description and visualizations can help show the potential Elgeseter Street has. However, it is recommended to do more work to further convince stakeholders that decide the fate of the road. Since it is believed that the addition of greenery and pocket parks can have a large positive impact on the street, there should be arranged workshops that help people realize what effect these additions can have. One can choose a more open area in Elgeseter Street and gather pots of plants in all sizes to create a temporary pocket park. Adding seating, bushes, flowers, and more can help boost the effect, and create a social space that pedestrians in Elgeseter Street can experience. Collecting their feedback on the implementation can help improve the pocket park designs, in addition to convincing people of the importance of greenery and social spaces.

Another topic that is recommended to be researched is what impact a reduction of speed limit would have on the different travellers in Elgeseter Street. The results can further support the study's mentioned benefits for pedestrians, and thereby increase the chance of this improvement.



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# Appendixes

Appendix 1: N100 – Relevant Requirements for Elgeseter Street

Appendix 2: Interview guide – Area management

Appendix 3: Interview guide – Road and traffic

Appendix 4: Interview consent form

Appendix 5: The final design for Elgeseter Street

## Appendix 1: N100 – Relevant Requirements for Elgeseter Gate

### 2 Streets

#### 2.2 General design requirements for streets

2.2.1-1 Streets shall have a speed limit of 60 km/h or lower.

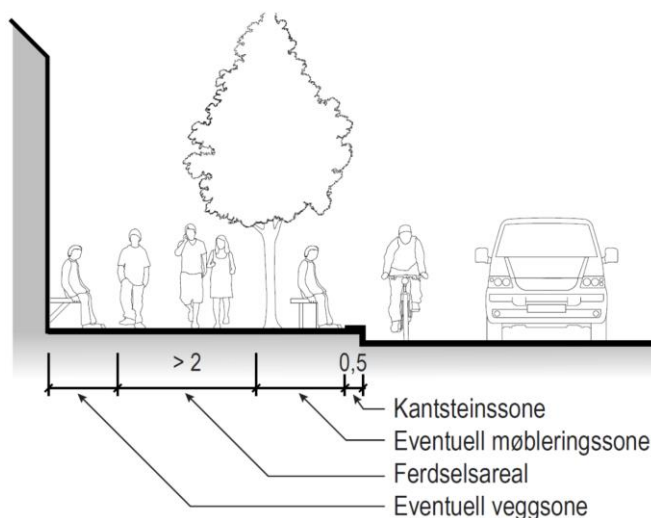
2.2.1-4 Streets shall be illuminated

2.2.1-5 In streets with multiple lanes in each direction, there can be a divider instead of the yellow-centred line. This divider shall have a width of a minimum of 1,5 m.

#### 2.3 Street elements

Streets can be made up of one or more of the following elements: Sidewalks, car lanes, lanes for public transport, joint-use lanes, heavy traffic lanes, bicycle lanes, sidewalks, parking spaces for bicycles and cars, delivery stops, and bus stops.

2.3.1-3 All sidewalks should have a roaming zone with a width of 2 meters or more. If the sidewalk has a furnishing zone, the roaming zone should be expanded to 2,5 meters to make room for mechanical snow removal.



Figur 2.3.1-1 – Inndeling av fortauet i soner med breddekrav (mål i m).

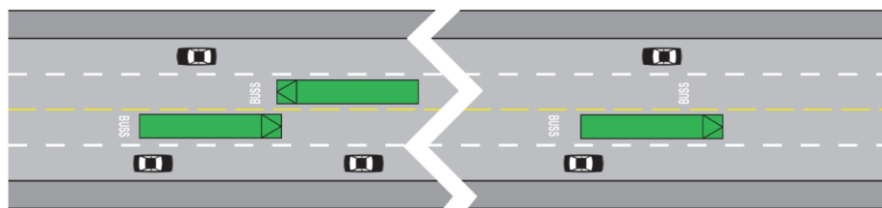
2.3.1-4 Sidewalks shall have curb stone zones with a minimum width of 0,5 m. The width shall be 0,7 m wide by edge stops and bus pockets.

2.3.2-3 The main network for public transport shall have a lane width of 3,25 m. The main network for cars should have a lane width of 3,5 in streets with a speed limit of 50 km/h or 60 km/h.

2.3.2-4 In streets where lanes are next to curbs, there shall be a curb clearance width of 0,25 m.

2.3.3-3 The following requirements apply to centred public transport lanes:

- The intersections should be designed as traffic light-regulated T-shaped or X-shaped intersections.
- The speed limit by crossings for bus stations should be 40 km/h.
- The continuous length of centred public transport lanes shall be a minimum of 1 km.



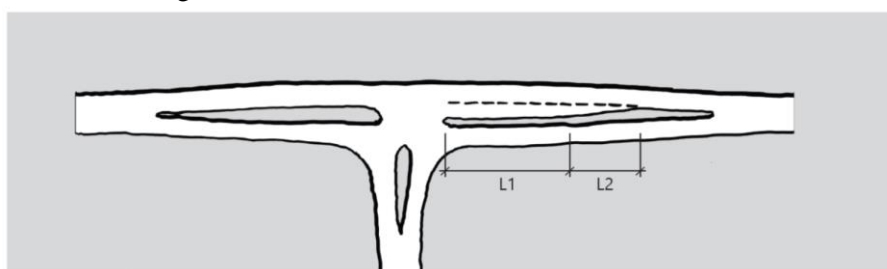
Figur 2.3.3-2 — Gate med midtstilt kollektivfelt.

2.3.6-1 Streets with an AADT > 15 000 or a speed limit of 60 km/h shall not have bicycle lanes.

#### 4 Theme chapters

##### 4.1 Intersection design

4.1.1.3-3 Left turn lanes should be designed as Figure 4.1.1.3-2 illustrates. L1 and L2 should be calculated using a calculation model for left turn lanes.



Figur 4.1.1.3-2 — Utforming av venstresvingefelt

4.1.1.3-4 Left turn lanes should be designed with physical channelization when the speed limit is 50 km/h or 60 km/h.

4.1.1.7-1 In signal-regulated intersections, there shall be at least one light in sight from 1,2 times stop sight.

##### 4.2 Solutions for pedestrians and cyclists

4.2.5.1-6 When adding a pedestrian crossing near an intersection, the distance from the intersection shall be 1-2 m, or 5 m so there is room for one car between the intersection and the pedestrian crossing.

4.2.5.1-7 Bus stops shall be placed at least 5 m from a pedestrian crossing in front, and 1 m from the pedestrian crossing behind.

4.2.5.1-9 If a pedestrian crossing crosses more than 2 lanes, there shall be a traffic island added.

4.2.5.1-10 Traffic islands should have a minimum width of 2 m and extend at least 2 m past the crossing point.

##### 4.4 Curbstone

4.4.1-1 Curb stones between car lanes and sidewalks shall have a minimum height of 12 cm if the speed limit is  $\geq$  50 km/h.

##### 4.11 Vegetation

The recommended width of dividers with vegetation are:

- 4 m for dividers in the middle, but 2-2,5 m can be accepted
- 3 m along sidewalks

## Appendix 2: Interview guide – Area management

# Interview Guide

## AREA MANAGEMENT

### **What is a realistic and fitting solution for Elgeseter street considering social aspects and comfort?**

What implementations can make Elgeseter street more social?  
What implementations can make Elgeseter street more comfortable?

### **Assignment:**

This paper will be a continuation of a feasibility study the student started working on during the autumn of 2022 as a pre-study. The student has previously collected data and presented alternatives to create a street design for Elgeseter street that focuses on pedestrians, placemaking and social neighbourhoods. The master thesis should focus on creating a more concrete and detailed solution for Elgeseter street, based on evaluations of collected data and suggested alternatives.

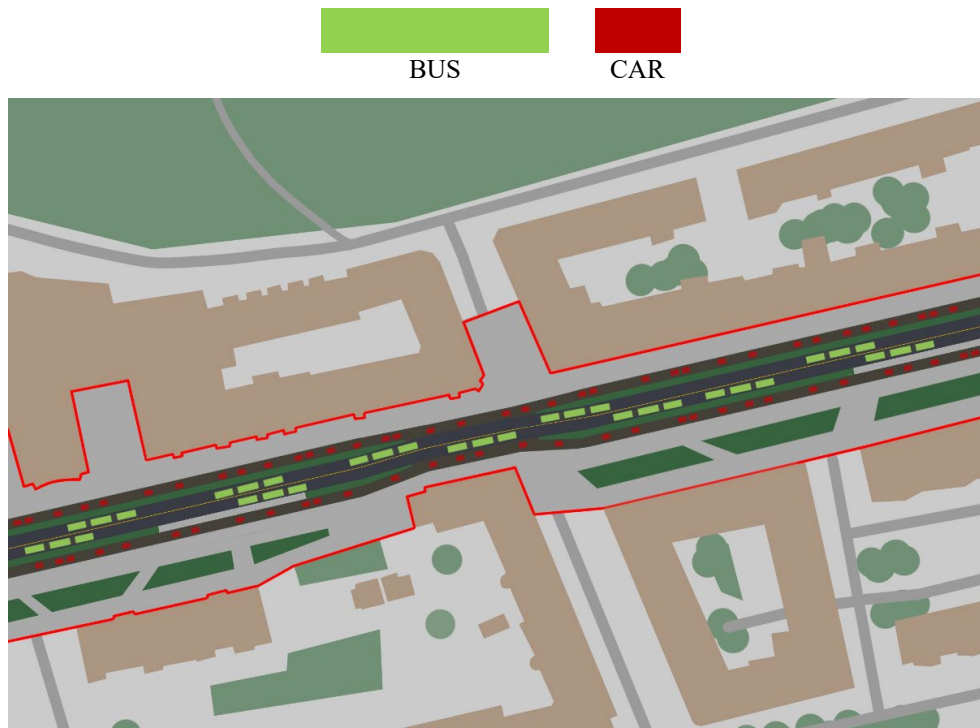
The final design should prioritize the social aspects of streets and placemaking while considering the prioritization of metro buses, emergency vehicles, important areas, and buildings with antiquarian value. There should also be an overall goal to create a design that considers accessibility and the environment.



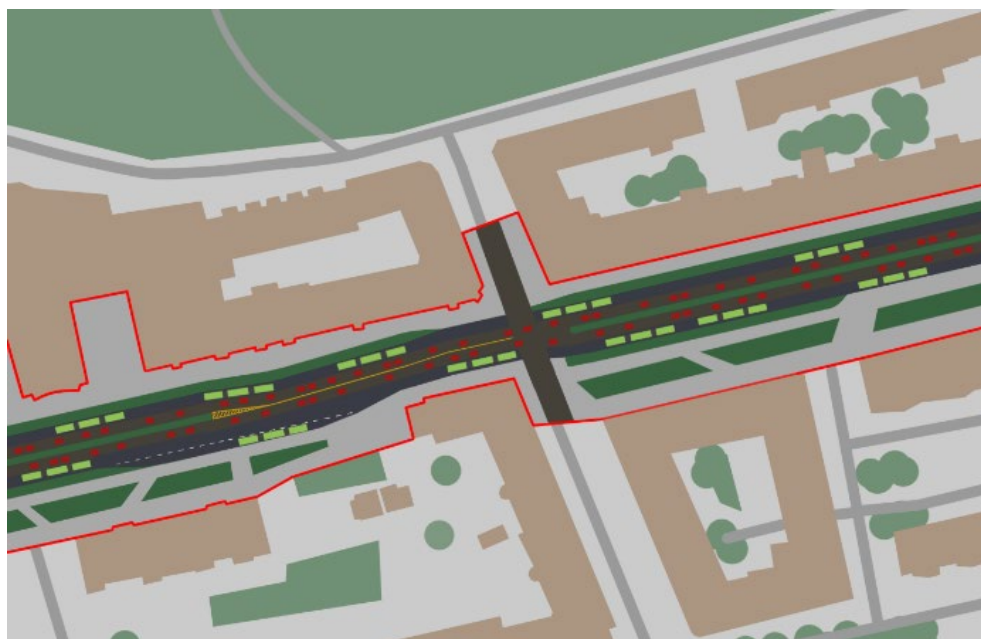
## ALTERNATIVES

1. Which alternative with public transport lanes do you think is most appropriate in terms of area management and increasing social activity in the street?

### PLACEMENT OF PUBLIC TRANSPORT LANES



*Figure 1: Centred public transport lanes.*



*Figure 2: Public transport lanes on the sides.*

English

2. Which alternative with green areas do you think is most appropriate in terms of area management and increasing social activity in the street?

AMOUNT OF GREENERY



*Figure 3: Only green dividers in the middle.*



*Figure 4: Green divider in the middle and along sidewalks.*



*Figure 5: As much greenery as possible.*

## SOCIAL ASPECTS

3. I believe adding restaurants and shops on the first floors of buildings will increase social activity. Are there any difficulties that might come with these additions?
4. Restaurants and cafés can have outdoor seating on the sidewalk. With the noise and air pollution in Elgeseter street, do you know any measures that can improve the outside seating experience in a trafficked area?

I would like to transform the area around Elgeseter Gate 26 into a square with shops, greenery and seating, see Figure 6 and 7 below. The goal is to transform the area from a parking lot with trees to an area that will increase social activity in the neighbourhood and encourage walking as the area is located between two bus stops: Studentersamfundet and Hesthagen.

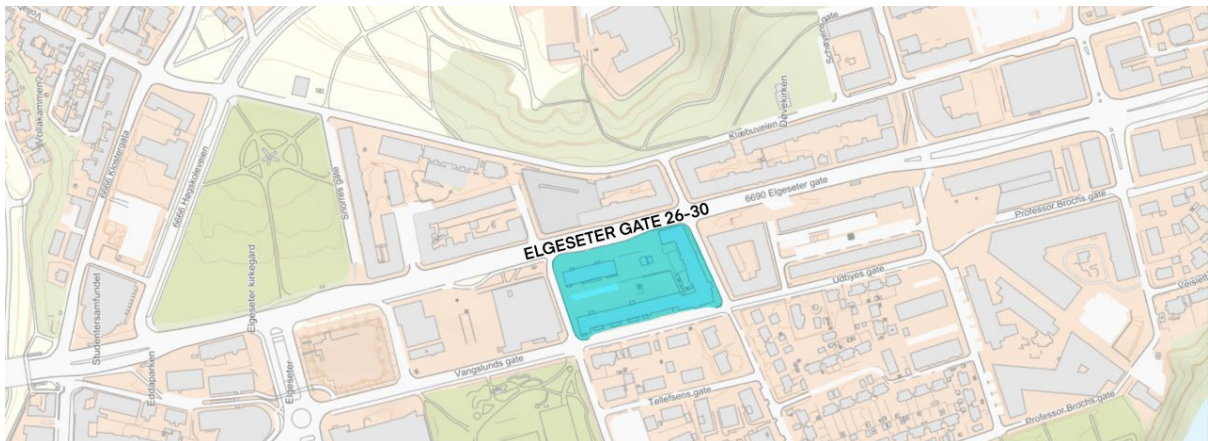


Figure 6: Map over Elgeseter street showing suggested placement of a square.

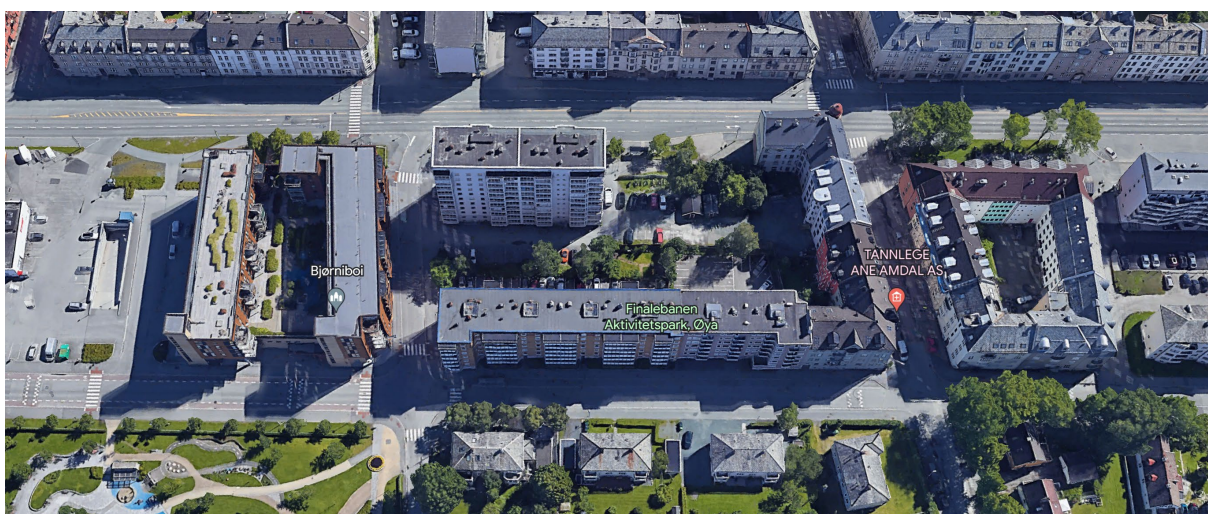


Figure 7: Photo of Elgeseter 26-30 taken from Google Earth.

5. Do you think this could be a good addition to Elgeseter street? If so, are there any elements that you think are important to add in this area?

English

## VISUALS

6. Do you think the older buildings in Elgeseter street need renovation? If so, what kind of renovations do you suggest?
7. Do you have any suggestions for different ways of adding greenery along Elgeseter Gate?
8. Below in Figures 8 and 9 are photos of Elgeseter Gate 35, 37 and 39 before and after adding my suggestions via editing. Do you have any comments on the advantages and disadvantages of this solution?
9. Can you think of other changes or additions that could also increase social activity or comfort?



*Figure 8: Photo of Elgeseter Gate 35, 37, and 39 today.*



*Figure 9: Elgeseter Gate 35, 37, and 39 after photo editing.*

English

### CREATING A REALISTIC ROAD DESIGN

10. Are there any other challenges along Elgeseter street you can think of that should be considered when preparing a new street design?
11. Are there any new construction projects along Elgeseter street that have started that could affect the framework for the new road design?

## Appendix 3: Interview guide – Road and traffic

# Interview Guide

## ROAD AND TRAFFIC

### **What is a realistic and fitting solution for Elgeseter street considering social aspects and comfort?**

What implementations can make Elgeseter street more social?  
What implementations can make Elgeseter street more comfortable?

### **Assignment:**

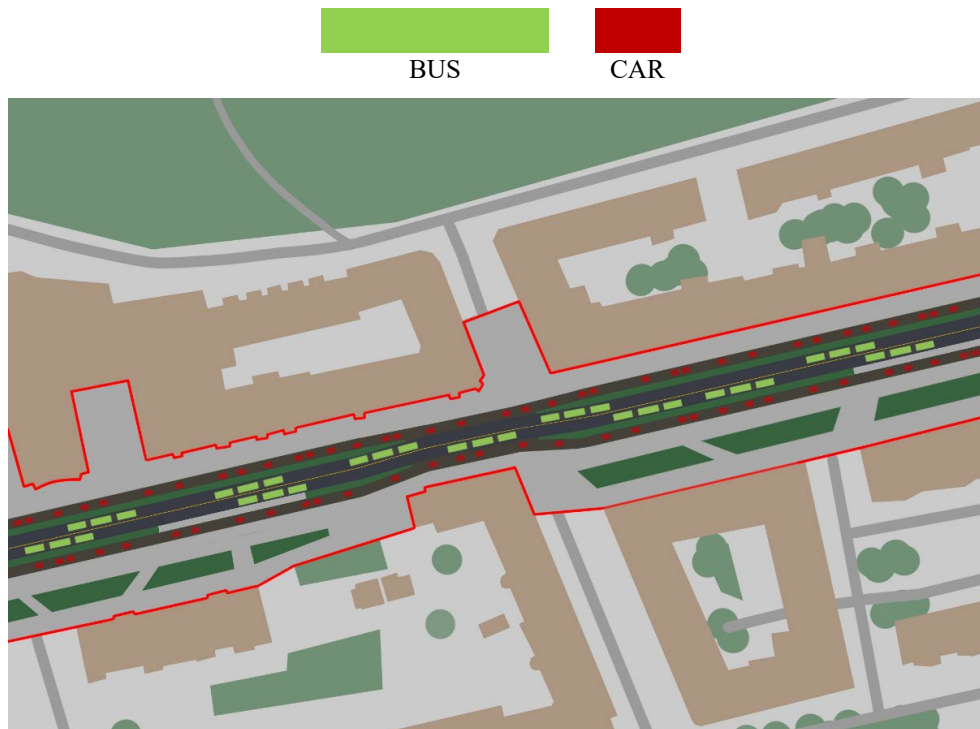
This paper will be a continuation of a feasibility study the student started working on during the autumn of 2022 as a pre-study. The student has previously collected data and presented alternatives to create a street design for Elgeseter street that focuses on pedestrians, placemaking and social neighbourhoods. The master thesis should focus on creating a more concrete and detailed solution for Elgeseter street, based on evaluations of collected data and suggested alternatives.

The final design should prioritize the social aspects of streets and placemaking while considering the prioritization of metro buses, emergency vehicles, important areas, and buildings with antiquarian value. There should also be an overall goal to create a design that considers accessibility and the environment.

## ALTERNATIVES

1. What do you think are the advantages and disadvantages of the alternative solutions for placing public transport lanes?

### PLACEMENT OF PUBLIC TRANSPORT LANES



*Figure 1: Centred public transport lanes.*



*Figure 2: Public transport lanes on the sides.*

English

2. What do you think are the advantages and disadvantages of the alternative solutions for the amount of green space in the road design?

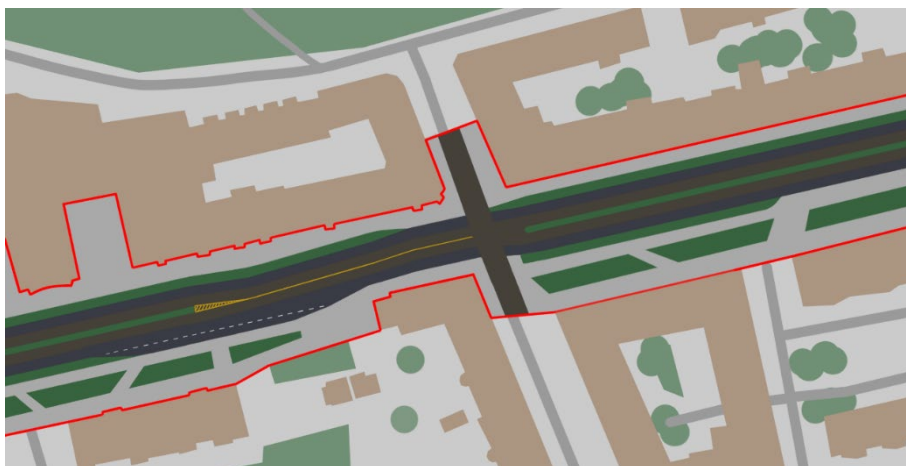
### AMOUNT OF GREENERY



*Figure 3: Only green dividers in the middle.*



*Figure 4: Green divider in the middle and along sidewalks.*



*Figure 5: As much greenery as possible.*



English

### COMFORT

3. What are your thoughts on adding underground crossings in areas where there is heavy pedestrian traffic, considering space and accessibility?
4. Do you have any suggestions to reduce the number of cyclists along Elgeseter street's sidewalk?
5. Do you know any measures that can help reduce noise and air pollution caused by traffic?
6. Can you think of other changes or additions that can improve Elgeseter street's road and traffic conditions?

### CREATING A REALISTIC ROAD DESIGN

7. Are there any other challenges you can think of that should be considered when preparing a new road design?
8. The geometric design of the street is determined by Handbooks V120 and N100, are there other requirements from other sources that should be taken into account?
9. Are there any legal documents I should review before I start preparing the road design?

## Appendix 4 - Interview consent form

### **Do you want to participate in the research project *"Master's thesis – Elgeseter street"***

This is a question for you to participate in a research project where the purpose is to find a better solution for the road design of Elgeseter Gate in Trondheim, focusing on area management, increasing social activity and comfort. In this document, we provide you with information about the goals of the project and what participation will mean for you.

#### **Purpose**

This assignment will be a continuation of a feasibility study the student has been working on in the fall of 2022. The student has previously collected data and presented alternatives for road design of Elgeseter Street that focus on pedestrians, area management and social neighborhoods. The master's thesis should focus on creating a more concrete and detailed solution for Elgeseter gate, based on evaluations of collected data and proposed alternatives.

The final design should prioritize the social aspects of streets and location while considering the priority of Metro buses, emergency vehicles, key areas and buildings of antiquarian value. It should

**Research question:** What is a realistic and suitable solution for Elgeseter street considering social aspects and comfort?

**Sub-question 1:** What implementations can make Elgeseter street more social?

**Sub-question 2:** What implementations can make Elgeseter street more comfortable?

### **Who is responsible for the research project?**

The Norwegian University of Science and Technology is responsible for the project, and collaborates with Trøndelag Fylkeskommune through a co-supervisor; Mahgol Afshari.

### **Why are you asked to participate?**

The student wants to interview professionals that work with transport, road and area management, who can contribute with thoughts and advice regarding the development of Elgeseter Street in Trondheim.

### **What does it mean for you to participate?**

If you choose to participate in the project, this means that you participate in an interview with audio recordings of approx. 30 min to one hour. The interview contains questions about alternative solutions for road design, challenges at Elgeseter gate and your opinion on different solutions.

### **Participation is voluntary**

Participation in the project is voluntary. If you choose to participate, you can withdraw your consent at any time without giving any reason. All your personal data will then be deleted. It will not have any negative consequences for you if you do not want to participate or later choose to withdraw.

### **Your privacy – how we store and use your information**

We will only use your information for the purposes we have disclosed in this statement. We treat the information confidentially and in accordance with the privacy regulations.

The student, supervisor at NTNU, and co-supervisor at Trøndelag Fylkeskommune will have access to information. Name and contact information will be replaced with a code that is stored on a separate list of names separate from other data.

In the thesis, it will only be necessary to state the job title, but it should be noted that participants can be recognized if the job title is relatively unique.

### **What happens to your personal data when the research project ends?**

The project is scheduled to end on 11.06.2023. After the end of the project, the data material containing your personal data will be anonymised and replaced with a formal title.

### **What gives us the right to process personal data about you?**

We process information about you based on your consent.

On behalf of the Norwegian University of Science and Technology, Sikt – the knowledge sector's service provider has assessed that the processing of personal data in this project is in accordance with the privacy regulations.

## Your rights

As long as you can be identified in the data material, you have the right to:

- access to what information we process about you, and to receive a copy of the information
- to have information about you corrected that is incorrect or misleading
- to have personal data about you deleted
- to lodge a complaint with the Norwegian Data Protection Authority about the processing of your personal data

If you have any questions about the trial, or would like to know more about or exercise your rights, please contact:

- NTNU at Alenka Temeljotov-Salaj.
- Our data protection officer:  
Thomas Helgesen  
[thomas.helgesen@ntnu.no](mailto:thomas.helgesen@ntnu.no)  
93 07 90 38

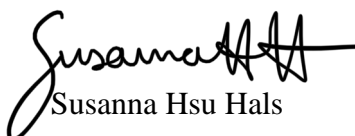
If you have any questions related to the assessment made by the privacy services from Sikt, please contact us via:

- Email: [personvernjenester@sikt.no](mailto:personvernjenester@sikt.no) or phone: 73 98 40 40.

Best regards



Alenka Temeljotov-Salaj  
(Researcher/supervisor)



Susanna Hsu Hals

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## Declaration of consent

I have received and understood information about the project “*Master’s thesis – Elgeseter street*”, and have had the opportunity to ask questions. I agree to:

- to participate in interviews.

I consent to my data being processed until the project is completed

---

(Signed by project participant, date)

## Appendix 5 – Final design for Elgeseter Street

### The final design

This paper contains a detailed description of the final street design for Elgeseter Street with a focus on improving social aspects and walkability. Additionally, there are technical drawings made using ArchiCAD showing overviews of the road plan as well as cross sections. There have also been rendered more realistic photos from a 3D-model of the street design.

#### 1 Description

This chapter contains a description of the suggested final Elgeseter street design. There are several short descriptions and illustrations showing different parts and decisions made for Elgeseter Street in this study's street design.

##### 1.1 Focus area

The focus area for this project is illustrated in Figure 1-1 below, outlined in orange. The area was determined by the border of buildings lining the street, and areas with potential for pocket parks have been included in the focus area as well.

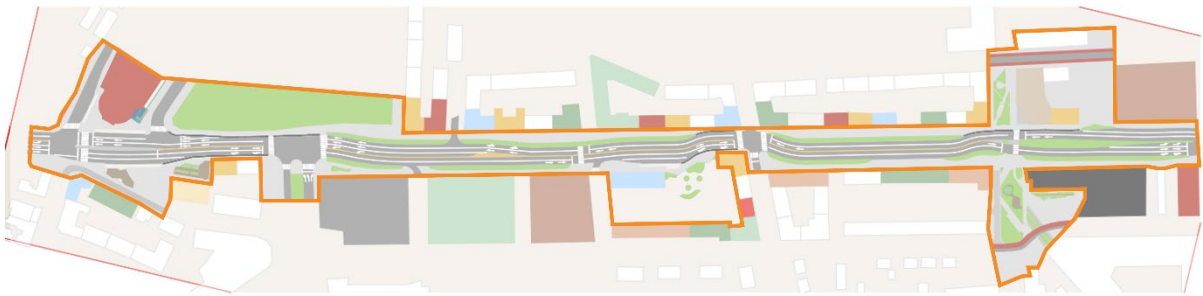


Figure 1-1: Focus area for Elgeseter Street's new design, marked in orange. (Made by: Susanna Hsu Hals)

##### 1.2 Centre line

The centre line of the new road is marked in red in Figure 1-2 below. By Studentersamfundet it is connected to the existing centre line on Elgeseter Bridge, and by Handelshøyskolen it connects to the existing grass divider in the middle of the road. The new centre line is curved to slow traffic and make the road more interesting. In wider areas, the centre line is further west to make room on the east sidewalk due to the sun conditions in the afternoon. In areas by Elgeseter Street 4, 6, and 30B the buildings stick out and force the centre line further east again, making the line curvy.

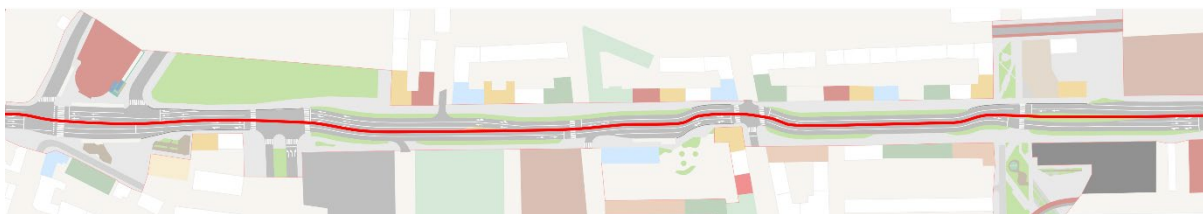


Figure 1-2: Illustration of Elgeseter Street showing the centre line of the new suggested street design. (Made by: Susanna Hsu Hals)

### 1.3 Cross sections

Due to the change in widths between buildings along Elgeseter Street, the cross sections vary to meet the minimum width requirements. The three types of cross sections and their widths are shown in Figure 1-3 to Figure 1-5. The narrowest cross section is used by Elgeseter Street 4, 6, and 30 B, while the default cross section used in other areas has green dividers with rows of trees between sidewalks and the road. The cross-section with a green divider in the middle is kept from the street design by Handelshøyskolen today. There might have to be deviations related to the widths of sidewalks where the street is too narrow, however, they should not be much less than 3 meters wide. Certain areas are also wider because of pockets with bus stops and left turn lanes.

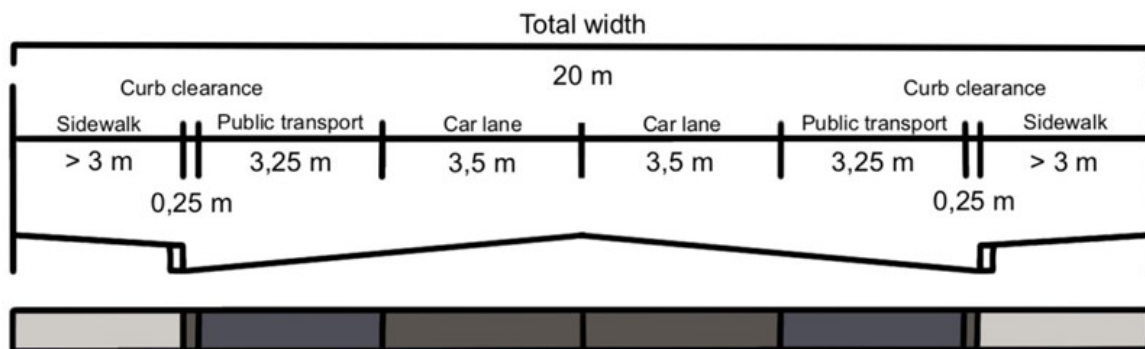


Figure 1-3: Width and structure of cross section with no dividers. (Made by: Susanna Hsu Hals)

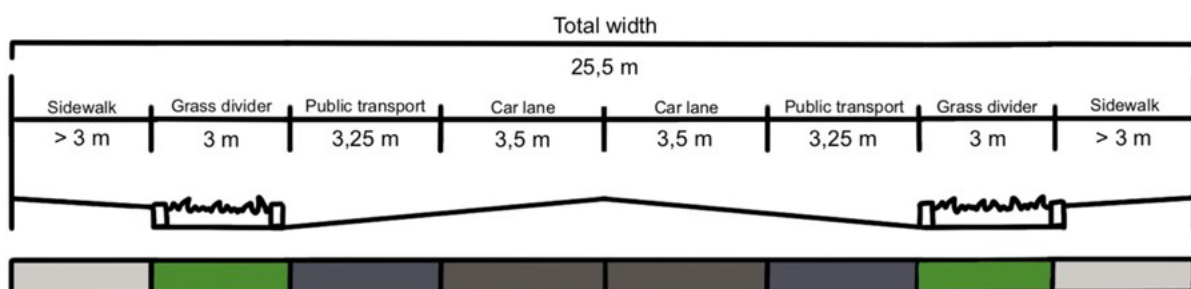


Figure 1-4: Width and structure of cross section with grass dividers between vehicle lanes and sidewalks. (Made by: Susanna Hsu Hals)

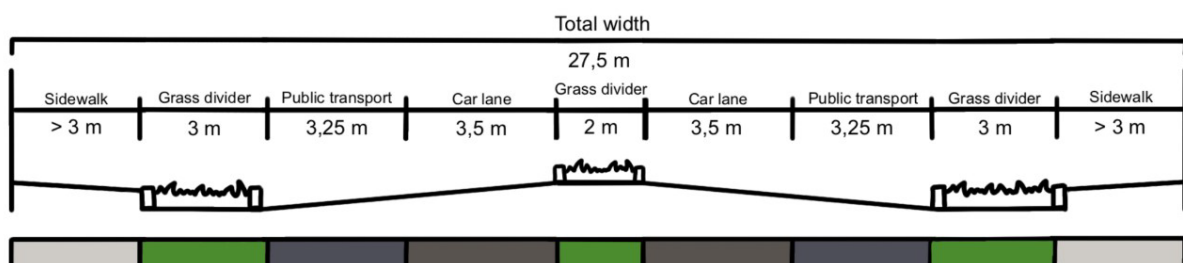


Figure 1-5: Width and structure of cross section with grass divider in the middle of the road and separating vehicle lanes and sidewalks. (Made by: Susanna Hsu Hals)

## 1.4 Crosswalks

When creating the new design for Elgeseter Street, the student kept the existing ones and added two new crosswalks. The new crosswalks are marked below in Figure 1-6.

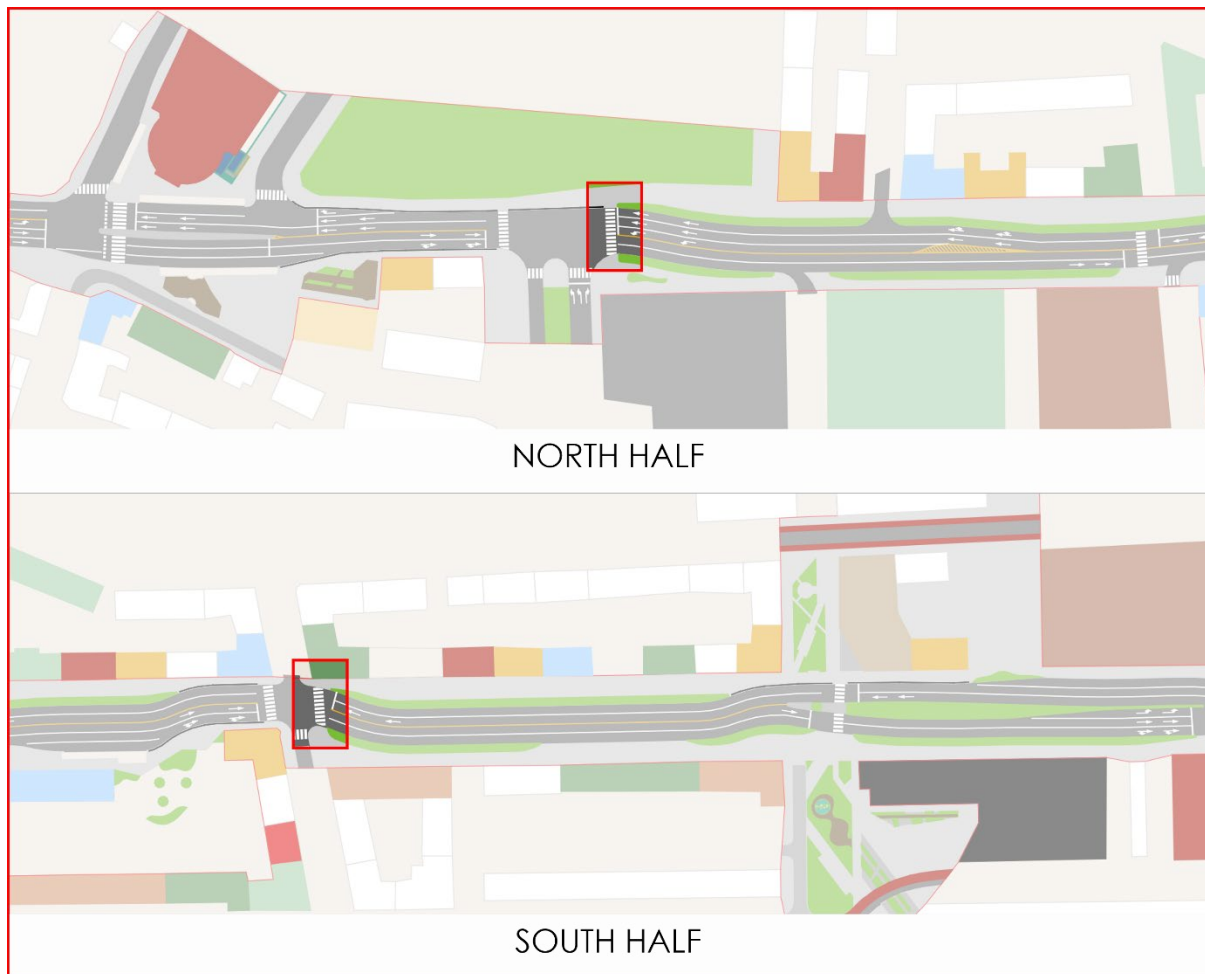


Figure 1-6: Illustration of Elgeseter Street's new design with new added crosswalks highlighted. (Made by: Susanna Hsu Hals)

## 1.5 Renovations of facades

For this study, the student has evaluated the facades along Elgeseter Street and picked out buildings that can be renovated to improve the aesthetics. The photos of facades are taken from Google Streetview and then digitally edited to look renovated. Some of the older facades have been cleaned, and colours from the Trondheim palette have been added to some old and new buildings. Figure 1-7 shows the Trondheim palette used for inspiration, as well as the colours of facades today and the new suggested colours. The student has chosen to let the newer buildings keep their facades as they are while most of the older ones have been coloured. Figure 1-8 shows a closer look at some of the older facades with existing colours and the new digitally renovated facades. These buildings can be found on Elgeseter Street 31B, 33, 35, 37, and 39.

Kine Angelo's Trondheim Palette



Today's facade colours along Elgeseter street



Suggestion for new facade colours along Elgeseter street



Figure 1-7: Illustration showing Kine Angelo's Trondheim Palette, existing facade colours along Elgeseter Street and the new suggested colours for this project. (Made by: Susanna Hsu Hals)

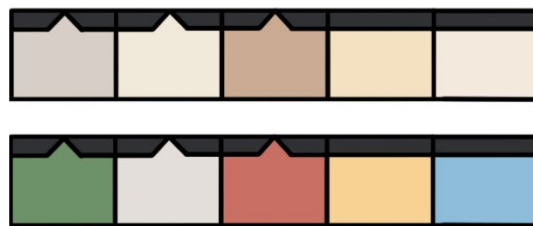


Figure 1-8: Illustration showing a close-up of certain buildings before and after editing with renovations and new colours from the Trondheim Palette. (Made by: Susanna Hsu Hals)



## 1.6 Pocket parks

Removing parking areas along Elgeseter Street opens up several areas that can be utilized to add pocket parks. Figure 1-9 shows pocket parks the student has decided to place in the new design.

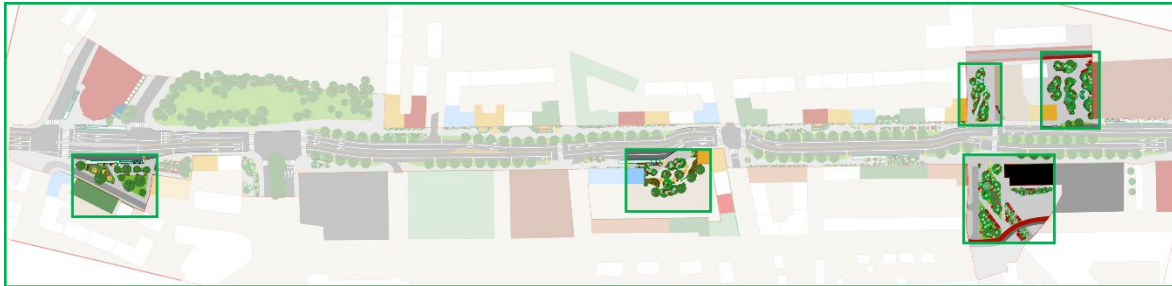


Figure 1-9: Overview of Elgeseter Street's new design with the added pocket parks highlighted. (Made by: Susanna Hsu Hals)

## 1.7 Stores, restaurants, and cafés

The new design has social businesses like cafés, restaurants and shops on the first floors of several buildings. They are all placed on the east side that now has wider sidewalks and more room for seating connected to these businesses. Figure 1-10 shows an overview of social businesses in the new design, where restaurants and cafés are highlighted in pink while shops are highlighted in blue.

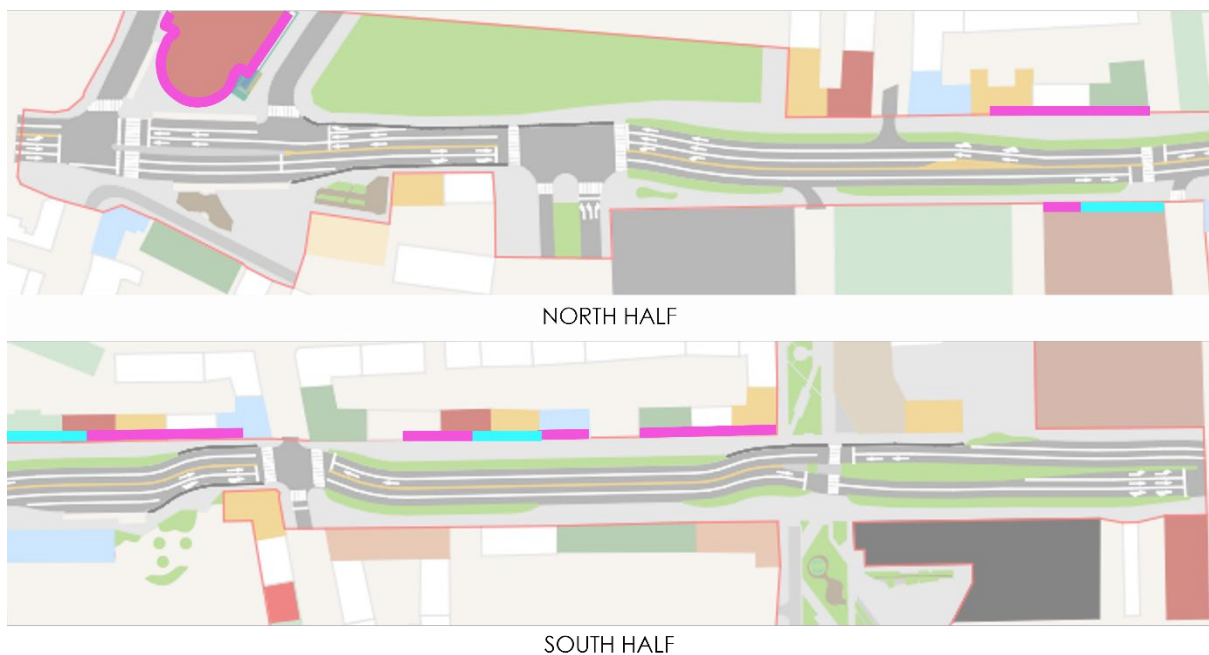


Figure 1-10: Overview of Elgeseter Street with added social businesses highlighted in pink and blue. (Made by: Susanna Hsu Hals)

## 2 Technical drawings

# Project: Elgeseter Street Design

Trondheim Municipality



## Drawing List

Project: Elgeseter Street Design

Trondheim Municipality

Drawing nr.	Drawing title	Date	Sign.
A101	Front page	07.06.23	SHH
A102	Drawing list	07.06.23	SHH
B101	Plan – Entire Elgeseter Street	30.05.23	SHH
C101	Plan – Part 1	30.05.23	SHH
C102	Plan – Part 2	30.05.23	SHH
C103	Plan – Part 3	30.05.23	SHH
C104	Plan – Part 4	30.05.23	SHH
E101	Cross section – Studentersamfundet	01.06.23	SHH
E102	Cross section – St. Olav's and park	01.06.23	SHH
E103	Cross section – Elgeseter Street 30B	01.06.23	SHH
F101	Profile – Studentersamfundet	04.06.23	SHH
F102	Profile – Elgeseter Street 6 and 7	07.06.23	SHH
F103	Profile – Elgeseter Street 18 and 19	07.06.23	SHH
F104	Profile – Elgeseter Street 30B	07.06.23	SHH



**B101: Plan of entire Elgeseter Street**

The drawing shows the entire Elgeseter Street design from Elgeseter Bridge to Handelshøyskolen.

The upper plan show the simplified design, while the lower plan include all details. The buildings are coloured in their suggested facade colours based on the study.

- Border of Area Restriction
- Grass
- Sidewalk
- Road
- Buildings
- Trees

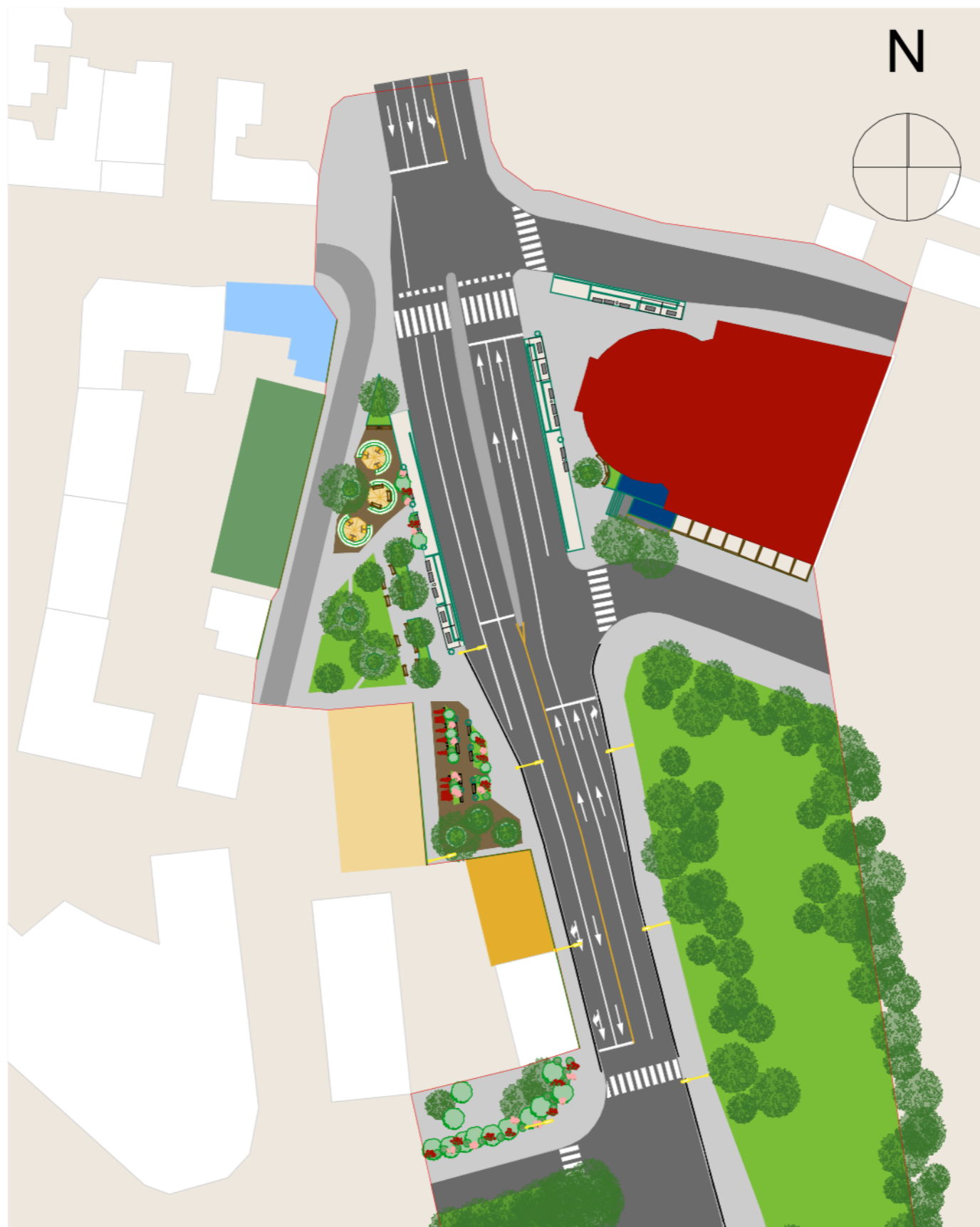


Project <b>Elgeseter street design</b>	Date: <b>30.05.23</b>
Organization: <b>NTNU</b>	Sign.: <b>SHH</b>
Drawn by: <b>Susanna Hsu Hals</b>	Drawing Scale A3: <b>1:2500</b>
Drawing: <b>Plan - Entire Elgeseter Street</b>	Drawing nr.: <b>B101</b>

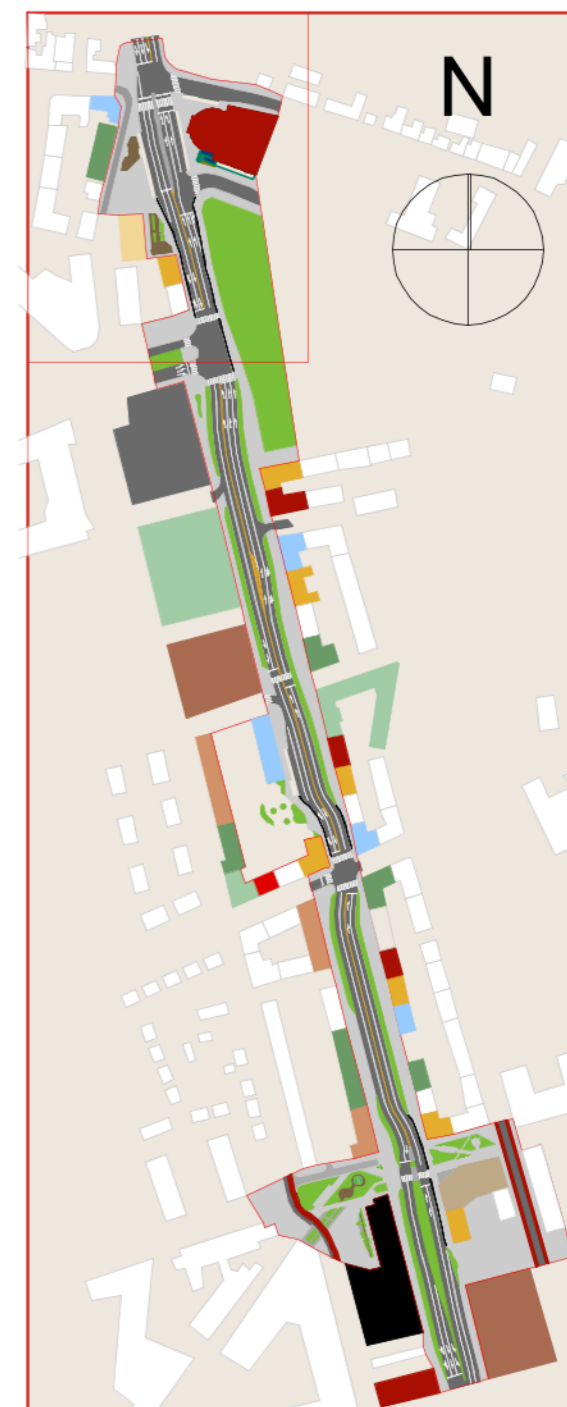
**C101: Plan - Part 1**

The drawing shows Part 1/4 of the Elgeseter Street design.  
The buildings are coloured in their suggested facade colours based on the study.

- Border of Area Restriction**
- Grass**
- Sidewalk**
- Road**
- Buildings**
- Trees**









ARCHICAD EDUCATION VERSION



Project: <b>Elgeseter street design</b>	Date: <b>30.05.23</b>
Organization: <b>NTNU</b>	Sign.: <b>SHH</b>
Drawn by: <b>Susanna Hsu Hals</b>	Drawing Scale A3: <b>1:1000 / 1:5000</b>
Drawing: <b>Plan - Part 1</b>	Drawing nr.: <b>C101</b>

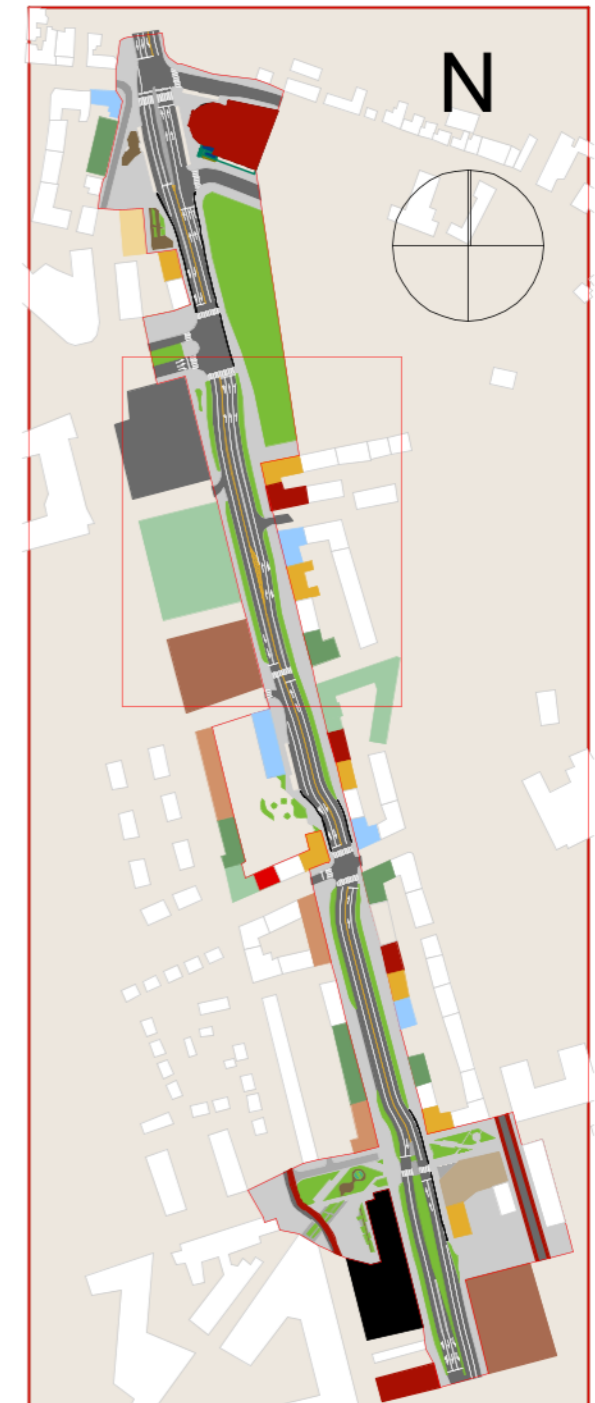
### C102: Plan - Part 2

The drawing shows Part 2/4 of the Elgeseter Street design.  
The buildings are coloured in their suggested facade colours based on the study.

-  **Border of Area Restriction**
-  **Grass**
-  **Sidewalk**
-  **Road**
-  **Buildings**
-  **Trees**



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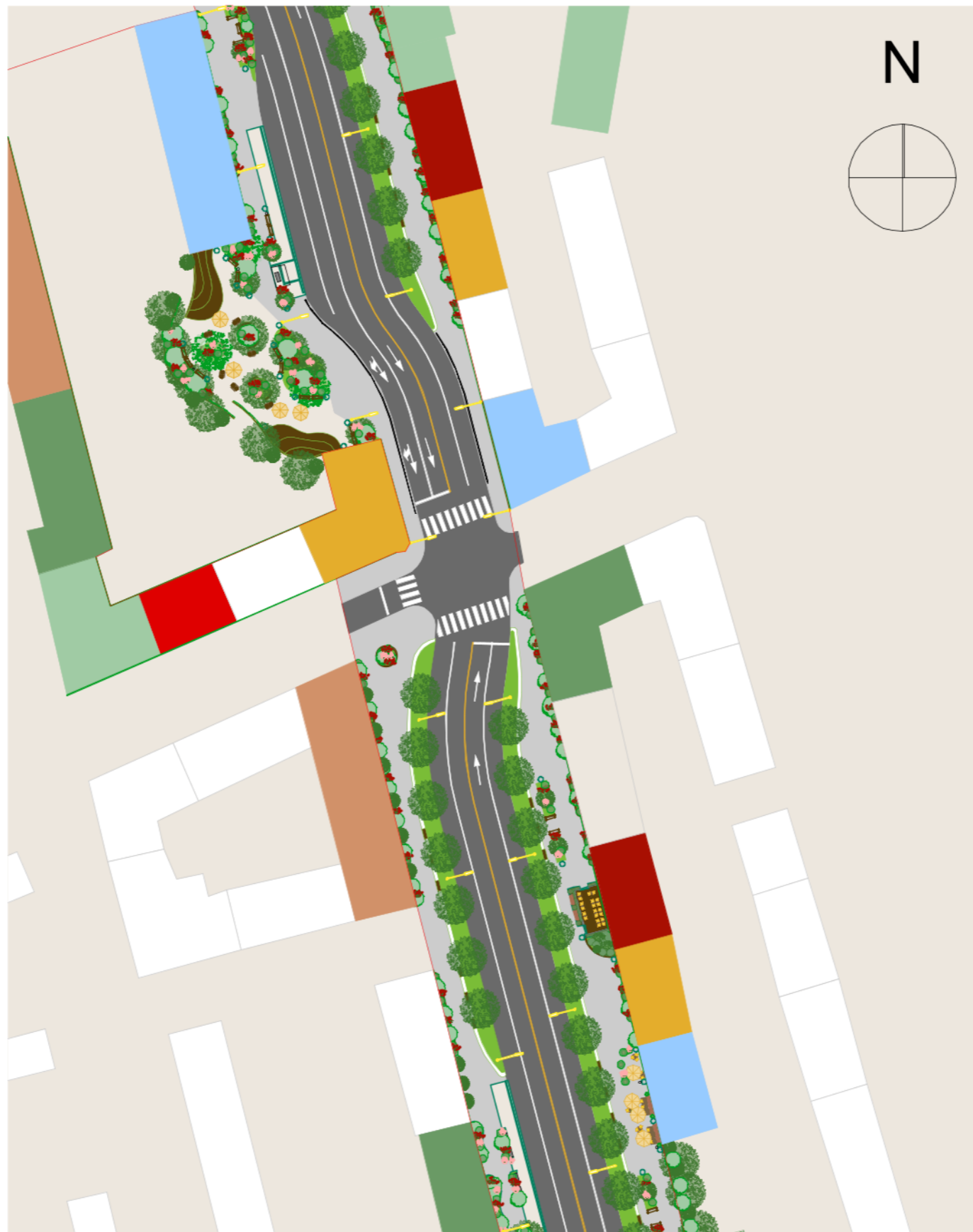
Project: <b>Elgeseter street design</b>	Date: <b>30.05.23</b>
Organization: <b>NTNU</b>	Sign.: <b>SHH</b>
Drawn by: <b>Susanna Hsu Hals</b>	Drawing Scale A3: <b>1:1000 / 1:5000</b>
Drawing: <b>Plan - Part 2</b>	Drawing nr.: <b>C102</b>

**C103: Plan - Part 3**

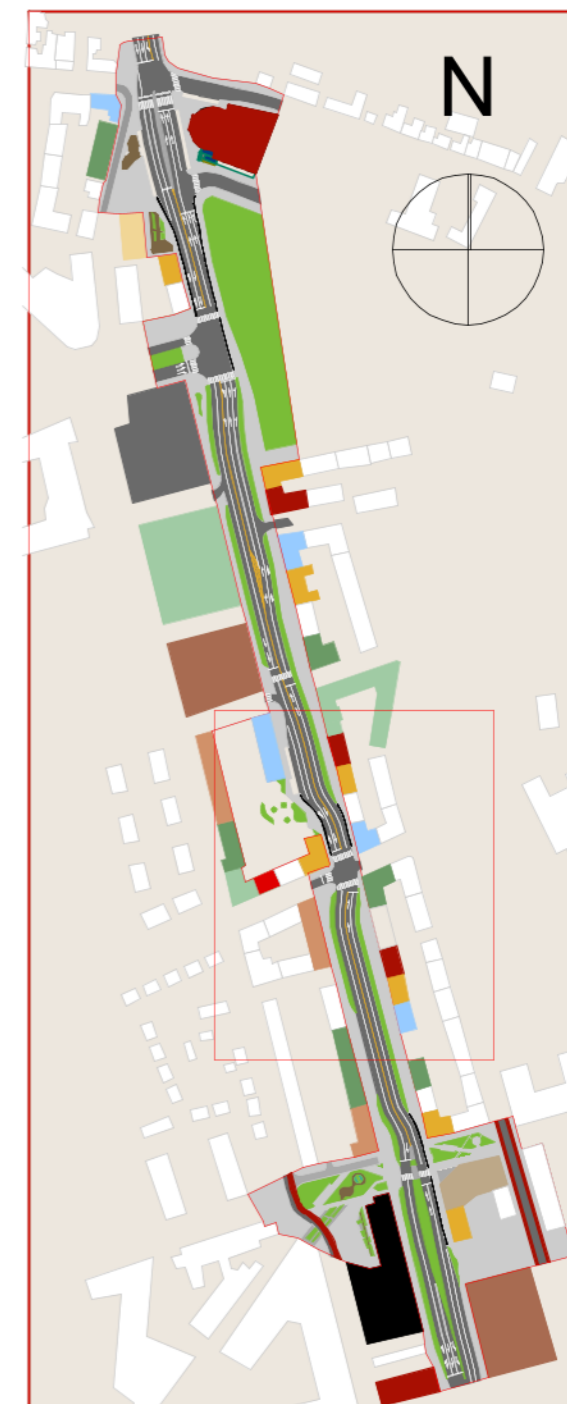
The drawing shows Part 3/4 of the Elgeseter Street design.

The buildings are coloured in their suggested facade colours based on the study.

-  **Border of Area Restriction**
-  **Grass**
-  **Sidewalk**
-  **Road**
-  **Buildings**
-  **Trees**



ARCHICAD EDUCATION VERSION

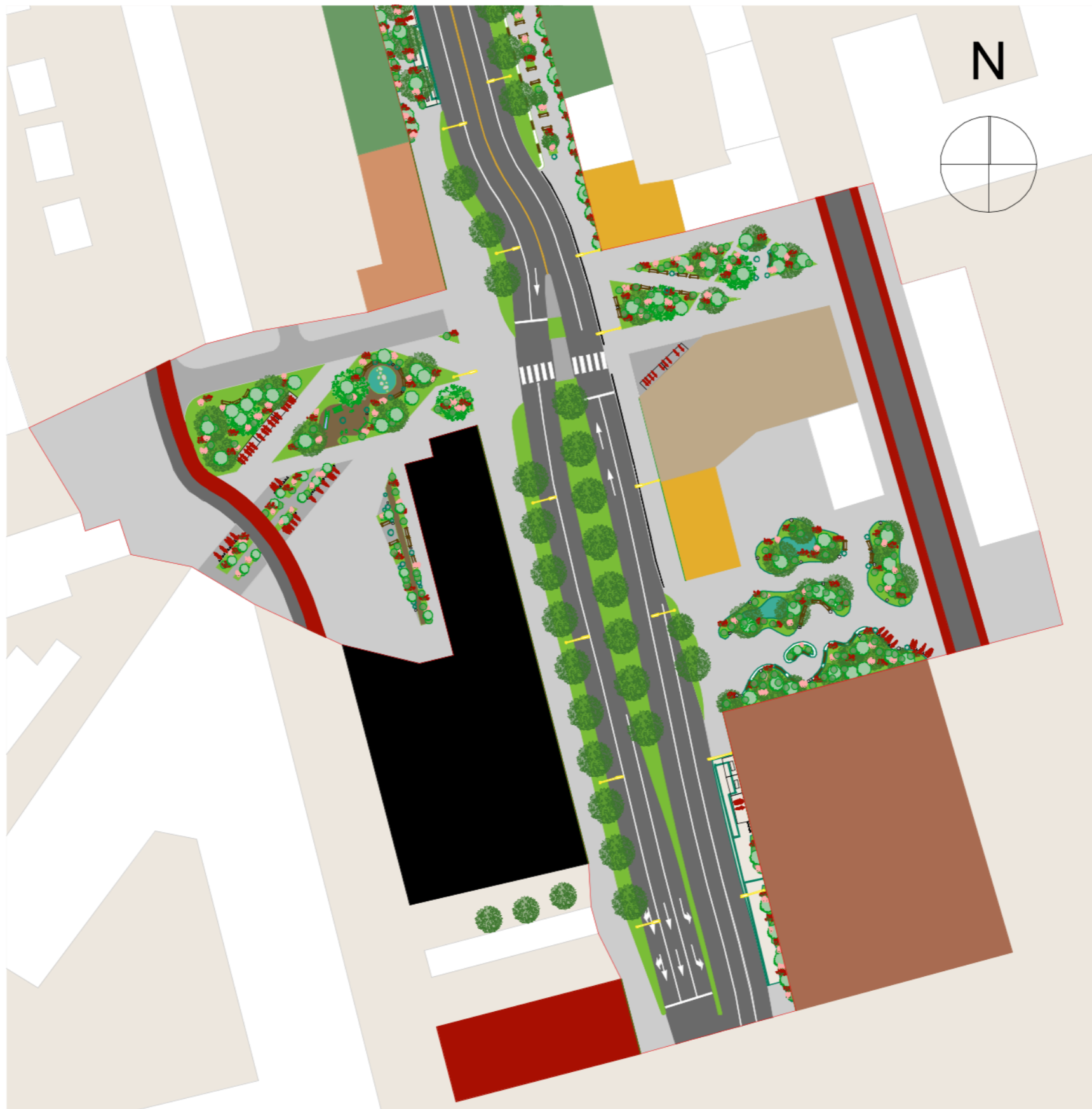


Project: <b>Elgeseter street design</b>	Date: <b>30.05.23</b>
Organization: <b>NTNU</b>	Sign.: <b>SHH</b>
Drawn by: <b>Susanna Hsu Hals</b>	Drawing Scale A3: <b>1:1000 / 1:5000</b>
Drawing: <b>Plan - Part 3</b>	Drawing nr.: <b>C103</b>

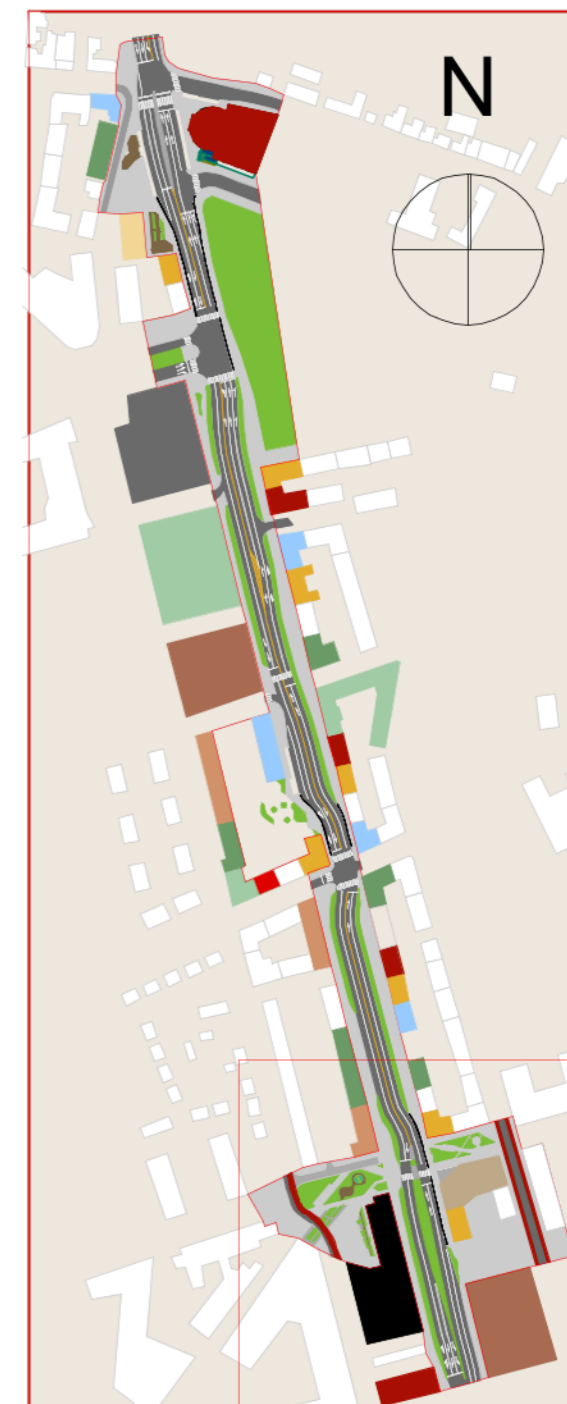
**C104: Plan - Part 4**

The drawing shows Part 4/4 of the Elgeseter Street design. The buildings are coloured in their suggested facade colours based on the study.

-  **Border of Area Restriction**
-  **Grass**
-  **Sidewalk**
-  **Road**
-  **Buildings**
-  **Trees**



ARCHICAD EDUCATION VERSION



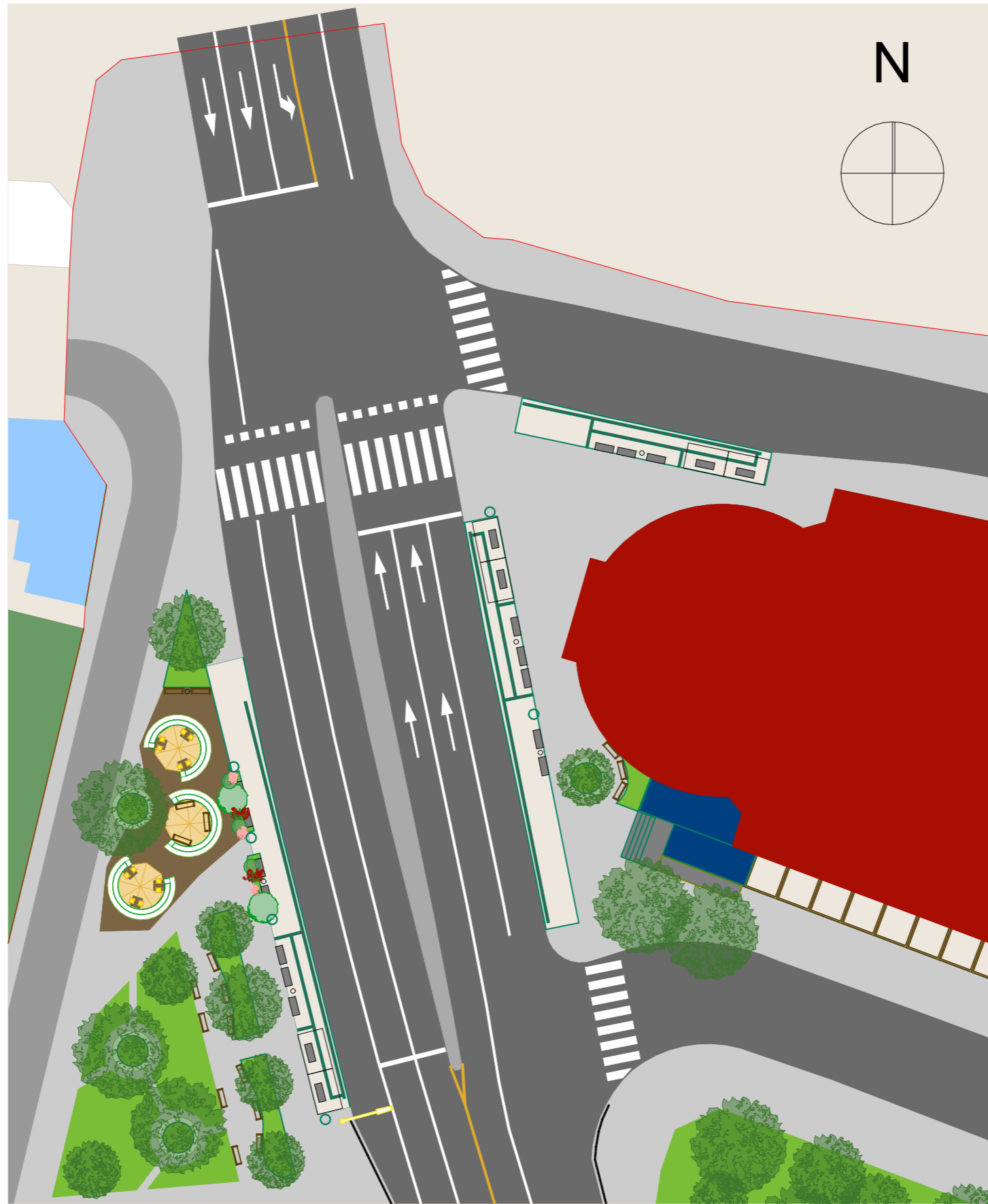
Project: <b>Elgeseter street design</b>	Date: <b>30.05.23</b>
Organization: <b>NTNU</b>	Sign.: <b>SHH</b>
Drawn by: <b>Susanna Hsu Hals</b>	Drawing Scale A3: <b>1:1000 / 1:5000</b>
Drawing: <b>Plan - Part 4</b>	Drawing nr.: <b>C104</b>



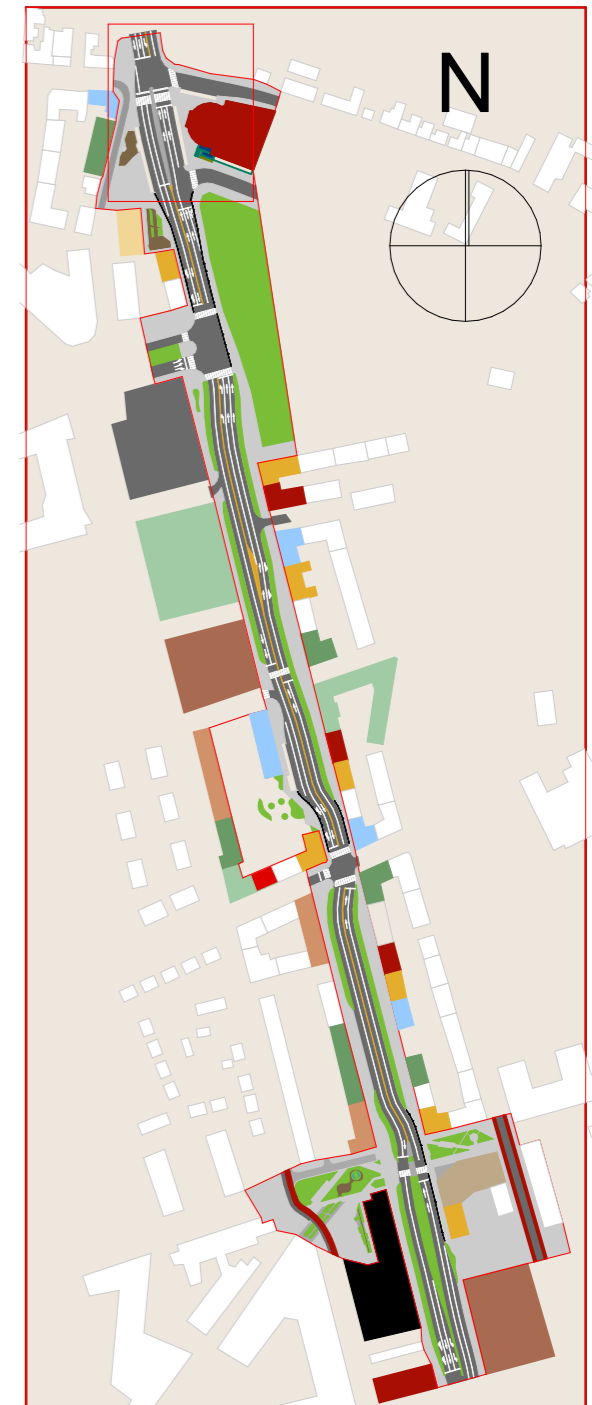
**E101: Cross Section - Studentersamfundet**

The drawing shows the furthest north cross section by Studentersamfundet. The buildings are coloured in their suggested facade colours based on the study.

- Border of Area Restriction**
- Grass**
- Sidewalk**
- Road**
- Buildings**
- Trees**



**ARCHICAD EDUCATION VERSION**

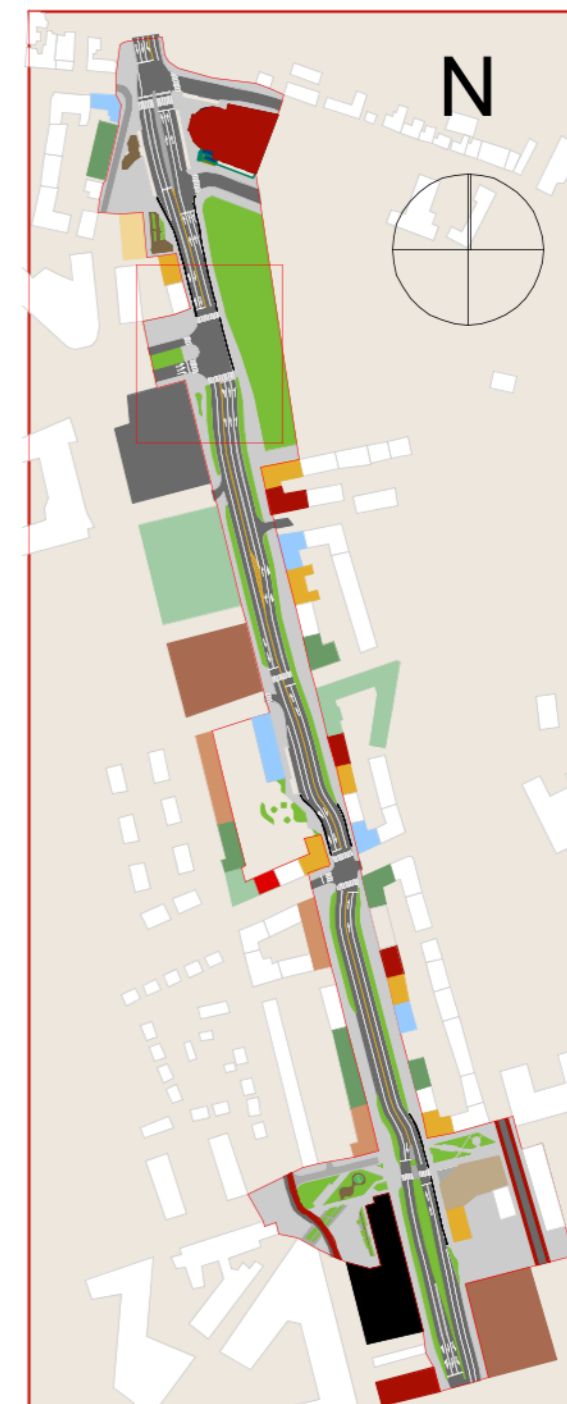


Project: <b>Elgeseter street design</b>	Date: <b>01.06.23</b>
Organization: <b>NTNU</b>	Sign.: <b>SHH</b>
Drawn by: <b>Susanna Hsu Hals</b>	Drawing Scale A3: <b>1:500 / 1:5000</b>
Drawing: <b>Cross Section - Studentersamfundet</b>	Drawing nr.: <b>E101</b>

**E102: Cross Section - St. Olav's and Park**

The drawing shows the cross section by St. Olav's Hospital and Høyskoleparken. The buildings are coloured in their suggested facade colours based on the study.







- Border of Area Restriction**
- Grass**
- Sidewalk**
- Road**
- Buildings**
- Trees**

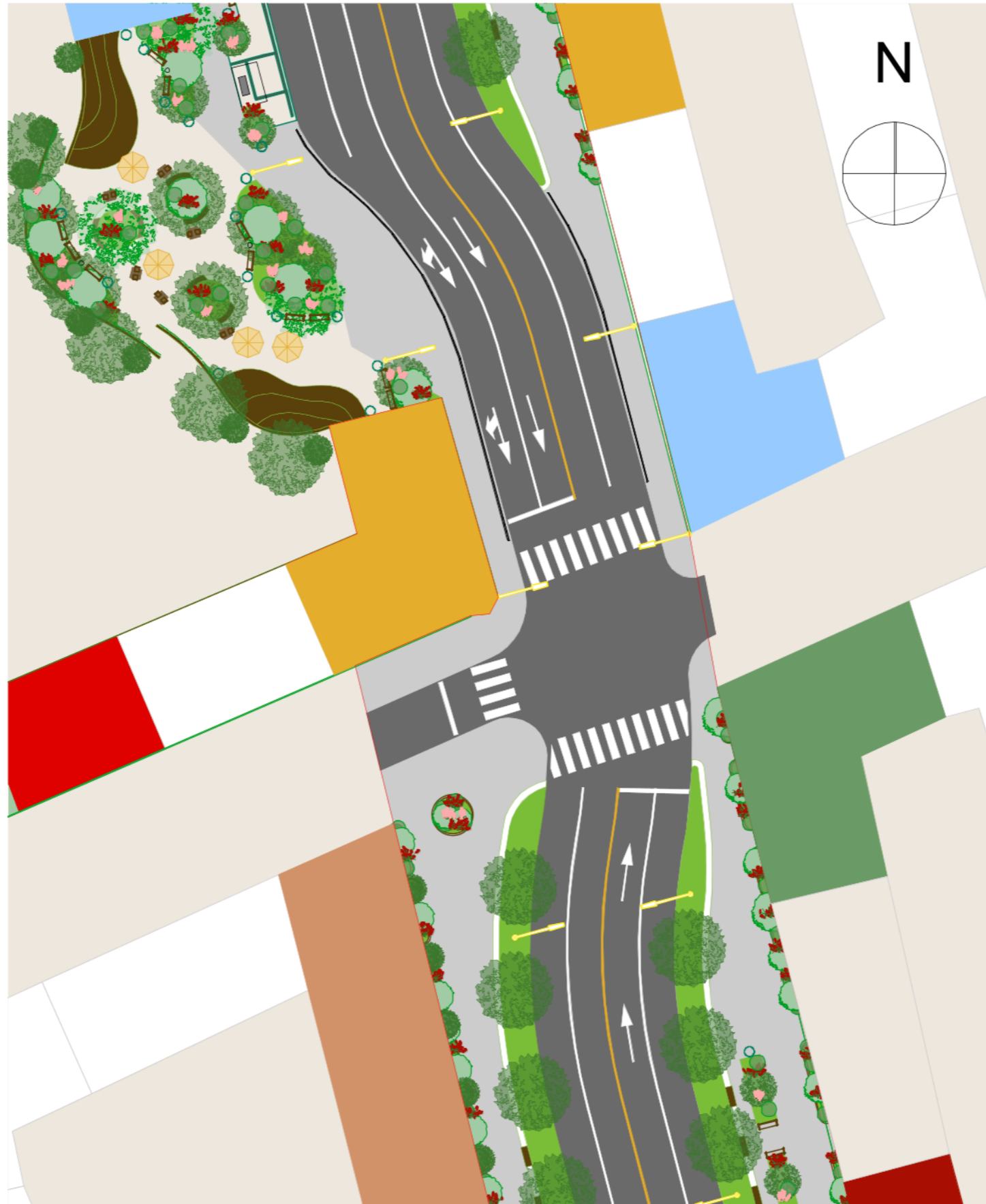


Project: <b>Elgeseter street design</b>	Date: <b>01.06.23</b>
Organization: <b>NTNU</b>	Sign.: <b>SHH</b>
Drawn by: <b>Susanna Hsu Hals</b>	Drawing Scale A3: <b>1:500 / 1:5000</b>
Drawing: <b>Cross Section - St. Olav's and Park</b>	Drawing nr.: <b>E102</b>

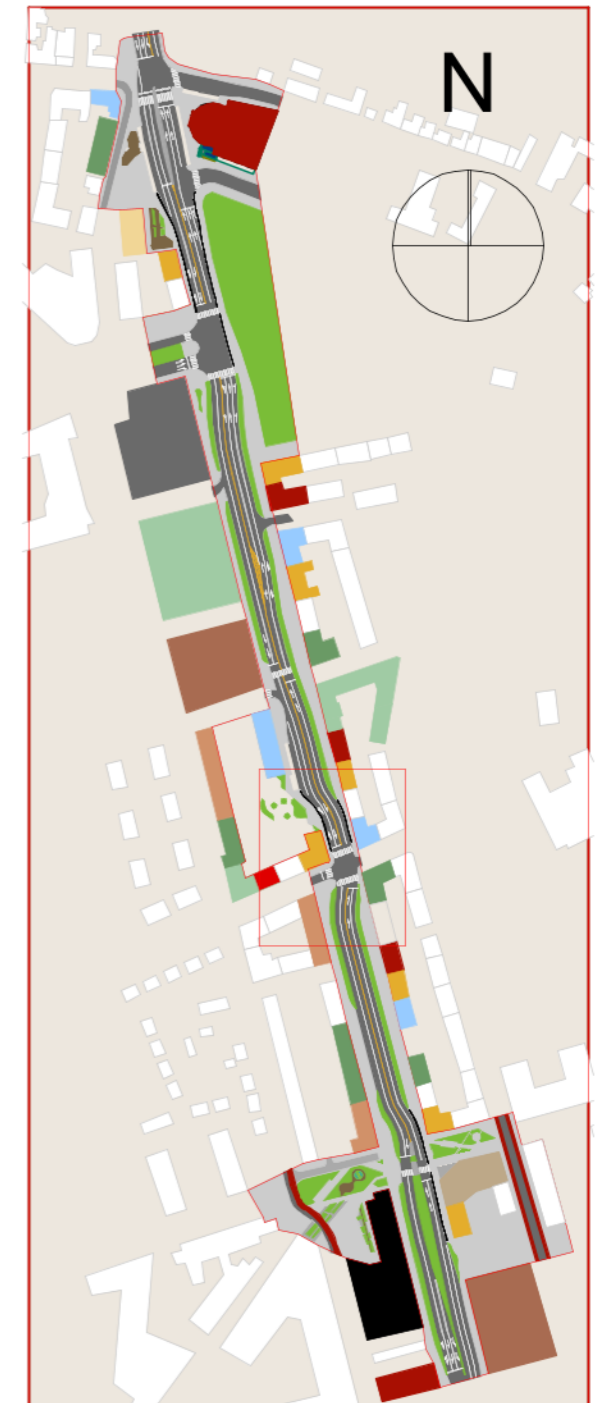
### E103: Cross Section - Elgeseter Street 30B

The drawing shows the cross section by Elgeseter Street 30B. The buildings are coloured in their suggested facade colours based on the study.

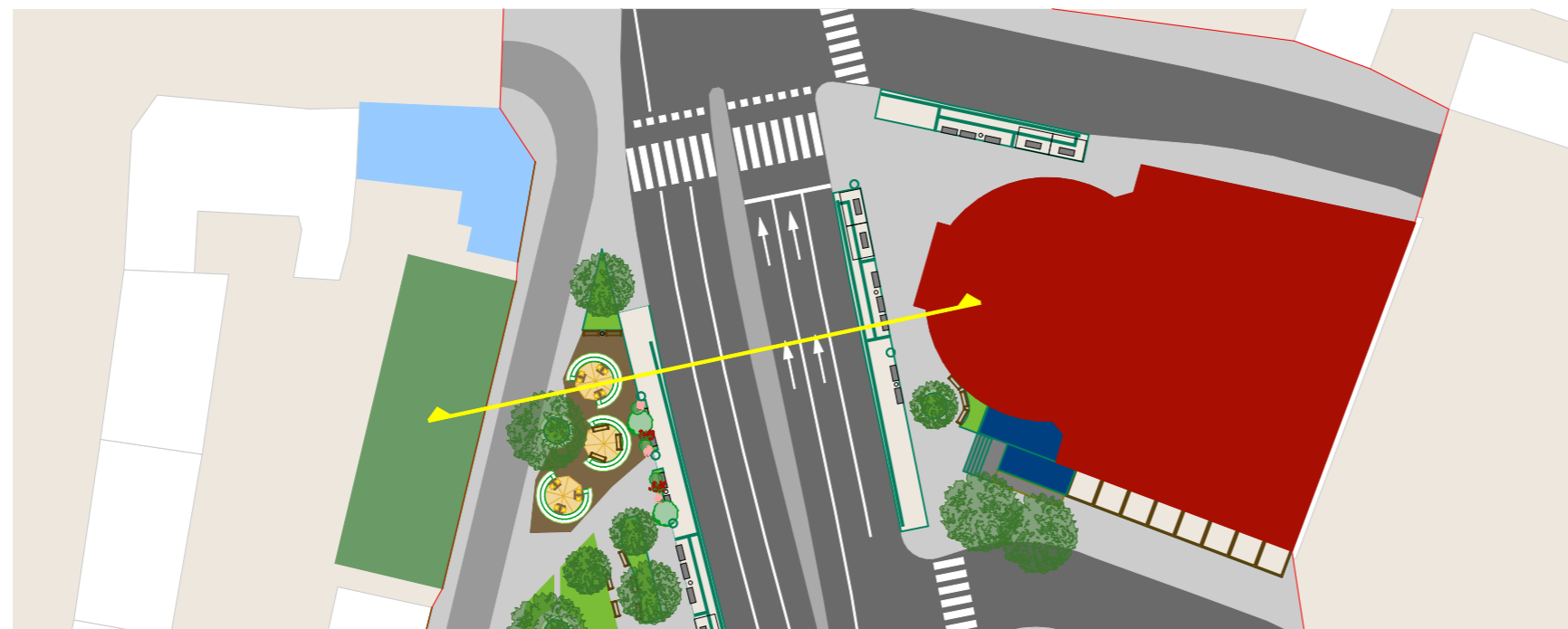
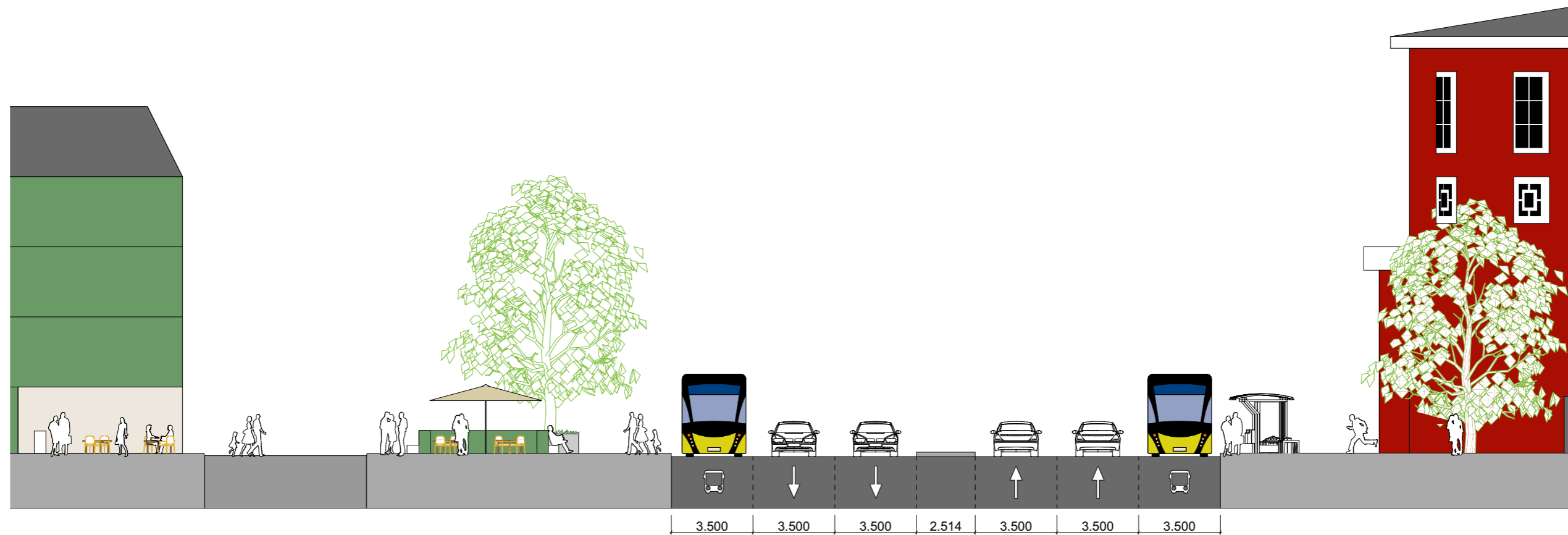
-  **Border of Area Restriction**
-  **Grass**
-  **Sidewalk**
-  **Road**
-  **Buildings**
-  **Trees**



ARCHICAD EDUCATION VERSION



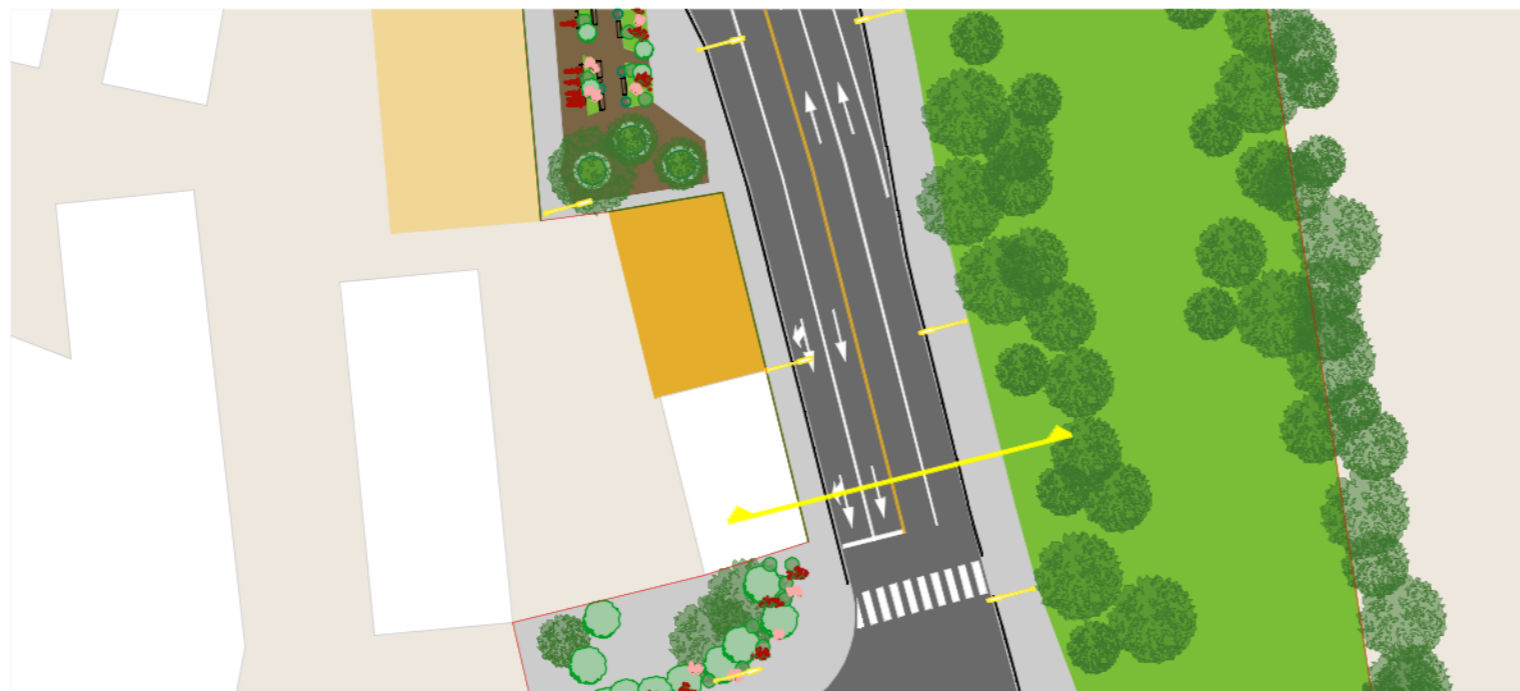
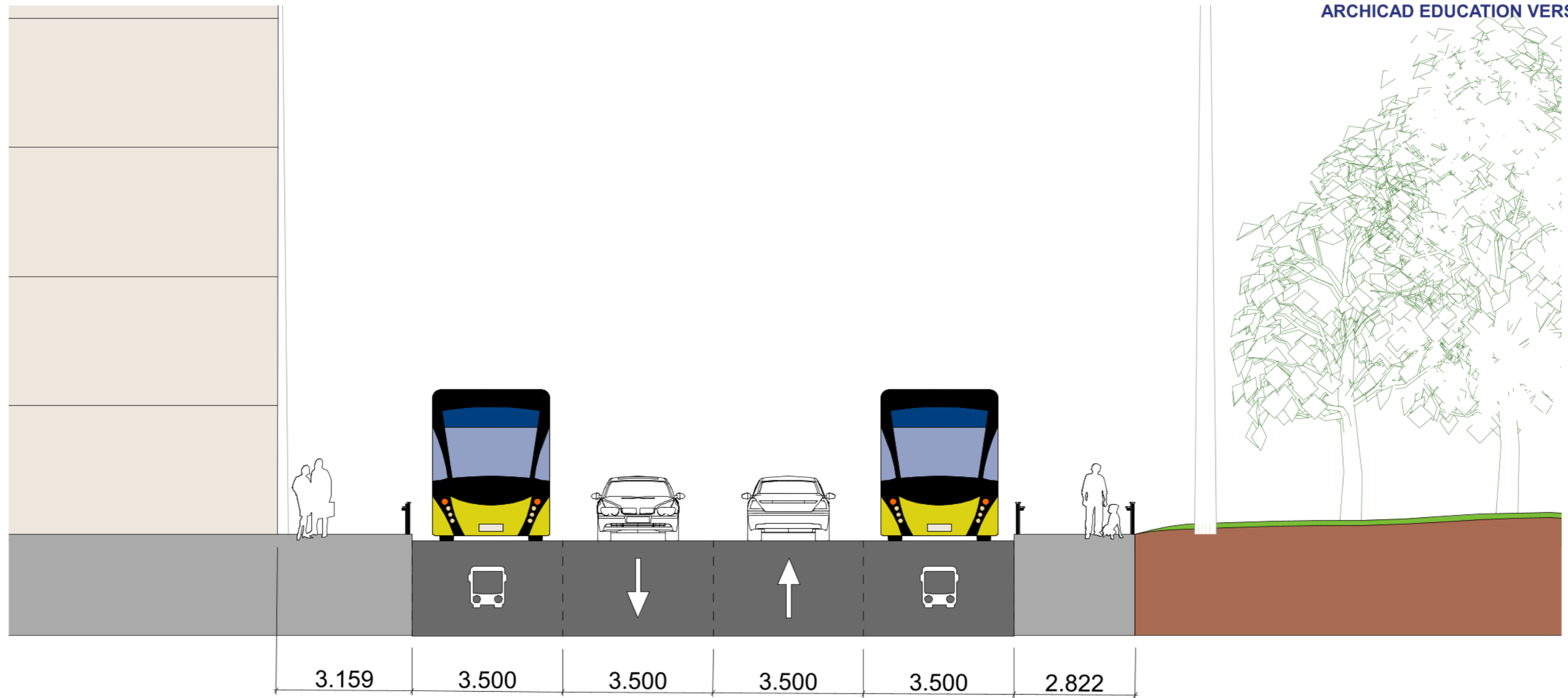
Project: <b>Elgeseter street design</b>	Date: <b>01.06.23</b>
Organization: <b>NTNU</b>	Sign.: <b>SHH</b>
Drawn by: <b>Susanna Hsu Hals</b>	Drawing Scale A3: <b>1:500 / 1:5000</b>
Drawing: <b>Cross Section - Elgeseter Street 30B</b>	Drawing nr.: <b>E103</b>



**F101: Profile - Studentersamfundet**

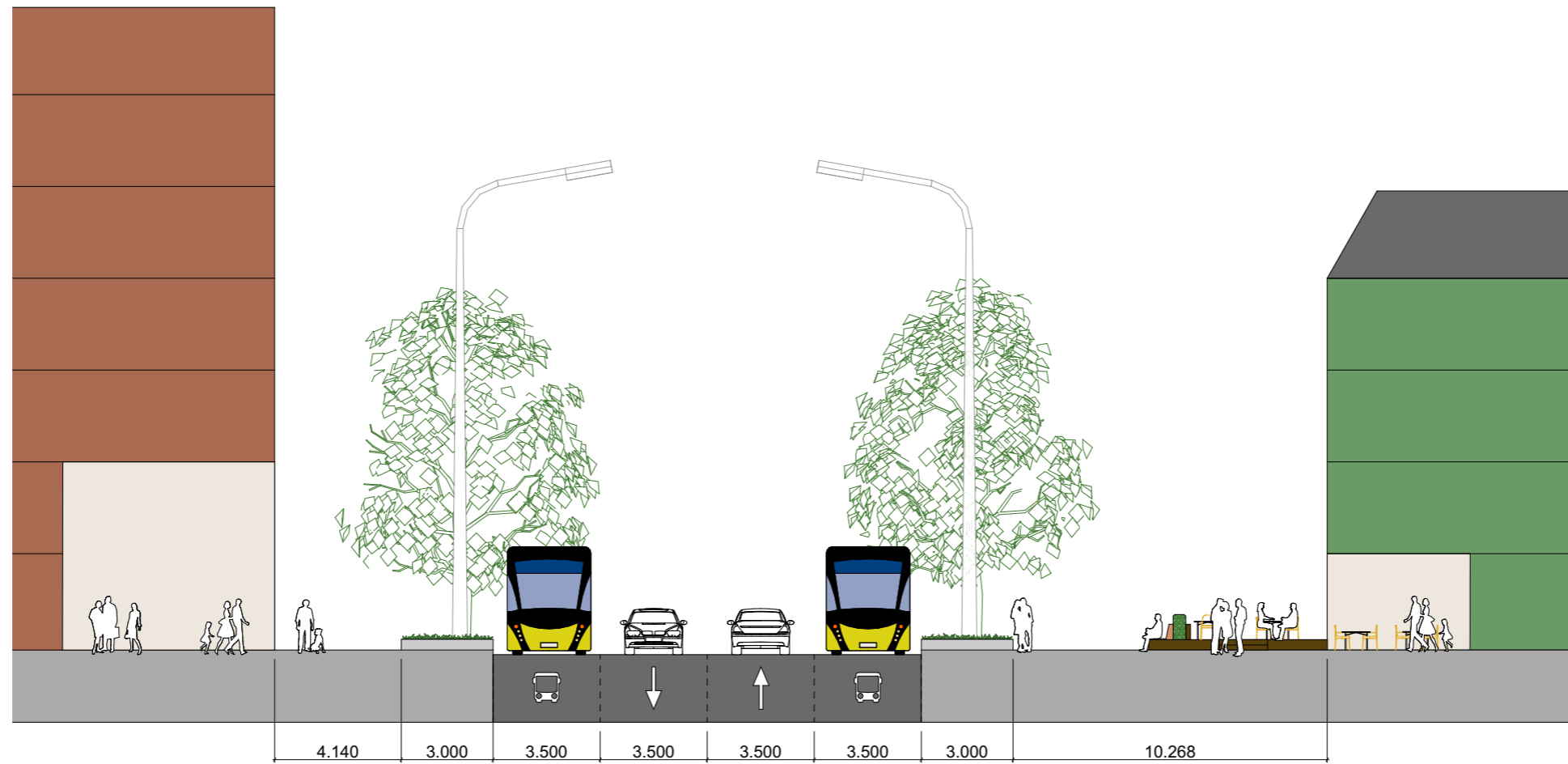
The drawing shows the profile of the street by Studentersamfundet looking north. The location of the profile is marked in yellow on the street plan below.

Project: <b>Elgeseter street design</b>	Date: <b>04.06.23</b>
Organization: <b>NTNU</b>	Sign.: <b>SHH</b>
Drawn by: <b>Susanna Hsu Hals</b>	Drawing Scale A3: <b>1:200 / 1:800</b>
Drawing: <b>Profile - Studentersamfundet</b>	Drawing nr.: <b>F101</b>



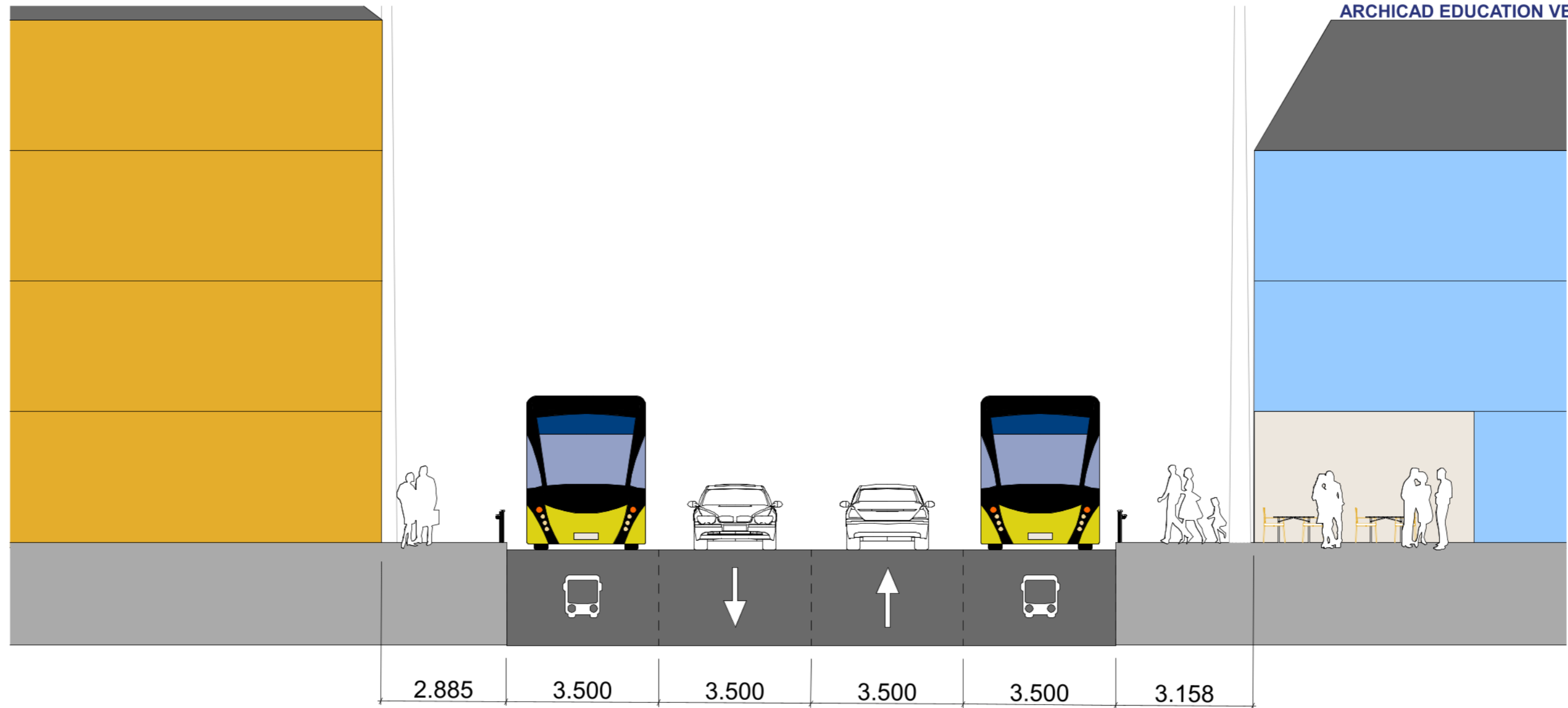
**F102: Profile - Elgeseter Street 6 and 7**  
 The drawing shows the profile of the street by Elgeseter Street 6 and 7 looking north. The location of the profile is marked in yellow on the street plan below.

Project: <b>Elgeseter street design</b>	Date: <b>07.06.23</b>
Organization: <b>NTNU</b>	Sign.: <b>SHH</b>
Drawn by: <b>Susanna Hsu Hals</b>	Drawing Scale A3: <b>1:100 / 1:800</b>
Drawing: <b>Profile - Elgeseter Street 6 and 7</b>	Drawing nr.: <b>F102</b>



**F103: Profile - Elgeseter Street 18 and 19**  
 The drawing shows the profile of the street by Elgeseter Street 18 and 19 looking north. The location of the profile is marked in yellow on the street plan below.

Project: <b>Elgeseter street design</b>	Date: <b>07.06.23</b>
Organization: <b>NTNU</b>	Sign.: <b>SHH</b>
Drawn by: <b>Susanna Hsu Hals</b>	Drawing Scale A3: <b>1:200 / 1:800</b>
Drawing: <b>Profile - Elgeseter Street 18 and 19</b>	Drawing nr.: <b>F103</b>



**F104: Profile - Elgeseter Street 30B**  
 The drawing shows the profile of the street by Elgeseter Street 30B looking north.  
 The location of the profile is marked in yellow on the street plan below.

Project: <b>Elgeseter street design</b>	Date: <b>07.06.23</b>
Organization: <b>NTNU</b>	Sign.: <b>SHH</b>
Drawn by: <b>Susanna Hsu Hals</b>	Drawing Scale A3: <b>1:100 / 1:800</b>
Drawing: <b>Profile - Elgeseter Street 30B</b>	Drawing nr.: <b>F104</b>

3 Renders from model





