

Which Governance Aspects Promote and Inhibit the Uptake of Nature-Based Solutions in Cities?

Sustainable Urban Drainage Systems in Tampere, Finland and Eindhoven, the Netherlands

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ABSTRACT

The 21st century is shaped by two major processes: Urbanisation and climate change. Cities are major contributors to global warming, while increasingly suffering from its impacts ([UN, 2018](#)). Grey infrastructure accompanied and supported urbanisation in the past. It now turns out to be insufficient when it comes to extreme weather events. Cities therefore need to find new answers to mitigate the causes of climate change and respond to the new challenges. Nature-Based Solutions ([NBS](#)) provide an answer to this problem. The [NBS](#) concept offers a new, more sustainable city development, embracing all approaches which bring nature back into the urban environment ([Kabisch et al., 2016](#)). In the [NBS](#) concept Sustainable Urban Drainage Systems ([SUDS](#)) are a promising means to re-naturalise urban water cycles ([Davis and Naumann, 2017](#)).

This study examines the development of [SUDS](#) in the two cities of Tampere and Eindhoven. Both cities are frontrunners in the application of [SUDS](#) in Europe. Semi-structured interviews with actors from the private, public and societal sector identify barriers and supporting governance aspects for the uptake of [SUDS](#).

Cooperation among different stakeholders, knowledge distribution about main benefits of the concept, the creation of a vision towards a common goal, personal commitment of individuals, the provision of sufficient funding and the support by science and politics are identified as major aspects promoting [SUDS](#) uptake. Eindhoven stands out with new approaches for cross-sectoral cooperation. Tampere fosters new ways of cooperation and tests the new solutions in two districts which are exempt from mainstream development.

Path dependency of public institutions, silo-thinking, lack of knowledge and vision, the lack of effective regulation, the exclusiveness of the development to expert groups and financial barriers are identified as main obstacles impeding further uptake. The new concept requires a change in administrative procedures, an organisational change of municipal institutions. For a further uptake cross-sectoral cooperation should be made the rule and stakeholder involvement should be encouraged. More evidence about performance and effectiveness of [SUDS](#) should be provided.

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ACRONYMS

BI	blue infrastructure	16
CIRIA	Construction Industry Research and Information Association ..	19
EbA	ecosystem-based adaption	4
EC	European Commission	2
EE	Ecological Engineering.....	16
ESS	ecosystem services	4
EU	European Union	8
GI	green infrastructure	4
ICLEI	International Council for Local Environmental Initiatives	65
IPCC	International Panel on Climate Change	39
IUCN	International Union for Conservation of Nature.....	16
NBS	Nature-Based Solutions	iii
OECD	Organisation for Economic Co-operation and Development	32
R4E	Roadmaps for Energy.....	66
SDGs	Sustainable Development Goals.....	27
SUDS	Sustainable Urban Drainage Systems.....	iii
SYKE	Suomen Ympäristökeskus - Finnish Environment Institute	99
TNC	the Nature Conservancy	16
UGI	urban green infrastructure	4
UN	United Nations	27
UNaLab	Urban Nature Labs	vii
WB	World Bank	16

1

INTRODUCTION

The topic of global climate change and the urgent need to react to and to diminish its consequences are omnipresent today. The problems and threats associated with this man-made phenomenon demand for changes in many aspects of human life. Cities are at the centre of this development. Worldwide the process of urbanisation is accelerating. This trend adds to the problems as urbanised structures are one of the major factors in anthropogenic climate change (UN, 2017). By the end of 2017 more than half of the world's population lived in cities. But by 2030, cities are projected to house up to 75% of the world population (UN, 2016; bpb, 2015). This number alone shows the important role urban environments play in dealing with impacts of climate change.

Cities are equally endangered by the consequences of anthropogenic climate change as natural environments. Today's urban consumption and production patterns are highly dependent on external material influx and functioning supply channels. Urban population density, its dependency on outside assistance and gaps in mitigation and coping strategies make cities extremely vulnerable to the projected consequences of climate change (Betsill and Bulkeley, 2007). These consequences include an increased chance of extreme weather events, rising sea levels, changing median temperatures and other numerous and complex-to-cope-with effects (Elmqvist, 2014).

On a global scale, 90% of all urban areas on earth are located in coastal regions. Others are on the banks of inland waterways or on rivers connected to the sea. So they are exposed to risks of flooding from rising sea levels and extreme weather events (Jabareen, 2013). The high proportion of concrete- or asphalt-sealed and built-up areas in cities increases the danger of flooding in times of increasing precipitation. Urban heat-island effects and prolonged periods of extreme heat or cold can also be among the side effects of city constructions because urbanised surface areas capture and store heat. Most modern cities are not equipped with the right infrastructure to cope with more frequent and stronger storms and other extreme weather events. Cities house most of the administrative, governmental, economic and social infrastructure of a country. Their protection should therefore receive special attention (Kabisch et al., 2016).

But cities are not only victims: Whereas -on the one hand- they are particularly vulnerable to the consequences of climate change, on the other hand they are also its major contributor. As UN (2017) note, that although covering "less than 2 percent of the earth's surface[,] cities consume 78 per cent of the world's energy and produce more than 60% of all carbon dioxide and significant amounts of other greenhouse gas emissions, mainly through energy generation, vehicles, industry, and biomass use".

According to UN (2017, p. 1) however, when properly planned, capacitated and managed cities can be "*places of innovation and efficiency*". These planning and managing principles from a governance point of view will be the main topic of this master thesis. Most scholars agree that cities must become more sustainable by reducing their negative impact on the natural

environment and by becoming more resilient to hazards like flooding or overheating. One of the numerous approaches towards urban sustainability are the so-called *Nature-Based Solutions (NBS)*.

The EC (2015) defines NBS as “[...] actions which are inspired by, supported by or copied from nature and [...] use the features and complex system processes of nature [...] in order to achieve [...] reduced disaster risk, improved human well-being and socially inclusive green growth [...].” NBS combine desired climate change adaptation and mitigation techniques while also incorporating ethical and social values in order to achieve a sustainable and inclusive development of urban areas. NBS contribute to climate change adaption as well as to climate change mitigation (Maes and Jacobs, 2015).

The master thesis is conducted in the context of the European research project UNaLab¹ funded by the European Commission (EC) Horizon 2020 Programme² in the cluster *Smart and Sustainable Cities*³. More specifically it is conducted in the Fraunhofer Institute of Industrial Engineering IAO and the Competence Team on Urban Governance Innovation⁴. The UNaLab Project consists of a consortium of 28 partners. Those partners are research institutions, private companies, municipalities and political bodies located around the world. They individually make contributions to the project. The main scope of the project is to facilitate and expand the use of NBS in cities. Focus is laid on providing proof for the effectiveness and the applicability of NBS to present challenges.

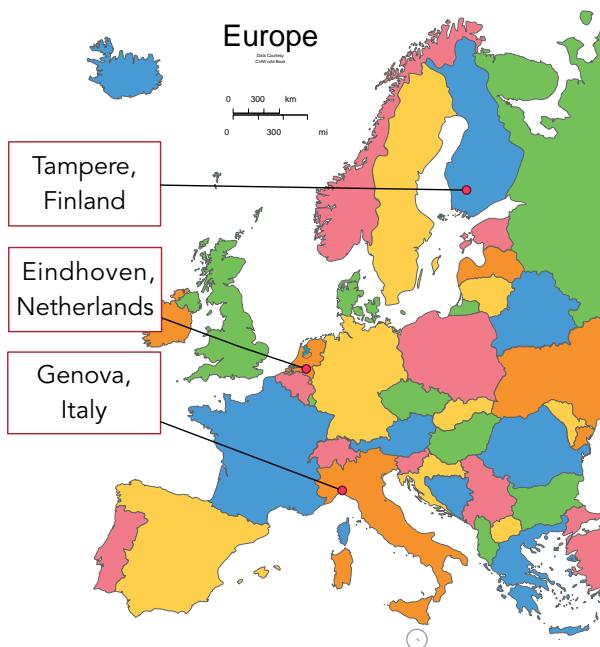


Figure 1.1: Map of Europe indicating the UNaLab’s project forerunner cities⁵

In Figure 1.1 the location of the UNaLab project’s three ‘forerunner’ cities is depicted. This thesis will involve the two mentioned first as case stud-

¹ See: https://cordis.europa.eu/project/rcn/210510_de.html

² See: <https://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020>

³ See: <https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/calls/h2020-scc-2016-2017.html>

⁴ See: <https://www.mu-se.iao.fraunhofer.de/de/ueber-uns/teams/urban-governance-innovation.html>

⁵ Map source <https://www.cia.gov/library/publications/the-world-factbook/docs/refmaps.html>

ies, namely the city of Tampere in Finland and the city of Eindhoven in the Netherlands. These cities have already made experiences with the implementation of NBS in the past. Furthermore, these two cities suffer under climate change impacts affecting their individual urban water cycle. Changing precipitation amounts and changed temporal precipitation patterns meet poorly equipped and outdated drainage and sewage systems finally resulting in a growing risk of urban flooding. In Figure 6.2 last year's flash flooding of downtown Eindhoven can be seen, Figure 1.2 shows a similar situation in Tampere during the summer of 2017. NBS in water-related climate change adaptation and mitigation are referred to as Sustainable Urban Drainage Systems (SUDS). The thesis is focussed on the individual implementation of SUDS in Tampere and Eindhoven. The specific NBS of Sustainable Urban Drainage Systems (SUDS) are seen as viable alternative or additional measure to classical grey infrastructure and classical technical approaches to urban water management.



Figure 1.2: Flash flooding in Tampere in summer 2017⁶

In the field of SUDS the two cities began early with the implementation of pilot projects in their city boundaries. In the following this thesis tries to illuminate the process of how such SUDS projects come to life in Tampere and in Eindhoven and what can be learned from the individual processes.

The thesis will start with a first chapter on basic questions why and how this topic is relevant not only for science but also for addressing the current challenges cities face. The research objective and the research questions will be clarified.

Chapter 2 "RESEARCH METHODOLOGY" explains why and how the chosen research approach is applied.

Chapter 3 consists of a literature analysis and the integration of the topic into the current scientific debate. Results of other relevant scientific publications are summarised and set in context to this work.

The following two chapters will present results and findings made in both case studies. Those results are then discussed in the last chapter. They are followed by concluding remarks.

⁶ Photo Source: <https://www.aamulehti.fi/>

⁷ Photo Source: <https://omroepbrabant.nl/>

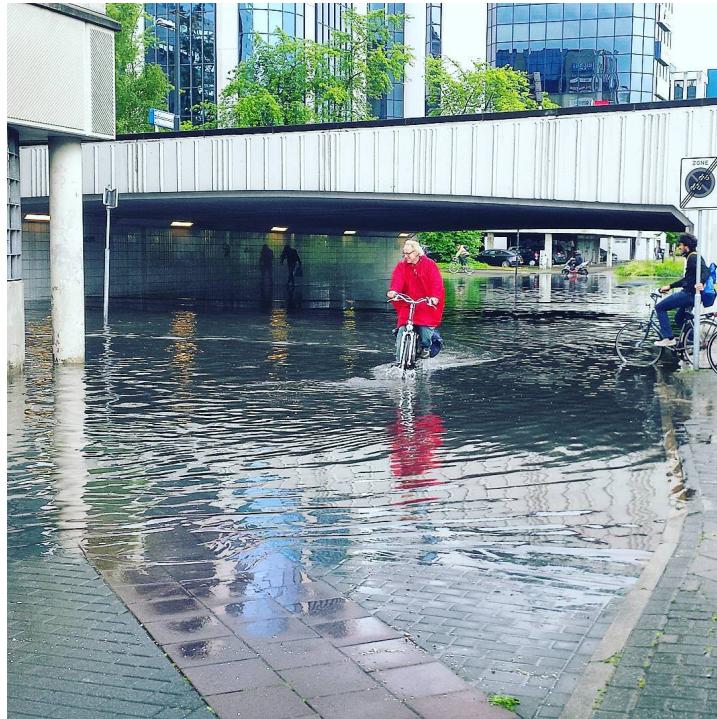


Figure 1.3: Flash flooding in the city center of Eindhoven in summer 2016⁷

1.1 PROBLEM DEFINITION

Cities face the ‘wicked problem of climate change’ Matthews et al. (2015, p. 1). ‘Wicked’ because the associated risks demand for coordinated and holistic coping strategies affecting almost all sectors of city management. It is not only about finding solutions that make a city more sustainable in the future. It is also about finding suitable adaptation strategies for today, about carrying out corrective measures against the new dangers.

The reaction of cities towards the multitude of projected changes requires cooperation of the multiple actors shaping the city’s development and daily life. Municipalities need to integrate considerations about climate change into their existing agenda, into their set of responsibilities, their duties and their procedures. They need to overcome not only technological barriers of putting in place new environment-friendly technologies and maintaining them. Also institutional barriers like e.g. path dependency or gridlocked administrative procedures need to be dealt with.

Among the manifold ways to address urban climate change resilience and adaptation the concept of NBS has evolved into a promising idea on the agenda of several supra-national, national and regional development strategies. The term NBS is used in a broad sense and as a kind of word-container relating to all kinds of practices of climate change adaptation. NBS comprise all nature-related topics in the urban space. In literature, there is often no clear distinction between NBS and other related concepts like urban green infrastructure (UGI) or green infrastructure (GI), ecosystem-based adaption (EbA), urban ecosystem services (ESS) (MEA, 2005; Potschin et al., 2016) or cultural ESS (Rall et al., 2017; Kabisch et al., 2016). NBS can serve as an umbrella term for these sustainability-related concepts for the

urban space. The term of [NBS](#) and its related concepts are further specified in the following chapter of [LITERATURE REVIEW](#) on page [15 ff.](#)

Introduction to Nature-Based Solutions ([NBS](#)) and Sustainable Urban Drainage Systems ([SUDS](#))

Prominent examples of [NBS](#) are e.g. facade greening, Sustainable Urban Drainage Systems ([SUDS](#)), city parks, green roofs, urban parks, trees and green spaces or possibilities of improving the water flow in cities ([Kabisch et al., 2017](#)). As the two cities of subject to this study have made special progress in the field of water-related sustainability and climate change adaptation, a focus is laid onto those concepts. In the realm of [NBS](#) approaches affecting water-related issues are categorized under the term of Sustainable Urban Drainage Systems ([SUDS](#)). Here, water flows in the city are engineered so as to imitate original natural water flows with e.g. permeable pavements, rain gardens and green retention areas or with the renaturation of classical concrete-built drainage systems. The sample cities face rising population density and, subsequently, rising building structure density. Usually, the increase in a city's density leads to enlarged areas of sealed soils. In the end this makes them prone to a higher risk of flooding. Excess rain- and stormwater is forced into under-dimensioned 'grey-infrastructure' drainage systems ([Bokalders and Block, 2014](#)). Traditional solutions to deal with excess rain- and stormwater in cities are piped drainage systems. These systems were mostly thought up, designed and built before rising city densities and before the knowledge about climate change. They often do not have sufficient capacity to keep up with the recent developments in the number of inhabitants and climate change. These systems also often lack the capacity for the projected future developments of increased rainfall concerning its spatial and temporal distribution ([Boogaard et al., 2016; Forzieri et al., 2016](#)). For example, the drainage systems of some quarters of Eindhoven date back to the beginning of the 20th century and are still in use. Traditional drainage systems in general incorporate high costs for set-up, maintenance and repair ([Davis and Naumann, 2017](#)).

[SUDS](#) are an alternative answer to the problem of flooding and the downsides of conventional drainage engineering in urban areas. In comparison with their traditional grey-infrastructure counterpart [SUDS](#) feature not only beneficial characteristics in reducing negative impacts of flooding and water pollution. They also often prove to be more cost-effective in the long run ([Davis and Naumann, 2017](#)). At the same time [SUDS](#) qualify for an extensive list of [ESS](#) under which air purification and local micro-climate amelioration are to be mentioned. [SUDS](#) can also enhance the subjectively experienced well-being of inhabitants by providing new green spaces in the city ([Bokalders and Block, 2014](#)).

According to [Davis and Naumann \(2017\)](#) [SUDS](#) include:

1. Rainwater harvesting systems: Collect and store water from other surfaces
2. Green roofs and facades: Can be installed on roof tops or walls, create a living space and provide also possibilities for further uses of the space such as recreation.
3. Permeable pavements: Hard surfaces that still enable rainwater infiltration.

4. Bioretention systems, such as raingardens that collect water in a pond before it flows through the vegetation and filtrates to the soil
5. Trees, they catch rainwater, add on biodiversity and provide shade
6. Swales, detention basins, retention ponds and wetlands. Slow down and capture rainwater. Wetlands, for instance, can be created in two different scales: bigger ones, nature kind, in peri-urban areas and smaller bioswales along city streets in urban cores.
7. Soakways and retention basins promote infiltration

[SUDS](#) are no completely new concept. The extensive list defining measures which qualify as [SUDS](#) compiled by [Davis and Naumann](#) shows the numerous facets of this [NBS](#) ([Fletcher et al., 2015](#)). With the perks of being more cost-effective than traditional solutions while providing a multitude of benefits for the urban space, [SUDS](#) seem like a Swiss army knife to urban planners. Especially the cost-effectiveness proves to be a strong argument concerning chronically underfunded local public budgets ([Davis and Naumann, 2017](#)). The study wants to find out whether these perks are also true for the two sample cities in Finland and in the Netherlands. Furthermore, it will be studied what disadvantages of [SUDS](#) can occur. It will be tried to find out how those can be avoided. Further explanations and definitions will follow in the chapter of [LITERATURE REVIEW](#).

Governance of [NBS](#) – from Theory to Practice...

[NBS](#) and related ideas find their way into reality and urban practice mostly through political and administrative processes. If inhabitants of a city district decide on establishing a community garden, it is not only about committed individuals and facilitating associations and coalitions - it is also about the city administration letting them pursue their ideas. Either passively letting them carry on, actively promoting or coercively impeding the process. This works also the other way round - what tools does the state provide to its citizens to interfere with government processes like e.g. new regulations or new spatial planning policies? How is it possible for citizens to articulate their wishes, problems and visions about the city? Is cooperation and citizen involvement in urban development processes hindered or promoted by the administration?

How interaction between the different societal stakeholders is enabled and channeled is described by the term *governance*. Governance systems and properties vary between different cultures and between different countries. To be able to fully understand how ideas in the field of [SUDS](#) come to life, a fundamental understanding of the prevailing legal procedures and political processes is essential. These aspects are dealt with in the chapter [LITERATURE REVIEW](#) on page 15 ff.

1.2 RESEARCH OBJECTIVE

Among others, [Frantzeskaki et al. \(2016\)](#), [Keskitalo and Andersson \(2017\)](#), [Kabisch et al. \(2017\)](#) and [Kabisch et al. \(2015\)](#) state that there is a great need of “*locally-attuned research*” to facilitate scaling-up and mainstreaming of climate change adaption and mitigation strategies. Local organisations and

urban administrations are complex structures and difficult to understand. By looking closely enough, this thesis aims at contributing to the scientific discourse by providing insights of two new case studies. The two cities of subject will be thoroughly assessed in terms of their decision-making process towards the implementation of NBS and SUDS. The thesis aims at finding out strong points and possible weak spots in the local implementation of SUDS. By looking closely into the processes '*on the ground*' insights relevant not only for the two sample-communities are generated. Special attention is given to the prevalent policy processes and development strategies in the two communities.

Ehnert et al. (2017) take a look at different political and institutional contexts in sustainability transitions. Unsurprisingly, the governance context implies varying barriers or possibilities for these transitions and can be characterised as one of the key factors of implementations of NBS. Ehnert et al. (2017) highlight the underrepresentation of this perspective in past research on NBS and sustainability transitions. Implementation of NBS is dependent on the prevailing political and decision contexts.

By building on the UNaLab project network insights can be won alongside with well-informed and well-connected local partners. Generated insights help the two sample communities in their wish to further mainstream climate adaption measures.

The study will follow these basic guiding questions in accordance with the title of the thesis "*Which Governance Aspects Promote and Inhibit the Uptake of Nature-Based Solutions in Cities?*":

- *How did the municipalities of Tampere and Eindhoven integrate SUDS into their urban development projects?*
- *Why did the municipalities prefer SUDS over classical grey-infrastructure solutions?*
- *What barriers and which strong-points can be found in the individual implementation processes?*

1.3 METHODOLOGY

The research design of this work follows an inductive qualitative research approach of Cresswell (2003) and the case-study concept proposed by (Yin, 2009). Prior to semi-structured expert interviews, a literature review on the keywords of SUDS, NBS, municipal governance, urban governance and sustainable urban development was carried out. Throughout the research a continuous literature study was performed. The findings of the interviews are summarised and set in contrast to the literature.

The literature analysis ensures sufficient covering of the topic's breadth while the semi-structured expert interviews provide the study with the necessary depth in order to understand the topic at hand.

Key literature for the literature analysis consists of the publications cited in this thesis and the following titles including their references. Basic literature on research methods and governance is provided by Cresswell (2003) and Yin (2009).

Regarding the topic of NBS and their subconcept SUDS, insights of the EU-funded project NATURVATION⁸ carried out by Jagt et al. and Sekulova and

⁸ See: <https://naturvation.eu/>

Anguelovski comprise a basic, up-to-date classification of the topic of NBS in scientific literature (Jagt et al., 2017; Sekulova and Anguelovski, 2017). The *Final Report of the Horizon 2020 Expert Group on 'Nature-Based Solutions and Re-Naturing Cities'* published by the EC (2015) provides a thorough compilation of recent projects carried out under the patronage of the European Union (EU). It comprises basic definitions and the understanding of NBS and SUDS in the scientific and political network of the EU member states. Furthermore, it helps in the identification of policy loopholes in the EU members' community. With insights of the EU-funded Projects of OpenNess (Potschin et al., 2016) and GreenSurge (Nilsson et al., 2017), considerations can be enriched by further practical examples dealing with sustainable urban water management and the topic of SUDS⁹. The book '*Nature-Based Solutions to Climate Change Mitigation and Adaptation in Urban Areas*' published by Kabisch et al. (2016) brings vital current insights in the topic of NBS and SUDS.

The case study is seen as a fitting approach towards research in the field of governance and SUDS. A case study combined with interviews allows the collection of a lot of data while achieving greater depth than other research designs. This is an advantage, especially in complex environments like public administrations and regional governance networks. Knowledge can be generated out of rare and individual cases (Yin, 2009). Like mentioned before, administrations and urban governance processes differ from nation to nation and even from city to city. Individual circumstances and special characteristics of each object of investigation demand for rich in-depth analyses.

⁹ See: <https://www.openness-project.eu/> and <https://greensurge.eu/>

2 | RESEARCH METHODOLOGY

The research takes place in the realm of public administrations and the relations between the different bodies of administration and their employees as well as civil, academic and business actors. The studied cities are in Finland and in the Netherlands. Multiple stakeholders are involved who belong to the civil, business, academic or public sector and stem from various professional and cultural backgrounds. They are engineers, technicians, volunteers, entrepreneurs or researchers. This reflects the complexity of the topic. As mentioned in chapter 1 there is in general a great need for *locally attuned* research in the field of NBS and SUDS. [Keskitalo and Andersson \(2017\)](#), [Kabisch et al. \(2017\)](#) and [Kabisch et al. \(2015\)](#) see that the topic is emerging and new on the scientific agenda. For a better understanding of the topic research has to be conducted from many different angles involving different techniques and disciplines. This thesis aims at providing material to this *locally attuned* research. It wants to provide insights in an area of research where there is little knowledge. Given the complexity and the little available knowledge in that specific field the thesis follows an exploratory, qualitative and inductive research approach. This approach corresponds with the open research questions, instead of fixed hypotheses. Following [Cresswell \(2003, p. 72\)](#)

"qualitative research is an approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem. The process of research involves emerging questions and procedures, data typically collected in the participant's setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data. The final written report has a flexible structure. Those who engage in this form of inquiry support a way of looking at research that honors an inductive style, a focus on individual meaning, and the importance of rendering the complexity of a situation."

To [Cresswell \(2003\)](#)

"if a concept or phenomenon needs to be explored and understood because little research has been done on it, then it merits a qualitative approach. Qualitative research is especially useful when the researcher does not know the important variables to examine".

In the beginning of the study it was not possible to identify those *important variables to examine*. Also the open-ended research questions demand for an open research method. This is why in this context the *inductive style* mentioned by [Cresswell \(2003, p. 72\)](#) is important.

Inductive research means that "*theory (or some other broad explanation) becomes the end point*" ([Cresswell, 2003, p. 249](#)) of research. Figure 2.1 shows the different steps of inductive research. From information which is gathered in a first step, open-ended questions are formulated and asked. These open-ended questions result in the generation of data which is examined for

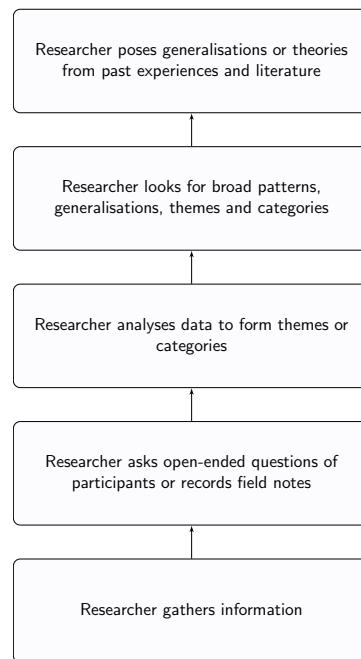


Figure 2.1: Inductive logic of qualitative research, adapted from [Cresswell \(2003, p. 251\)](#)

broad patterns, themes and categories. To pose generalisations or theories from past experiences and literature is only then a last step. The formulation of the three research questions were only the beginning of the study. Insights about the roles of the different stakeholders and their relation to one another can hardly be found in literature publications. According to [Cresswell \(2003, p. 72\)](#) the data is preferably *collected in the participant's setting* on-site.

2.1 THE CASE STUDY APPROACH

The study involves the two different cases of Tampere and Eindhoven. Both are complex, shaped by multiple stakeholders and multiple variables. Thus further pursue the case study approach by [Yin \(2009\)](#). According to [Yin \(2009, p. 13\)](#) "*a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context.*" Case studies enable the researcher to get a deep understanding of events with various sets of possible outcomes which is the case in this thesis.

The main characteristics of a case study are the following four criteria:

- **Holistic:** The context is illuminated as well as the studied phenomenon. The boundaries between the phenomenon studied and the context are not obvious. *In the context of this thesis this means that understanding the overarching governance contexts of Finland and the Netherlands need to be studied.*
- **Empirical:** It is based on a practical observation. *The study is carried out with expert on-site face to face interviews.*
- **Interpretative:** Its results are based on the interaction between researcher and object of research.

- **Empathic:** Despite previous planning, its design evolves in the process of development. *The chosen method of interviewing experts inherits the property of empathy.*

The different stages of a case study after [Yin \(2009\)](#) can be divided into the four phases of planning, data collection, data analysis and a final reporting phase:

- A written thesis proposal before announcing the thesis to the examination office was prepared. The research objective is described as explorative, descriptive and explanatory. It is responding to the questions on *why* and *how* the municipalities fostered SUDS development as well as *what* obstacles and arguments they perceived. The choice of cases was predefined by the framework of the [UNaLab](#) project. This refers to the first phase, the **planning process** of [Yin \(2009\)](#)'s method. According to [Yin \(2009\)](#) a research protocol is developed and noted. The researcher gets a clear image about the problems and goals of the proposed study.
- The referenced literature documents of this thesis were examined. Relevant literature was defined and reviewed using the criteria mentioned in chapter [3 LITERATURE REVIEW](#). Documentation on the authors is given in the bibliography section. Additional to literature data, interviews with local experts were conducted. The experts made statements which also represent a data source. This process can be referred to [Yin \(2009\)](#)'s second phase of **data collection**. The next section [2.2](#) explains why and how the expert interviews were conducted. Section [2.3](#) refers to **data analysis** and the **final reporting phase**.

2.2 SEMI-STRUCTURED EXPERT INTERVIEWS

The needed data for this research is not easy to get. The relevant processes are mostly informal. Knowledge about procedures inside the studied organisations is not well-documented. The thesis tries to explore individual stories and to illuminate individual workflows within those administrations. The easiest way to get this information is by talking to people who are part of the organisation and part of those processes. They hold the necessary information for this study and thus are referred to as 'experts'. Interviewing those experts is a way to study and explore complex contexts without belonging to them. Their special knowledge of contexts and procedures turn them into valuable subjects of research. Interviews with experts are a method to tap into their knowledge ([Gläser and Laudel, 2010](#)). According to [Gläser and Laudel \(2010, p. 36\)](#) experts are "*carriers of knowledge on the special contexts and procedures in which one operates*". They carry knowledge about the organisation in which they work, about their own working processes and about events or gatherings in which they participate. Only those "*directly involved in these processes*" ([Gläser and Laudel, 2010, p. 38](#)) have this knowledge and each of them has a special perspective on the facts concerned. The experts base their perspective on their individual position and their personal observations. They share two basic principles:

- The experts are a medium through which the scientist is able to gain knowledge about a certain subject of interest. They are not the target of the investigation, but they are witnesses of the processes of interest.

- The experts have a special, sometimes even exclusive position in the context that is to be investigated.

In order to effectively tap onto the knowledge of the experts a question guideline was worked out. It can be found in the Annex section. The guideline responds to the four *basic requirements* of Flick et al. (2012):

- **Range:** The guideline addresses a broad spectrum of problems to enable interviewees reacting in an unanticipated manner. The interview guide is not aimed at confirming the influencing factors fixed in the preliminary considerations. Experts from the civil, business, public and academic sectors are interviewed to ensure that different perspectives are represented. The interviewees are encouraged to create complex, coherent representations of their perception.
- **Specificity:** The purpose of the interviews is not the standardisation of answers, but the elaboration of the particular content of statements made by the interviewees. The topics and questions raised in the interview were specified according to the research questions mentioned in chapter 1 (Flick et al., 2012, p. 357).
- **Depth:** With an individual preparation to every single interview the interviewees are supported in presenting the affective, cognitive and value-related meaning of certain situations and in presenting his or her involvement.
- **Personal context:** Introductory questions about the personal and social context in which the respondents' actions take place are asked. It is understood that the knowledge about the context is a prerequisite for the interpretation of the reactions.

The selection of experts was done with the help of the two UNaLab project coordinators in Tampere and Eindhoven. Both coordinators are employed in their individual municipality. They have good knowledge about the structures and procedures which take place. The UNaLab project tries to find arguments which indicate the feasibility of NBS in urban areas. As local UNaLab coordinators the two contacts thus have special knowledge about important actors and processes in the field of NBS and SUDS. In November and December 2017 the coordinators were contacted via phone to explain the research ambitions and the scope of the research. An individual question guideline was worked out. The guideline follows the main research questions raised in chapter 1. It is attached in the Annex. The phone call lasted approximately 90 minutes in the case of Eindhoven and approximately 40 minutes in the case of Tampere. It yielded a list with 25 people in Tampere and 16 people in Eindhoven. The people on the list were individually contacted via e-mail and received the research ambition, scope and research background. Interview dates with 11 people in Tampere and with 12 people in Eindhoven could be arranged. The interviews took place between 11 - 17 February 2018 in Tampere and between 04 - 10 March 2018 in Eindhoven. When the interviews ended the experts were given the list with the other people contacted. They were asked to check the list if any important person in the field of SUDS was missing. This was not the case. Further information on the interviewees can be found in the results chapter 5 CASE STUDY: TAMPERE, 6 CASE STUDY: EINDHOVEN.

2.3 EVALUATION

The interviews were transcribed into text with the help of the speech-to-text service 'Temi'¹ and the software 'MaxQDA'². MaxQDA offers the feature of coding interviews according to defined categories. Coding in this sense means sorting and clustering the raw data into predefined categories. The coding was done in several rounds reading through the transcripts and looking for themes and clusters. The data is coded according to the question guideline. The following codes stated in bold print were defined before coding:

- **Tampere and Eindhoven:** To separate the statements of both cases.
- **Introduction:** Indicates the personal background of the interviewee and his or her position in the organisation.
- **Definition:** Refers to the individual definition of **SUDS** of the interviewees.
- **Arguments:** Refer to the question of the benefits perceived and of the success factors of **SUDS** implementation. This is further subcategorised in the codes of **local** arguments and **general** arguments. General arguments are not site-specific whereas local arguments are site-specific.
- **Barriers:** Refer to the barriers to **SUDS** implementation. Here, as well, a difference between **general** and **local** barriers is made.
- **Incentives:** Are thoughts, wishes or possible ideas for improvement an interviewee mentions. **General** and **local** incentives are again separated.

The following codes given in bold print emerged during the coding process:

- **Examples:** When interviewees talk about specific examples of **SUDS** this code is used.
- **Personal Motivation:** If an interviewee talks about personal details why he or she is committed to the promotion or the impediment of **SUDS**.
- The codes **Arguments**, **Barriers**, **Incentives** and **Examples** are each further coded according to their relevance for the **business**, **societal**, **municipal** or **state** level sector.

After the completion of the coding process the first two steps along the flowchart shown in Figure 2.1 are completed. The coded information is reorganised in broader themes and topics for each case in the chapters 5 CASE STUDY: TAMPERE and 6 CASE STUDY: EINDHOVEN. Broader themes are the *Definition*, the *Local Implementation and Success Factors*, the *Arguments for SUDS Implementation* and the *Barriers*. These broader themes are then again summarised in corresponding subchapters. This matches the third step on Cresswell (2003)'s inductive logic. In chapter 8 the findings of both case studies are compared with each other and with experiences taken from literature examples. This complies to the fourth step on Cresswell (2003)'s inductive logic.

¹ See <https://www.teymi.com/>

² See <https://www.maxqda.de/>

3 | LITERATURE REVIEW

The context and meaning of the key concepts of this thesis will be explained in the following chapter. The chapter will start with an explanation of the overarching concept of **NBS**. Then the concept of **SUDS** will be explained. This is followed by an explanation of the term *Governance* and its connection to this thesis. The Multi-Level-Governance concept and the different levels of governance are outlined. The chapter closes with the description of different governance aspects which showed to be relevant for **SUDS** and municipal organisations in the past.

3.1 NATURE-BASED SOLUTIONS (**NBS**)

As Potschin et al. (2016, p. 1) state, the term **NBS** “first entered the mainstream scientific literature in the early 2000s” in the context of solutions to agricultural problems, land-use management, land planning and water resource management. In the following years the term appeared in publications of industrial design, green infrastructure and in the context of urban water management practices (Locatelli et al., 2011; Singh et al., 2007). Chapter 1 introduced **NBS** as “word container for all kinds of green solutions in science”. Indeed as Nature (2017, p. 1) puts it, the term **NBS** tries to

sweep up [the phrases of] ‘ecosystem services’, ‘green-blue infrastructure’, ‘natural capital’ and add concepts such as ‘ecological engineering’ and ‘ecosystem-based mitigation’, and dump them into a policy-relevant pot, where sustainable practices that harness the natural world (wetlands to clean waste water, for example) can be devised, analysed and then pulled out for use by politicians, scholars and researchers.

To Neshöver et al. (2017, p. 11) the

NBS concept should be perceived as an opportunity [...] for sustainability science to achieve more recognition in policy, projects and practice, and to bring together ideas from all relevant actors.

When taking a closer look at the individual terms of **NBS**, different concept implications can be drawn. ‘Nature-based’ itself is referring to ecosystem approaches with ‘nature’ referring to biodiversity and ecosystem services (**ESS**). The term ‘-solutions’ indicates that **NBS** react to specific challenges.

Figure 3.1 depicts the “umbrella concept of **NBS**” according to Eisenberg (2017). On the bottom level of the Figure different overarching themes and disciplines are depicted. The green bubbles under the umbrella depict different scientific and practical concepts. In the sense of strategic thinking and planning of overarching strategies to deal with climate change **NBS** encompass the concept of ecosystem-based adaption (**EbA**). **EbA** is the “use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change” (IUCN, 2012). **EbA** helps

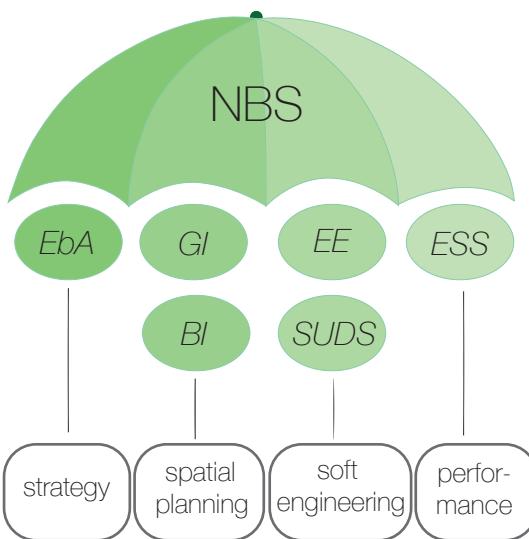


Figure 3.1: NBS as umbrella term for sustainability-related concepts. Adapted from the UNaLab project documentation (Eisenberg, 2017).

to frame relating concepts in the debate about climate change adaptation. In the spatial planning dimension NBS encompass concepts of green infrastructure (GI) and blue infrastructure (BI) in contrast to grey infrastructure. GI in this sense are all natural environments, e.g. parks or trees, while BI is the integration of water in the city. These concepts are applied in the ‘soft engineering dimension’. In contrast to ‘hard engineering’ which responds to needs of grey infrastructure, ‘soft engineering’ responds to the needs of GI and BI. The practical application of those can be found in the concepts of Sustainable Urban Drainage Systems (SUDS) which themselves are an example of Ecological Engineering (EE). Ecological Engineering (EE) is defined as “*the design of sustainable ecosystems that integrate human society with its natural environment for the benefit of both*” (Mitsch, 2012, p. 1). Performance monitoring in the field of NBS is done with insights from the concept of ESS. ESS describe in general the benefits humans can derive from natural systems (MEA, 2005). Several initiatives, research programs and scholars deal with the concept globally why several different approaches to ESS assessment can be found in literature (Bohan et al., 2016; Bokalders and Block, 2014).

Regarding the promotion of the concept of NBS in international sustainability debates, the World Bank (WB) alongside with the western conservation groups of the Nature Conservancy (TNC) and the International Union for Conservation of Nature (IUCN) played an active role and pushed the idea on top of their agendas (World Bank, 2008; IUCN, 2012; TNC, 2011). In their ‘Jeju Declaration’ the IUCN helped in further formalising the definition of the NBS term (IUCN, 2012). For the IUCN NBS can serve “*as a means of dealing with challenges linked to climate change, sustainable energy, food security, and economic and social development*” and further NBS “*build upon the proven contribution of well-managed and diverse ecosystems to enhance human resilience [...] in applying the strength, resources, and abundance of nature to environmental and social challenges*” (IUCN, 2012). Furthermore, for the UN Secretary General NBS are a tool for ‘improved urban planning’ and for an ‘increasing urban quality of life’ (UN, 2013). Also the EU took up the concept of NBS as a ‘priority area’ in their Horizon 2020 Research Programme and it plans to ‘invest substantially

in *Nature-Based Solutions to tackle socio-economic challenges' of the 21st century* (Maes and Jacobs, 2015, p. 123).

One can find several other definitions of NBS in the literature concerned. Another more recent attempt of the EC (2017) defines the concept as

"solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions"

The vagueness of this definition of NBS can impede its practical application and weaken its conceptual strength, but it also allows for a broad discussion to take place (Matthews et al., 2015). It does not exclude potential participants, it rather animates an active commitment by interested stakeholders. NBS touch societal, financial and urban-planning sectors with corresponding stakeholders from business, civic or public origin. Every one of these sectors follows its own logic and ways of thinking. How to implement possible NBS depends on different overarching theories and cultures, on different ethics and on the definitions of sustainability (Kabisch et al., 2016, ch. 1). Although NBS may incorporate technological approaches to ecological issues to some extent, its general approach differs from pure engineering solutions to environmental problems. Examples are electricity-powered vehicles or air filters to reduce air pollution (Grubb, 2004). Those traditional systems serve mostly as single-object systems providing one specific benefit.

3.2 SUSTAINABLE URBAN DRAINAGE SYSTEMS (SUDS)

In the soft engineering dimension of the NBS-umbrella¹ Ecological Engineering (EE) and its application in the Sustainable Urban Drainage Systems (SUDS) approach can be found. Traditional approaches of water management in cities were in the past mostly grey infrastructure, 'pipe-oriented' solutions. The paradigm of these single-objective engineering designs has been dictating the development of urban water management practices since the beginning of industrialisation (Davis and Naumann, 2017). The aim of those grey infrastructure systems is to channel all kinds of water out of the urban structures. The water is then treated and possible contaminations are removed effectively in centralised waste water treatment plants (Liquete et al., 2016). The method of dealing with waste water with the help of canals to transport it out of urban structures can be traced back to ancient times (Wiesmann et al., 2006). Advances in technology and the discovery of key processes in biology and physics made modern waste water treatment possible. For decades this advancement was seen as the method of choice to manage urban water effectively (Burian and Edwards, 2011). While the centralised approach to the management of urban drainage was seen as most sophisticated, the 'soil consumption' of urban structures grew with rising populations (Scalenghe and Marsan, 2009). Until today most development projects in housing, business or industry have also been based on materials which seal the soil. Sealed soils characterise the urban development. For a long time they were seen as beneficial not only because they reduced maintenance costs, e.g. for gardening and green-keeping. In the form of

¹ See Figure 3.1, page 16

streets they also enable modern ways of transport. A major disadvantage has been neglected for a long time: the sealed soils inhibit water infiltration and increase the amount of water which must be drained towards the sewer systems. As a side-effect of increasing urban development the connected service infrastructure had to grow, too (Spellman, 2014).

However, it has become increasingly difficult for the service infrastructure to keep pace with the urban development (EEA, 2012). Due to climate change rainfall increased in total and rainfall events increased in severity in the EU (EEA, 2012). The existing structures are now more often overloaded during rainfall events, which result in an increased risk for urban flooding (Davis and Naumann, 2017).

The traditional way of approaching flood prevention in urban contexts is to look at key figures of historical events, i.e. the amount and time of heavy rainfall in the past. With the help of those, specific thresholds for the design of water management structures are set. Planning is done for the worst case which happened in the past. The existing systems have to be able to cope with the incoming water should such a case occur once more in the future (Boogaard et al., 2014). Very often, no provisions are made for more severe events (Watson and Adams, 2011, p. 49). This traditional way of calculating and dealing with the risks associated with water in urban environments has shown to be problematic to prevent flooding in cities in a time of changing precipitation patterns (EEA, 2012). Increasing the capacity of piping systems and treatment plants results in increasing costs for planning, construction and maintenance (Davis and Naumann, 2017). The traditional systems cannot be enlarged limitlessly. Firstly, due to budgetary constraints of their public owners and secondly due to physical constraints regarding underground space in densely populated areas. Underground sewage competes with many other underground infrastructure such as telecommunication, energy and infrastructure. The traditional systems therefore are in need of support in order to be able to cope with future developments (EEA, 2012).

Continuous sealing of spaces has not only brought problems to urban water cycles but also entailed other detrimental effects to the urban structures. For example, the heating up of asphalt or concrete has led to what is commonly known as '*urban heat island effect*' (Douglas et al., 2011, ch. 11). Figure 3.2 shows the typical water cycle in a city and the problems that come with it. Figure 3.3 shows how the processes of climate change and urbanisation are interlinked. The outcomes of urbanisation and urbanisation itself can amplify climate change. Vice versa, the results of climate change can amplify the urban challenges. In the end this transforms to the need for new approaches as shown in the bottom box.

To cope with the multitude of different challenges "*more and more cities, organisations, and decision makers are moving towards integrated solutions*" according to Feilberg and Mark (2016, p. 3). SUDS are a prominent example of an integrated solution. With SUDS systems it is possible to tackle urban water issues while also providing a range of side benefits. Depending on their design SUDS qualify for various aspects of the triple-bottom-line of sustainability². According to Davis and Naumann (2017, p. 124) SUDS can be seen as "*promising alternative [...] in the transition towards regenerative urban [...] environments*".

² Of social, environmental and economic sustainability

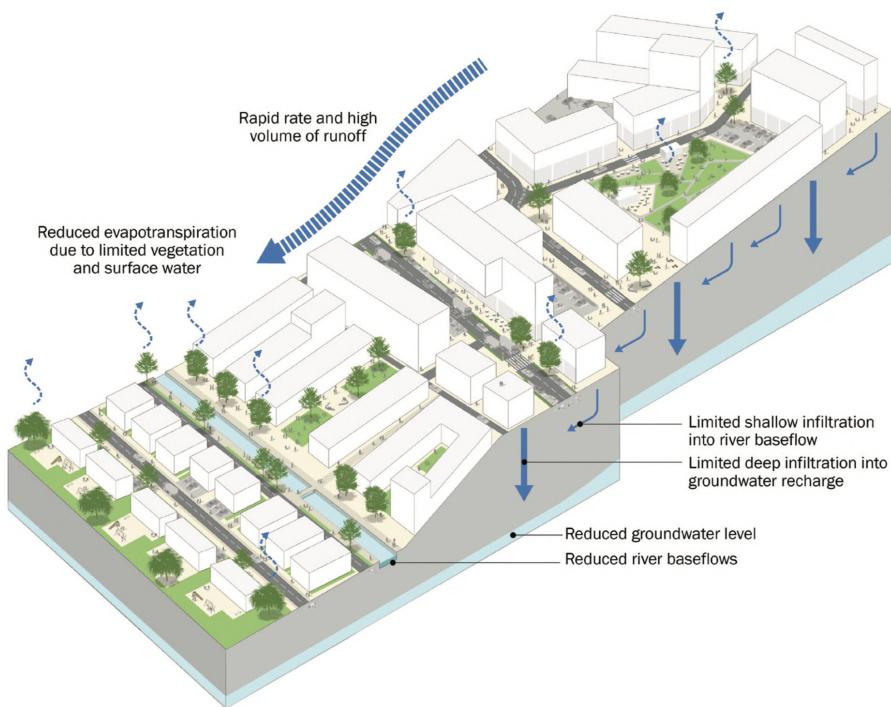


Figure 3.2: Urban water cycle *without SUDS* (CIRIA, 2015)

3.2.1 The Evolution of SUDS

As stated in the [INTRODUCTION](#), SUDS are not a completely new concept. Closer-to-nature water management practices have existed “*since the field of water management was invented*” ([Fletcher et al., 2015](#), p. 1). But as urban environments became more complex over time, so did their water management structures ([Fletcher et al., 2015](#)). The water management structures changed and so did the terminology used to describe them. This is one reason why the concept of SUDS is often used synonymously with related concepts of e.g. green infrastructure (GI) or its superordinate concept of NBS. The following paragraph summarises the development of the term [SUDS](#).

According to [Fletcher et al. \(2015\)](#) the development of terms around alternative ways to urban water management was always under strong local influence. [Ellis et al. \(2015\)](#) published the book ‘*Urban Drainage - A Multilingual Glossary*’ to explain different existing meanings and concepts around urban drainage. Different terms for identical concepts or inversely similar terms for different concepts were responsible for confusion in the past. Originally the term of [SUDS](#) emerged from regulatory approaches of storm water management in the UK ([Fletcher et al., 2015](#)). Especially the Scottish Environmental Protection Agency pressed ahead with regulatory requirements demanding the inclusion of best management practices for storm water treatment in municipal urban development plans and strategies. These regulations transferred the ‘*triple bottom line*’ understanding of sustainability science on water management principles. The resulting ‘*sustainable drainage triangle*’ of quantity, quality and habitat or amenity then set the cornerstone of the term [SUDS](#) ([Butler and Parkinson, 1997](#); [D’Arcy, 1998](#)). In 2000, [Martin](#) of the UK-based standardisation organisation ‘Construction Industry Research and Information Association ([CIRIA](#))’ published a guidance document and tried to further formalise the term. In general the [SUDS](#) definition com-

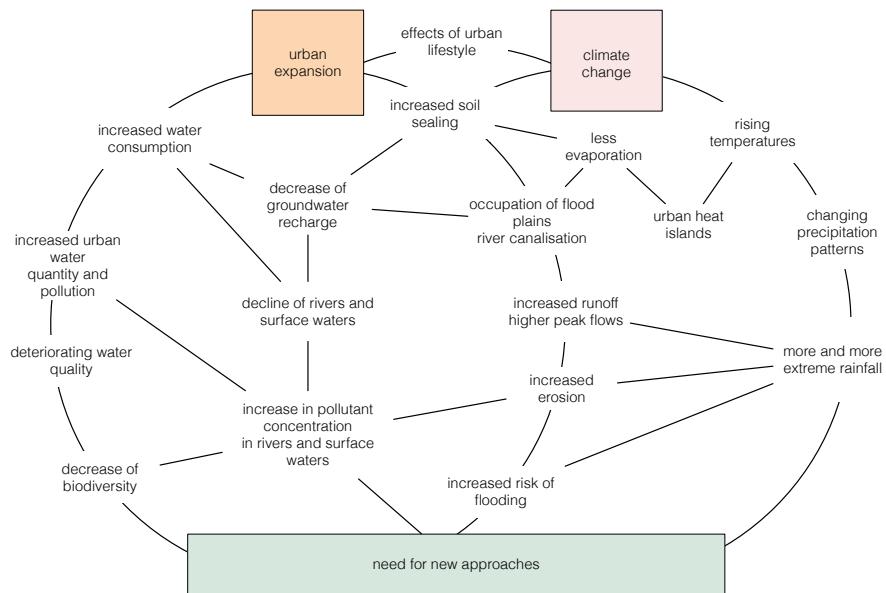


Figure 3.3: Urban expansion, climate change and the urban water cycle, adapted from Chocat et al. (2007)

prises a set of techniques and approaches for urban water management that is more sustainable than grey-infrastructure solutions. The term sustainable in this case stands for solutions which aim to be as close as possible to natural water drainage (Fletcher et al., 2015). The EC and EU adopted the definition of SUDS by CIRIA and included it in their relevant guidance documents.

3.2.2 Benefits Provided by SUDS

In the latest definition CIRIA (2015) added the category *biodiversity* to their *sustainability triangle* definition. By their latest definition SUDS can qualify to four basic categories of benefits. These benefit categories are depicted in Figure 3.4. They are referred to as *the four pillars of SUDS design* (CIRIA, 2015, p. 134). Table 3.1 summarises the benefits identified in the publications by Davis and Naumann (2017), CIRIA (2015) and Fletcher et al. (2015). Sub-categorisation was done accordingly to those four pillars. The category of ‘financial incentives’ was added. The benefit categories shown in Table 3.1 can be further described as following:

1. Water **Quantity** Control: SUDS can reduce the peak severity of water outflow. They can reduce the speed of the outflow while overall retaining water in their boundaries. SUDS make on-site water management and usage possible. They support traditional systems and ultimately reduce the risk of flooding. In this sense they contribute to the adaptation of public space to climate change. Due to their organic nature SUDS sequester carbon and therefore work for climate change mitigation (Kabisch et al., 2016).
 2. Water **Quality** Control: SUDS can incorporate techniques to improve water quality. The water is filtered through gravel or sand formations and the vegetation growing in the system. They can work as biological filter system to pre-treat or treat polluted waters. Due to water evapo-

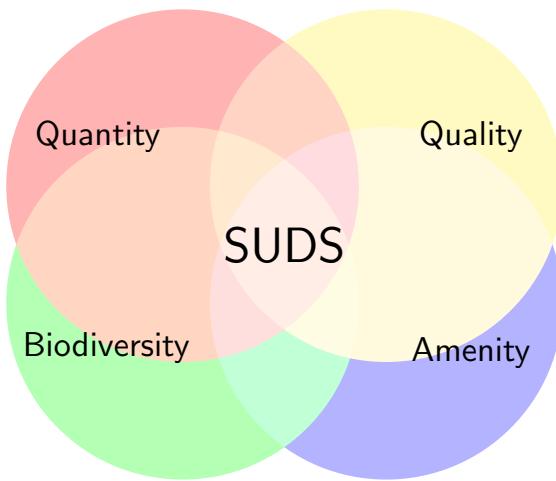


Figure 3.4: Benefit categories provided by **SUDS**, adapted from [CIRIA \(2015\)](#)

ration or plant transpiration they contribute to temperature reduction of urban areas or buildings ([Solcerova et al., 2014](#)). Vegetation also works as ‘dust filter’ in urban areas improving air quality ([Boogaard et al., 2016](#)).

3. **Urban Amenities:** **SUDS** qualify for individual and differently perceived benefits such as the increased aesthetic value of a site. They provide places for recreation and can improve well-being and the health situation for citizens in the neighbourhood ([Kabisch et al., 2016](#)). Depending on their management, community cohesion and an improved economic activity in their surroundings can be observed ([Davis and Naumann, 2017](#)).
4. **Increased Urban Biodiversity:** **SUDS** provide a habitat for animals in the urban context. They cannot only serve as breeding ground for insects and other important pollinators, but also host bigger animals like the squirrel in the case of Tampere ([Hiedanpää et al., 2012](#)).
5. **Financial incentives:** **SUDS** show lower total costs when looking at their whole life cycle in comparison to their traditional grey infrastructure competitors ([Davis and Naumann, 2017](#); [Kabisch et al., 2016](#)). This argument could possibly be enlarged as many different [ESS SUDS](#) provide cannot be integrated in traditional financial calculation models ([Bohan et al., 2016](#); [Bokalders and Block, 2014](#))

3.2.3 **SUDS** in Comparison to Grey Infrastructure

Depending on their design **SUDS** can provide either one or multiple benefits belonging to the aforementioned list. The first two pillars of ‘Runoff quantity and quality control’ can also be achieved through technical grey infrastructure solutions. The third pillar of ‘amenity’ can only partly be provided through grey solutions, whereas grey solutions in their traditional sense cannot contribute to the fourth pillar of ‘biodiversity’ at all ([CIRIA, 2015](#)). The optimal **SUDS** design can be found in the intersection of the four pillars

Table 3.1: Comprehensive list of SUDS benefits summarised from [Davis and Nau-mann \(2017\)](#); [CIRIA \(2015\)](#); [Fletcher et al. \(2015\)](#)

<i>Benefit</i>
Water Quantity
Reduced peak severity of outflow
Reduced speed of outflow
Overall retention of water
Reduction of flood risk
Water Quality
Water quality improvement
Ground water recharge
Air quality improvement
Pollution reduction and control
Temperature reduction
Climate change adaption
Climate change reduction
Urban Amenities
Aestetics
Recreation
Health
Well-being
Education
Economic opportunities
Community cohesion
Increased urban biodiversity
Financial incentives

Table 3.2: Grey, hybrid, green and blue infrastructure, adapted from [Depietri and McPhearson \(2017\)](#). Sorted by *appearance, role of ecosystem functions and examples*.

Grey	Hybrid	Green and Blue
Hard, built-up and engineered structures	Blend of biological-physical and engineering structures	Biophysical, ecosystems and their services
Very limited role of ecosystem functions e.g. canals, pipes and tunnels of the drainage system; dikes; wastewater treatment plants	Allow for some ecosystem functions mediated by technological solutions e.g. bioswales; permeable pavement; green roofs; rain gardens; constructed wetlands	Mainly relying on existing or restored ecosystem functions and water bodies e.g. wetlands restoration; installation of grass; urban trees; stream restoration; rivers; lakes; ponds

and covers all four benefit categories as shown in Figure 3.4. Table 3.2 summarises the difference between grey, hybrid, green and blue infrastructure according to [Depietri and McPhearson \(2017\)](#). [SUDS](#) embrace the two latter categories of hybrid and green and blue infrastructure. [SUDS](#) can work by making use of different natural processes in combination with green or grey components. Green components are the vegetation and organisms used to populate the [SUDS](#). Grey components can be e.g. permeable surfaces that provide stability or gravel for filtering purposes ([Zhou, 2014](#)). [SUDS](#) can also be constructed using only organic material, e.g. planting trees.

High peaks in water flows, e.g. during and after a heavy rain event are problematic for grey infrastructure. Too much water has to be discharged in too little time. When the infrastructure capacity is not big enough, the amount and the speed of the water flowing into the system has to be reduced. Reduction of water inflows can be achieved through either storage, evaporation, plant transpiration or the reuse of water. Reduction of flow speed is achieved mostly through different modes of water infiltration. Depending on the type of material the water passes while infiltrating into the ground its speed is reduced and its discharge is slowed down. Depending on the materials used for infiltration also pollution control and filtering can be achieved ([CIRIA, 2015](#)). The ultimate goal of a [SUDS](#) system is to “*harvest, infiltrate, slow down, store or convey a water flow*” ([Davis and Naumann, 2017](#), p. 125). In this theoretical definition and while respecting the aforementioned benefit categories any approach can qualify as [SUDS](#) system. The definition remains quite broad. This is why the list of possible [SUDS](#) solutions offers many different approaches both underground as well as above ground ([Davis and Naumann, 2017](#)). Amongst those examples [CIRIA \(2015\)](#) mentions the following classes:

- Rainwater harvesting systems - collect and store rainwater for reuse.

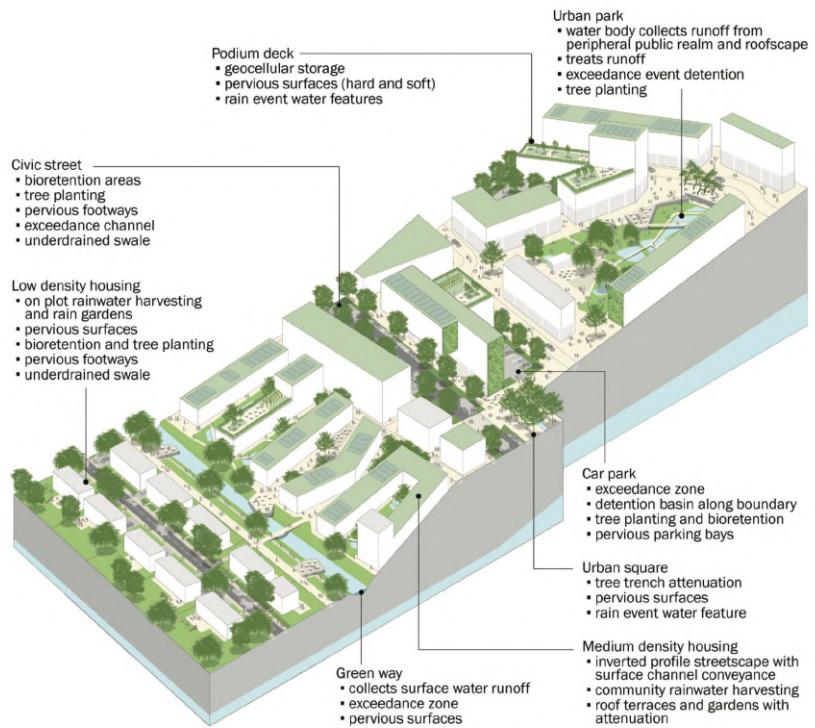


Figure 3.5: Urban water cycle with SUDS integration (CIRIA, 2015)

- Green roofs - create conditions for plant habitation on rooftops. The layer of soil which is needed for those conditions reduces water runoff.
- Permeable pavements - concrete, asphalt or stone construction made permeable through gaps in the material. They provide stability for pedestrians and vehicles while letting water infiltrate into the ground.
- Bioretention systems, raingardens, swales, detention basins, retention ponds or wetlands - collect and store water temporarily before letting it infiltrate gradually. Can also provide habitat for insects and animals.
- Urban trees - offer a multitude of benefits. They cool the air through shade and evapotranspiration. They are a habitat for insects and animals. They also capture and filter water.
- Soakways and infiltration basins - sites with intentionally increased infiltration. They provide controlled runoff and guidance of water flows. They can also work in filtering and biodiversity provision.

Figure 3.5 shows an urban water cycle with the inclusion of SUDS. They are not restricted to new developments but can be retrofitted in existing areas. Different local properties affect the feasibility of the SUDS interventions. For example, technical properties like the prevailing soil type and its specific infiltration capacity may impede specific SUDS solution types like swales. But also non-technical factors about the local population, administrative possibilities or cultural preferences have to be taken into account. SUDS are highly site-specific and sensitive to external conditions. Thus they have to be locally adapted and cannot be replicated without redesigning. The high number of different and locally adapted solutions makes it hard not to lose oversight

over the different SUDS options that exist. CIRIA (2015) list over 100 different SUDS approaches. The 'Adaptation Planning Support Toolbox' to enable 'easier integration of SUDS' into decision making by van de Ven et al. (2016) lists over 60 different SUDS solutions.

In the Netherlands SUDS are often referred to as 'Wadi'. The term originally stems from Arabic and means valley or river that only temporarily carries water after heavy rainfall (Brockhaus, 2005). 'Wadi' is a synonym to what a detention basin, retention pond or wetland in the above mentioned categories would be. In the city of Eindhoven around 80 SUDS interventions representing 40 different varieties of 'Wadis' and other SUDS can be found. The city of Tampere counts in total 90 sites with 40 different varieties of SUDS interventions.

3.3 GOVERNANCE AND SUDS

At first glance the SUDS concept can be perceived as a mere technical approach to tackle some of the urban challenges which are mentioned in the previous chapter. SUDS may seem like just another concept of urban development which has some perks, some downsides and which has to overcome some obstacles. It might be seen as a new urban water management practice only that now it comes with vegetation and in green colour.

But SUDS are much more. By definition they should deliver a large range of different technical, societal and environmental benefits. They are designed to be placed right in the middle of a city. In comparison the traditional water management solutions have only one task or benefit. They are usually built using one approach. They deliver water independently of its source towards storage or treatment facilities or towards open water courses. They work silently and invisibly beneath the built-up areas and usually do not interfere with life above ground. In cities this is shaped by a multitude of different stakeholders. These stakeholders compete over the limited amount of space, interact with each other and interact with their surroundings. In most cases SUDS are located above ground. They do not only occupy space in a city, but also change the possibilities for interaction for all the different stakeholders the city houses.

The question now is how this new and complex concept comes to life in a city. And this is where the term *governance* comes into play.

In general governance is a concept of the social sciences. Social science concepts always have an ambiguous relation to reality. They represent a certain way of describing, interpreting and understanding reality and at the same time they are part of reality and affect the actions of people, groups or organisations (Benz et al., 2007). At the beginning of its development the understanding of governance was closely linked to its word origin '*government*'. In its original sense it was understood as referring to political science and the "*exercise of economic, political and administrative authority to manage a country's affairs at all levels*" (Chesterman et al., 2005, p. 3). It referred to the hierarchical order in which countries are organised. But the term soon left the realm of political science and became also widely used in the areas of business and society, both in science and in practice (Kooiman, 2003).

The reason for its spreading into different disciplines and contexts is not the invention of a new and universal organisation model. The widespread use of the term reflects the evolving role that actors from the societal as well as from the economic sector have in the organisation of countries and in

international relations. By expanding the focus of the term on the sectors of society and economy the term shows how relevant these sectors are in relation to the whole system. It is not only the government which shapes the organisation of a country, a union or the international community. The organisation is also influenced by the different actors of society and economy, the interrelations between them and the interrelations with the administrative actors (Kooiman, 1993). In a modern understanding governance stands for all forms and mechanisms of coordination between those different actors. The actors themselves can be more or less autonomous and their actions can be interdependent. They can affect, impede or support each other (Benz et al., 2007). Governance as term is used to describe how the different actors are involved in administration. Finding out about the governance aspects is always about finding out how "*decisions are made and implemented*" (Buizer et al., 2015, p. 12). These decisions are made on various layers from an international, to a national, regional and local level. On each of those levels different procedures, actors and institutional architectures can be found. Depending on the constellation of involved actors on the differing levels procedures, pathways and institutional architectures differ. On an international level the differences reflect a different history of cooperation, cultures and beliefs. On the country, regional and local level these differences reflect individual cultures of national policy making and administrative mentalities. In order to be able to understand local processes it is advised to study superior processes as well (Kharchi, 2017). There can be large differences in power distribution, diffusion and in different resulting levels of local autonomy.

This modern understanding of the governance concept leaves room for interpretation. It can be seen as a blurred definition comparable to the broad definition of the NBS concept. This brings the advantage of a wider possible applicability to different disciplines and different contexts. To narrow down the understanding of the term for its use in specific contexts, different streams of governance research evolved in the past. To the circumstances in the European Union (EU) the multi-level governance concept is important. It will be explained in the following subsection.

3.3.1 Multi-Level Governance

The concept of multi-level governance has been developed in European integration research since the early 1990s. It serves as an alternative concept for understanding the dynamics in the EU multi-level system (bpb, 2016). It stands in contrast to the previously dominant integration theories of intergovernmentalism³ and neo-functionalism⁴. In contrast to these concepts, multi-level governance emphasizes that also actors who do not belong to governments shape policy-making in the EU. These actors can be found on the EU-level, the national state-level as well as on the sub-national levels. They come from the public, the civil as well as from the private sector. Hooghe and Marks (2001, p. xi) have coined the concept at the beginning of this century and stress the "*dispersion of authoritative decision making across multiple territorial levels*" in the EU. They argue "*that European integration has diffused authority across national and supranational levels*" (Hooghe and Marks,

³ Intergovernmentalism sees the nation states and national governments as main actors in political decision making in the European context. The national governments do not share their power with other actors.

⁴ Neo-functionalism also sees that the institutions which were formed through the cooperation of national governments as main force in policy implementation in the EU context. Other non-governmental actors play a negligible role.

2001, p. xii). In decision making in the EU different political decision-making levels as well as state and non-state institutions and actors have their say and cooperate.

The multi-level governance concept is not only a theoretical construct to describe the processes in the EU. It is also actively promoted by the EC and the European Parliament in the structural funds policy. The structural funds account to roughly 35% of the total budget of the EU. The structural funds belong to the *first pillar of the EU* (Sapala, 2016). Among other things, they are supposed to improve coherence in the EU and reduce economic differences between the member regions. But they also involve national governments, sub-national regions as well as single municipalities in the EU policy discourse. The funds also target at increasing the involvement of private and civil actors on each of those levels. All of those actors are enabled to jointly steer the development of the EU (Wiesner, 2018).

3.3.2 Horizontal Governance

According to the theory there are several levels of governance that interact with each other. Fig. 3.6 shows the four different layers which can be identified in the multi-level governance model. The *European* or supranational level, the *national* member state level, the *regional* level and the *municipal* level. A fifth layer representing the *international level* has been added. On each level different actors belonging to the societal (*purple dot*), private (*red dot*) or public sector (*yellow dot*) are represented. The connecting arrows in the figure represent the interaction between them. The boundaries of the different levels are depicted with dashed lines indicating their permeability. Stakeholders from one municipal governance level can interact *horizontally* with the stakeholders of another municipality. In the terminology of multi-level governance this is referred to as *horizontal governance*. Horizontal governance for municipalities are e.g. (inter)national city networks where the respective stakeholders can learn from each other, exchange ideas or collaborate in a different way (Lenhart, 2015).

3.3.3 Vertical Governance

The actors are not limited to their respective level. Actors from the local level may interact with actors of the higher levels. Local initiatives and developments may shape strategies and the focus of higher level authorities (Lenhart, 2015; Corfee-Morlot et al., 2011). The other way round - actors from higher levels interacting with actors from lower levels - is possible (Wiesner, 2018). This is referred to as *vertical governance* in the multi-level governance concept. For the SUDS development this shows to be an important process as their superior concept of NBS is part of several (inter)national development agendas and strategies. International, European, national as well as local institutions have taken up the concept and are possible partners for cooperation (Nature, 2017; Faivre et al., 2017; EC, 2015; World Bank, 2008). For example, the United Nations (UN) follow a specific set of Sustainable Development Goals (SDGs) thought up for the urban space. Also in the latest COP21 climate agreement in Paris different non-binding rules for the urban space were agreed on. The agreements on the scale of the UN are of multilateral nature affecting the behaviour of over 150 countries worldwide (Keesstra et al., 2018). Both, the Netherlands and Finland are part of the UN and ratified the latest agreements. On the European level

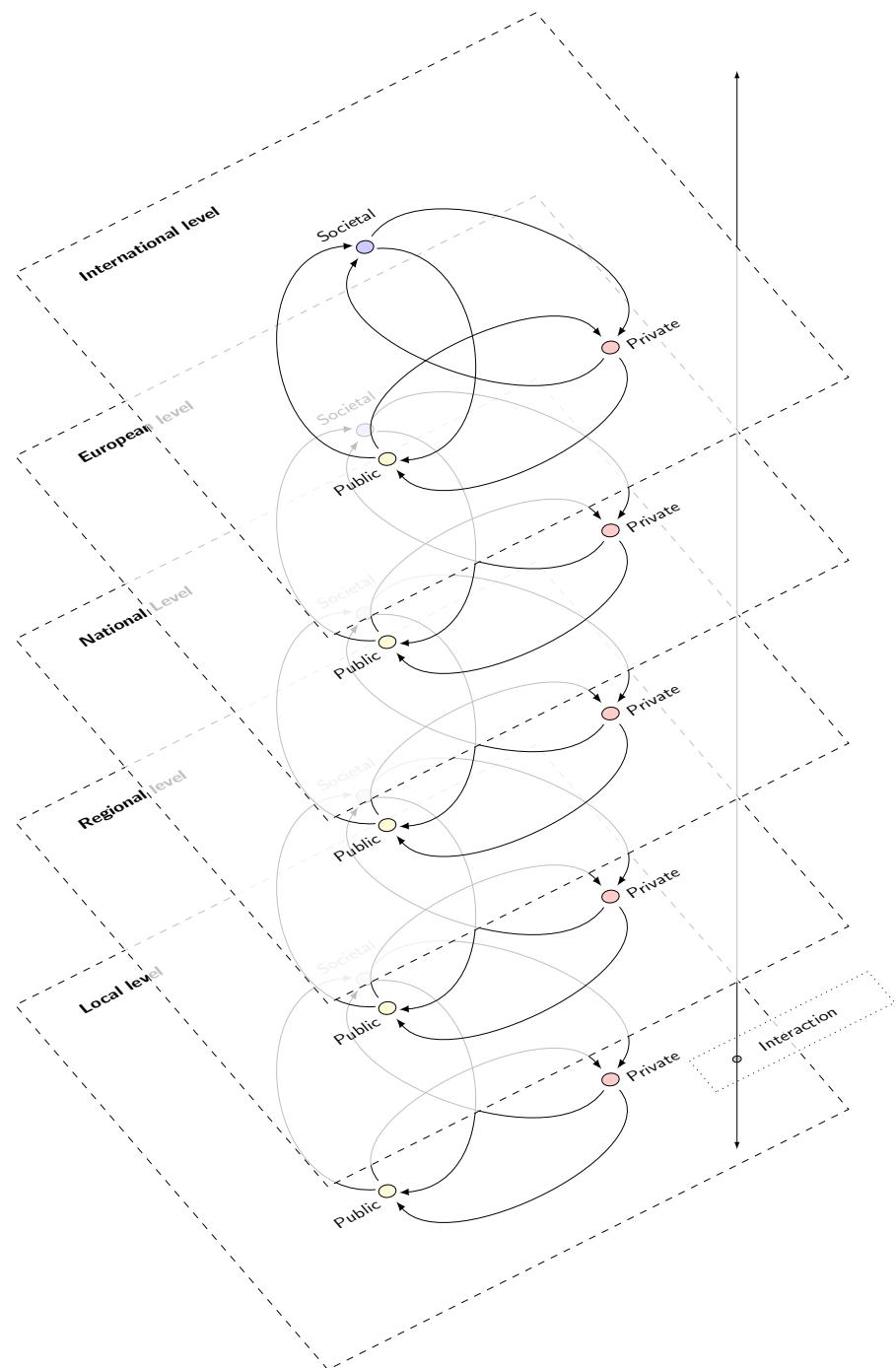


Figure 3.6: Different levels in multi-level-governance, adapted from Jänicke (2015)

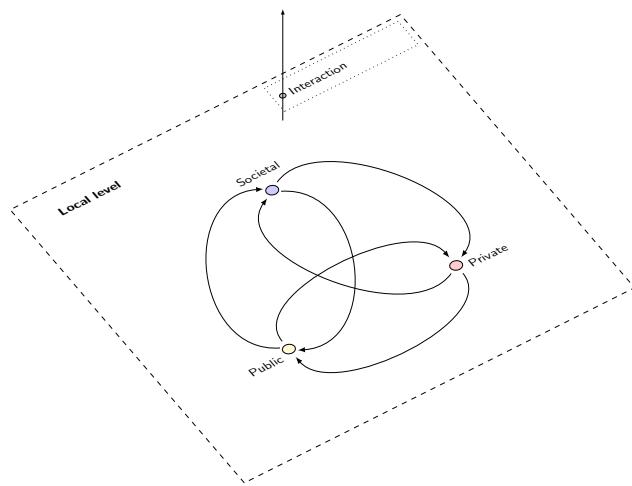


Figure 3.7: The local governance level (Jänicke, 2015)

the EU legislation and regulations for water, floods and the environment are important to the field of SUDS. The EU was and is active in several research projects directly and indirectly linked to the field of SUDS in Eindhoven and Tampere. Governmental actors from higher levels may support local initiatives through funding schemes, subsidies, regulations or advice. They may as well impede local initiatives e.g. by cutting the local autonomy (Bulkeley, 2010).

3.3.4 The Local Level

For this thesis a focus is laid on the bottom layer of the multi-governance concept which is shown in figure 3.7. Tampere as well as Eindhoven are both municipalities which are situated in EU member countries. SUDS are a local intervention. All interviewed experts are members of the municipal staff, local civil society, local scientific community or local private sector. Also the regional authority of the Waterboard in Eindhoven is locally active. They are situated on the “*local level*” in the multi-governance concept. According to Kern and Alber (2009, p. 9) “*four governing modes emerge as significant*” in urban governance in relation to sustainability. A municipality can act in a *self-governing, enabling, provisional or authoritarian* way. The different modes are stated and explained in Table 3.3.

Besides the local *mode* of governance also the governance *capacity* is an important factor for municipalities to Bulkeley (2010); Keskitalo and Andersson (2017). Scholars often refer to governance capacity in the face of climate change as *capacity to adapt* or as *vulnerability* (Smit and Wandel, 2006). Depending on the technologies, economic resources, human and social capital in the society as well as in the municipality, governance is able to adapt more or less appropriately. Cities face a certain pressure to adapt to outside changes. Especially in the field of SUDS this is the case as the changes in precipitation, urban flooding and urban heating are already noticeable.

In general the adaptation capacity is a “*system’s ability to adjust to a disturbance, moderate potential damage [to], take advantage of opportunities, and cope with the consequences of a transformation that occurs*” (Gallopin, 2006, p. 296). OECD (2018); Lenhart (2015) distinguish between two general dimensions of capacity: A *generic* capacity for the general response to changing conditions and a *specific* capacity for the response to a particular event. SUDS

Table 3.3: Modes of urban governing, adapted from Kern and Alber (2009)

Mode	Description	Example
<i>Self-governing</i>	Inward looking governance mechanism. The municipality as consumer - How do the local authorities manage themselves and their assets? Dependent on institutional set-up, reorganisations and strategic steering.	Public buildings with SUDS interventions, water saving and re-use in municipal buildings, adaptation of procurement processes to enable SUDS uptake, interdepartmental cooperation, vision creation, goal setting.
<i>Enabling</i>	The municipality as enabler of new partnerships with actors from civil and private sector. Convincing or influencing of civil and private actors to commit in SUDS development voluntarily.	Information campaigns, guidelines, events around SUDS, capacity building, fostering of greening initiatives.
<i>Provisional</i>	Provision of tools and infrastructure to foster SUDS uptake with a positive connotation. - "The carrot"	Funding schemes, subsidies, new forms of contracting, provision of space to greening initiatives, material and financial support.
<i>Authoritarian</i>	Governance through laws and regulation - "The stick"	Water fees, taxing of sealed soils, obligatory green roof installation, SUDS and other water-related themes in building regulation.

contribute to and are affected by both capacity dimensions. The capacity depends on various tangible and non-tangible factors: Available technologies, the will of municipal employees and of the citizens or companies to adapt, available funding and economic possibilities, the prevailing administrative and governance structures and their flexibility (Gallopin, 2006). For municipalities this is e.g. how well developed the cooperation with private and civil stakeholders is, what regulations or rules there are, what possibilities to cooperate with authorities of other levels and to use their rules or resources, where in the municipal organisation knowledge about SUDS is located, how cross-sectoral the cooperation is. SUDS are often perceived as an element of water management in administrative understanding. Their planning is therefore often situated in the water management department (Ashley et al., 2015; Davis and Naumann, 2017).

3.3.5 Governance Aspects

Climate change adaptation and mitigation policies have become a crucial part in several international development agendas and they seem ever-present in recent political debates. A lot of citizens, mayors and other local electives know about the overall topic of climate change. In spite of this, the complexity of the problem and the difficult accountability of local actors hinder implementation strategies at the lower levels of governance (Ehnert et al., 2017). Ideal linear mainstreaming application of *capacity building, training, information of key individuals and the following incorporation of results into policy* is a theoretical construct. Governance procedures and policy making rarely follow this principle. Rather than a linear implementation it is a patchwork of coexisting and converging processes and approaches (Pitkänen et al., 2016). In the traditional 'on-the ground' understanding of urban planning and governance, climate change adaptation and mitigation used to play a minor role. Other problems were perceived as 'more persistent threats' by local political actors (Kabisch et al., 2016, See p. 9). As stated in chapter 1, impacts of climate change are displaced through space and time and single actors cannot be held accountable for the overall outcome of climate change, like e.g. global warming. So arguing the importance of tackling this global issue to locally limited actors is "rather difficult" according to Sekulova and Anguelovski (2017). The mere breadth of sustainable development often hinders and limits its practical implementation. As touching a multitude of different planning and management sectors NBS do not allow for business-as-usual 'silo-thinking' approaches (EEA, 2012, See p. 5). The implementation of novelty inventions like NBS requires to overcome fixed patterns of thinking and decision making, usually known as path dependency (Matthews et al., 2015). It requires multi-sectoral approaches and interdisciplinary thinking.

SUDS as "truly multi-, cross- and transdisciplinary" (Charlesworth and Booth, 2016, p. 9) concept are in line with these requirements. Different stakeholders inside and outside of the municipality need to cooperate. It depends on organisation structures and their flexibility, if this is possible in a municipality. It is also about personal leadership and the will of the municipal staff. For example, whether the employees see SUDS as a possibility or as impractical, or whether they impede, passively follow or actively promote strategical decisions (den Exter et al., 2015). It is also a question of single personalities. For example, it plays a role if single persons feel dedicated to the topic and want to convince colleagues and promote SUDS. This again

follows an organisational question if the organisation lets them articulate their wishes and proposals or if initiatives are suffocated. This can also be a question of general decision-making or communication culture and the culture of perceived hierarchies (Bulkeley, 2010; Bulkeley et al., 2012; Davis and Naumann, 2017). Municipalities can actively foster this with e.g. staff training or else (Folke, 2016). Ties between individuals in politics, the private sector and the municipality can also play a role in the adoption of new practices in the urban space in general (Folke, 2016). Bulkeley (2010) mentions the fiscal and legal autonomy of municipalities as another important factor guiding the uptake of new measures.

Table 3.4, 3.5, 3.6 summarise the most important governance aspects for SUDS. The factors were identified and taken from four OECD studies on water governance in cities of Organisation for Economic Co-operation and Development (OECD) member countries (OECD, 2013, 2014b, 2015, 2018). The categories proposed by OECD (2014a) are used to organise the classification of the identified factors. There are the three overarching categories of *effectiveness*, *efficiency* and *trust and engagement*. In those, different sub-themes can be identified. They are stated in Table 3.4, 3.5, 3.6 alongside with a short description. Depending on their local expression, those factors either impose barriers, work as success factors or provide incentives to the SUDS concept.

The efficacy category as explained in Table 3.4 answers the question if ambitions that interfere with SUDS are set, which actors shape those ambitions and in which layers of administrations they are anchored. It also answers the question whether the governance aspects allow the implementation and pursuit of those ambitions.

Table 3.4: Efficacy Governance Aspects, adapted from OECD (2018)

Factor	Description
Capacity	Tangible and non-tangible capacity of the municipality, human-resources, knowledge and awareness – see description in previous subchapter
Policy alignment	If and how an overall vision exists and policies steer in the same direction. Is there an alignment of the policies relevant to the fields of e.g. infrastructure, health, environment, water, social services or urban design, spatial planning or else
Scale	Question about different organisational levels and the coordination between them. SUDS need to be introduced locally but their planning needs to be embedded in a greater context.
Roles and responsibilities	Especially difficult in cross-cutting concepts like SUDS. Who is taking the lead and which departments and opinions are marginalised, how is the cooperation between all involved stakeholders managed?

The efficiency category in Table 3.5 relates to questions whether the chosen pathways and the prevailing local conditions allow for an efficient SUDS uptake and support.

Table 3.5: Efficiency Governance Aspects, adapted from [OECD \(2018\)](#)

Factor	Description
Data	If and how data is collected and prepared, what quality of data is provided and how regularly this is done, if and how the data is used
Finance	Economic situation of the municipality, fiscal environment and autonomy, the focus and amount of funding
Legal concerns	To what extent regulations are in place and to what extent they can be enforced. Whose interests do these regulations reflect.
Innovative Governance	If mechanisms, structures and processes enable or suppress the uptake of innovations from staff or different stakeholders

Table 3.6: Accountability Governance Aspects, adapted from [OECD \(2018\)](#)

Factor	Description
Controlling	If the results of completed projects are assessed, if and how there is a consistent monitoring of individual projects
Co-creation	How possible future users, maintenance and construction companies or other stakeholders are involved. If and how possible trade-offs between stakeholders are enabled.
Communication	How the communication is handled, if processes are transparent and reliable, if trust can be built

The accountability section in Table 3.6 answers fundamental questions about democracy - if and how all stakeholders are involved, informed and valued. It also answers questions about transparency and if the public funding is used as intended.

4 | FINDINGS

The next two chapters present the findings of both case studies. Each case is introduced with an explanation of the respective national and municipal context. The formal properties of the expert interviews and the interview partners are mentioned. The actual results of the expert interviews follow. The results are ordered according to the research questions in the following subchapters:

- Local understanding of the concept
- Local implementation and the success factors
- Arguments for SUDS implementation
- Barriers to SUDS uptake
- Incentives for the Future

Each case study closes with a summary of the respective findings.

5 | CASE STUDY: TAMPERE

In the next chapter the results of the case study of Tampere will be presented. The chapter opens with a brief survey of Finland to contextualise the research. Key information on the political system is given. This is followed by the formal properties and the results of the expert interviews. The chapter closes with a summary of the case study.

5.1 THE FINNISH CONTEXT



Figure 5.1: Map of Finland with landscapes and the location of Tampere

In 2017, Finland celebrated 100 years of independence from Russia. After the Second World War Finland entered a treaty of friendship with the USSR and has since then been considered as neutral. The country became part of the EU in 1995 and entered the monetary union in 1999. Figure 5.1 shows the country with the landscape demarcations in dark green and the location of the Municipality of Tampere in red. The country is situated in Northern Europe with Sweden to its West, Norway to its North and Russia to its East. Three quarters of the country are covered by boreal coniferous forest.

Almost 10% of the country is covered by lakes. In total 5.5m people live there. This makes Finland the least populated country in the [EU](#).

The Finnish Political System

Finland is a federal parliamentarian democracy organised in a decentralised unitary state. The political environment of the past 30 years can be described as stable with a strong majority of politically central parties and without an effective opposition. Finnish policy making is driven towards consensus building with a highly developed sense of public responsibility towards its citizens. Strong local authorities see themselves as responsible for an effective delivery of services to their citizens. This governance style and a relatively high public spending level are in line with the other Nordic democracies ([Aylott, 2013](#)).

The highest organs of executive power are the president and his cabinet. The president is elected directly by the people for a six-year period. He appoints or dismisses the ministers, from whom the parliament can withdraw its confidence ([Aylott, 2013](#)).

The regional division of Finland into 19 landscapes ('*maakunta*') dates back to a time when Finland was a part of Sweden. Unlike today's administrative regions, these have a traditional regional identity but no significance as administrative units. However, the municipalities of a landscape cooperate in a landscape network ('*maakuntaliitto*') ([Aylott, 2013](#)).

Since 2010, the country has been divided into six regional administrative districts and the autonomous region of Åland. Each regional administrative district comprises one or more landscapes. The general state regional administration is exercised by regional administrative authorities ('*aluehallintovirasto*'). Its tasks include general executive tasks and an administrative supervision of the territory.

Finland's 311 municipalities are self-governing bodies with extensive competences. The municipalities have a high level of autonomy particularly in education, health and social services. Half of the Finnish public spending is allocated through municipal structures. The municipalities are grouped together in 70 administrative communities or sub-regions ('*seutukunta*'), in which the municipalities cooperate in the areas of economic development and the provision of public services. They formulate regional development programmes and regional land-use plans. They also formulate visionary documents for a more distant future ([EU, 2018](#)).

5.2 TAMPERE

Tampere is the capital of the region of '*Pirkanmaa*'. 500,166 people live in this region. The city counts 231,853 inhabitants. Figure 5.2 shows a geographical map of Tampere and the surrounding municipalities and lakes. The labels are given in Finnish and in Swedish ([NLS, 2017](#)). Tampere is located on an isthmus between the two lakes Näsijärvi in the North and Pyhäjärvi in the South. A characteristic of the city is the canal which connects the two lakes and flows through the city centre. A hydroelectric power plant placed right in the middle of the city uses the flowing stream to generate electricity. The city is described as "business-" and "knowledge-hub" and has been continuously growing during the past years. Anually around 4,000 people move to Tampere ([StatFi, 2018](#); [MoT, 2018b](#)).



Figure 5.2: Map Tampere and the surrounding municipalities.

The city is located in a border region of subarctic and temperate climate. In summer the temperatures vary from 12°C to 21°C. Winter lasts from November to April with average temperatures below 0°C. The likelihood for rain is almost constant throughout the year with 7 to 12 rainy days per month¹.

In particular the city faces challenges regarding its urban water cycle. During the last years, the city has experienced changing precipitation patterns and more extreme rainfalls already. According to climate forecasts this effect will most likely intensify in the decades to come. Urban heat islands and air pollution are not among the most pressing city challenges.

According to the latest climate change estimations by the International Panel on Climate Change (IPCC) the region around Tampere will have to cope with a temperature rise which is 1.5 times higher than the global average (IPCC, 2014, p. 60 ff). The precipitation in this region is projected to increase by 10% to 25% for the period 2070 to 2099 in comparison to the period from 1971 to 2000 (OECD, 2013, p. 147). Due to the general temperature increase there will be most likely a shift from less snowfall to more rainfall throughout the seasons. The snow season is expected to become shorter and more discontinuous. The winter snow cover is also expected to shift further up north. For the mentioned time periods an increase in the seasonal winter runoff by roughly 10% is expected. Longer and drier summers will most likely reduce groundwater levels and water discharge and can ultimately lead to drought periods. These changes may affect the groundwater quality negatively (OECD, 2013, p. 147). The greatest impacts on the Finnish water cycle are expected due to more extreme rainfalls. The average summer rainfall is expected to decrease, but there is an increase in danger for extreme rainfall and subsequent flooding. On average an increase in intense rainfall

¹ Average in Eindhoven = 10 to 13 rainy days

events from 40% to 60 % is expected for southern and central Finland and Tampere (MMM, 2014; YM, 2017, p. 12). The development around SUDS is believed to help in adapting to those changing conditions.

Tampere takes part in several climate change adaptation and mitigation networks and is committed to several sustainability related goals. E.g. the EU Covenant of Mayors², a strategic climate alliance with its seven neighbouring municipalities or the '6Aika Network' - an initiative of the six biggest Finnish cities to "combat urban challenges"³. In 2013 the city published a 'City Strategy for 2025' in which sustainable development is stated as one object for city development (MoT, 2013).

In the field of SUDS the city has been following a storm water management program since 2012. Several master planning programmes of the past years stressed the wish of the administration for a sustainable development of the municipality. They did not mention SUDS namely but described the concept with different words or used practical examples such as green-roofs or else (MoT, 2018b, 2017c,b, 2016). In 2017 the city published a work programme on the city development until 2040 (MoT, 2018b). Here, SUDS development is referred to as "sustainable water management". Until today 90 SUDS interventions were realised in Tampere. They concentrate mostly around the districts of *Vuores* in the South-East of the inner city and *Hiedanranta* which is situated between the indicated train line and Lielalhti in the South-West of the inner city on the shoreline of lake Näsijärvi. A map indicating the detailed position of all different SUDS sites can be found in the Annex.



Figure 5.3: View on the center pond in the Vuores district⁴

When talking about SUDS development in Tampere, the districts of Vuores and Hiedanranta have to be mentioned. Vuores is a district development project for a residential area planned to provide 13,000 people with new housing by the end of 2025. "Around 2003 first considerations were made" (according to expert alias B2) and officially it started in 2005 . The first residents moved there in 2010. The district branding presents the district as en-

² See <https://iclei-europe.org/members/member-in-the-spotlight/archive/tampere/>

³ See <https://6aika.fi/in-english/>

⁴ Photo source: Ramboll Studio Dreiseitl

compassing “high-quality architecture, an ecological attitude [and] cutting-edge technological solutions” (MoT, 2018a). The installed SUDS solutions are specifically mentioned and used as marketing argument. The SUDS stormwater system in Vuores is among the “largest in the Nordic countries” (Särki-lahti, 2017, s. 4). The district buildings cluster around this large SUDS-pond. Figure 5.3 shows the view on this central element. In between the buildings and around the districts smaller SUDS interventions were realised. Figure 5.4 (a) shows an installed infiltration soakway and figure 5.4 (b) a rain garden.



Figure 5.4: Smaller SUDS in Vuores⁵

The Hiedanranta district is only being planned. The former industrial site of a paper and pulp mill was bought by the municipality in 2014. The district is advertised as a “smart and sustainable city district” and as platform for “circular economy and eco-efficiency”⁶. It is planned to house 25,000 people in the future. The co-created planning documents explicitly describe SUDS as ‘innovative water management solutions’ (MoT, 2018a). The district as such explicitly includes NBS. The city collected ideas on the possible development from citizens and selected companies in several workshops in the years 2015 to 2017 (MoT, 2017a). Figure 5.5 depicts the vision for the Hiedanranta district with different SUDS in the form of urban trees, permeable pavements and rain gardens.

5.2.1 Municipal Organisation

Figure 5.6 shows the organisation chart of the municipality of Tampere. The municipality is organised in a classical hierarchical structure. In spite of its appearance the structures are not perceived as strictly following the hierarchical levels by the municipal staff. This is in line with the “Nordic

⁵ Photo source: Municipality of Tampere

⁶ See <https://www.tampere.fi/asuminen-ja-ymparisto/kaupunkisuunnittelu-ja-rakentamishankkeet/hiedanranta.html>

⁷ Photo Source: Studio Buenaventura



Figure 5.5: Vision image of the Hiedanranta District⁷

democracy style” (Brandal et al., 2013). The decision-making power in the municipality is exercised by a municipal council (*'valtuusto'*) directly elected by the people every four years. The municipal council elects the local government or city board (*'kunnanhallitus'*) as administrative organ. In the case of Tampere, the municipal government is chaired by a full-time municipal director (*'kunnanjohtaja'*) (EU, 2018). The City Board is in charge of the general administration and the finances of the municipality. It is also commissioned with implementing the decisions of the council in local law. Below the council, mayor and board there is the central municipal administration. It operates as staff to the mayor and as link between the municipal staff and the organs.

The municipal organisation is subdivided in three service sectors. Namely in “Welfare”, “Growth, Innovation and Competitiveness” and “Urban Environment and Infrastructure”. The three sectors are again subdivided into different departments. In the departments different service units are assigned with specific tasks. In the department of “City Planning and Infrastructure” the plans for city development are prepared and the decision where and how to include SUDS is made. The city planning department decides which other departments and service units should be involved in the planning process. Since the introduction of the Stormwater Programme in 2012 the Service Unit “Drainage Water” is involved in every development project of the Department of “City Planning and Infrastructure”.

5.2.2 Expert Interviews Tampere

In total ten persons were interviewed in Tampere. From these, three are employed in the municipality of Tampere. They belong to the different departments of Environment, Stormwater Management and Urban Planning. Three persons belonging to the academic sector were interviewed. Two of those work as researchers in the management department of the University of Tampere and have direct on-site research projects in business research

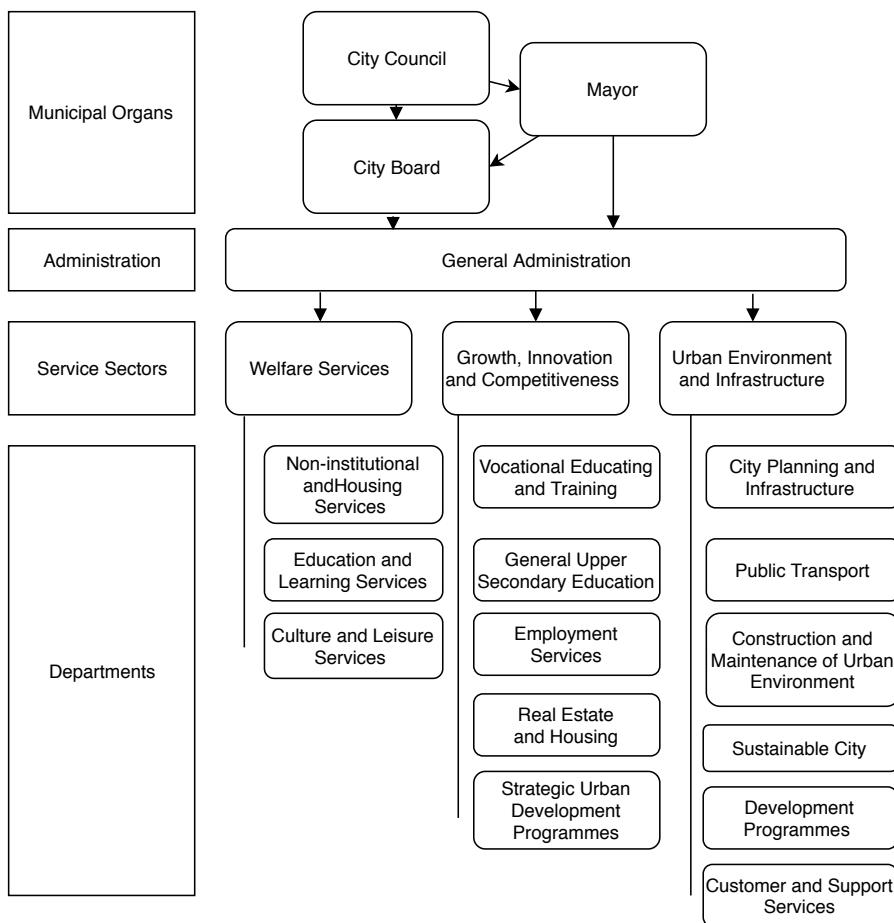


Figure 5.6: Organisation of the Municipality of Tampere

connected with NBS and GI. In addition, one researcher from the Technical University of Tampere who also has direct links to the implementation of SUDS was interviewed. Two interviewees belong to the business sector. One of them is the director of an engineering consulting office and has over 15 years of experience in stormwater solutions and cooperation with municipalities in Finland. The other one has approximately 10 years of experience in green infrastructure planning and urban design for Finnish municipalities. The interviewed persons alongside with their cluster affiliation (Public sector, Business, Academia, Civil Society) and their hierarchical position are noted in table 5.1. This table offers the specific reference code which is used to allocate the given statements to the different interviewed experts in the following chapter. The interviews were conducted in the English language.

5.2.3 Local Understanding of the Concept

For the people interviewed in Tampere the concept of SUDS is well-known. The prominent lighthouse project of city development in the district of Vuores incorporates a large intervention of a SUDS system.

The importance of aesthetic aspects is highlighted and one interviewee explains that SUDS to her consist "mainly of something green" (M1). For most interviewees SUDS are solutions that imitate the natural water cycle (M1, M3, M2, B2, A2). "They are a system that works like nature and we

Table 5.1: Interview Contacts in Tampere

#	Alias	Cluster	Position
1	A1	Academia	Senior Researcher Management
2	A2	Academia, Civil Society	Post-Doc Researcher, Volunteer
3	A3	Academia	Stormwater Engineering
4	B1	Business	Group leader consulting. Water services and ecosystem services assessment
5	B2	Business	Director water services. Stormwater planning and design
6	C1	Civil Society	Volunteer
7	M1	Municipality	Project Manager Environment
8	M2	Municipality	Environment and Monitoring
9	M3	Municipality	Coordinator UNaLab project
10	M4	Municipality	Project leader stormwater management

should always have a working nature in the back of our head while planning those solutions - I think that's the sustainable part about it' " (A1). Interviewee (M3) mentions that there is a direct connection to the provision of ESS. Most interviewees picture SUDS solutions as de-paved or permeable pavements and roads in the city. Green roofs are mentioned several times as SUDS solution.

For the interviewees SUDS also offer combined uses and multi-functional outcomes.

5.2.4 Local Implementation and Success Factors

In total there are today 40 different sites with SUDS interventions in Tampere. The development of SUDS in the city premises started with the development of the Vuores district. The city administration published a development paper for the district south of the main city. Following up on this paper, a protest by local dwellers started and "forced" the development of a "discussion about how to create an innovative district incorporating new ideas" (A3). "Some people were really concerned about environmental issues and feared that the municipality would just cut down all the trees and build houses on the ground" (A3). The Vuores district marked a starting point of "new thinking in the municipality" (M4) and was "clearly the beginning of SUDS implementation in Tampere" (B2).

Local Conscience

According to (B2) there is a high local "conscience for water quality and the preservation of Finnish water". If new urban development projects interfere with the water of the nearby lakes, they immediately "attract public awareness". (B2) sees this as a main driver behind the "thoughtful" implementation of SUDS in the two district development projects of Vuores and Hiedanranta. "Something really had to be done differing from mainstream solutions" (B2).

Vuores

According to (A3) the "development around Vuores sparked something in the municipality and in the engineering consultancies around here - it raised an ambition". According to (B2) "15 years ago you could count the stormwater experts in the companies on one hand". And he further explains "the needed change and the new trends were not seen by the companies' bosses but by the technicians working in this field". To (M1) it's also 'the technicians who look ahead'. (M2) confirms that "Vuores sparked a movement" in Tampere. "Before this project there was hardly any movement in Tampere" (B2) says.

Import of Concepts

The knowledge about SUDS "had to be imported and did not exist in the municipality" (A1). The city assigned the "famous German design consultancy for public space" (B2) 'Studio Dreiseitl'⁸ to develop the design plans and the SUDS implementation for Vuores.

To (A1) this situation persists until today as to him the "the whole SUDS development in Tampere is 'expert-driven' ". To (A1) also the necessary

⁸ See <http://www.dreiseitl.com/de/studio>

import of ideas persist as “the ideas are born somewhere and then imported to Finland and adapted to local conditions - why are they not born here?”. He stresses that “the private sector works as main distributor and importer of knowledge and application of these new concepts”. These imported ideas and “international inspiration” (A1) work as a motor of innovation in the Finnish SUDS approach. Company and municipal “planners visited Toronto and other international sites to look at the new solutions, that was around 10 years ago” and so “for the bigger picture the international context is very important” (A1). Although nowadays “mostly local actors are involved in storm water management here in Tampere” (A2). On the demand side, most interviewed persons see the public sector as the main driving force behind the development. As (M1) states that “in the SUDS development and implementation the motor clearly is the municipality”. One can say that the private sector has yet to value the new solutions voluntarily.

Public Interest and Urban Gardening

The interviewees express mixed opinions on the role of public interest. Most interviewees agree on the point that there is low citizen commitment for overall greening and environmental policy and that “citizens do not care too much about this topic” (M1). Although in the case of the Vuores district there was “a lot of uprising” (A3). In the field of SUDS there is an urban gardening initiative and one allotment garden in the city premises. According to (C1) “there are some very active citizens but it is also hard to be committed anyhow”.

If committed citizens decide to start their own greening initiatives, e.g. in the field of urban gardening with gardening boxes or plots, there are two possible ways they can do so. The city of Tampere provides the citizens with gardening plots in two allotment gardens outside the city. The plots are owned by the municipality, but organised and rented out to the applicants through the ‘4H’-Organisation⁹. The plots have existed since the 1980s. People can apply for a plot to work on. The waiting time for a plot is from one to three years. According to (C1) this offer is already at full capacity and all available plots are booked out. (C1) also mentioned that people taking up on this offer are already somewhat semi-professional gardeners and very dedicated to the task. The level of skills you need in order to begin and participate in the allotment gardening is “rather high” (C1). The municipal plots are located outside the town and cannot provide any direct benefits to the urban area. In the new district of Vuores and on unused premises belonging to the church of Tampere two other allotment gardens were established. In the case of the church, unused premises were transformed to allotment gardens because of an initiative of (C1). The plots were immediately booked out and are now occupied as well.

If citizens want to put up garden boxes or other forms of urban greening on land owned by the municipality it is possible. To do so a permission is needed from the real estate department. The citizens are also able to obtain subsidies for their projects from this department. All this works through an informal network. Committed citizens have to contact one specific person in the real estate department. But there is no information that it is possible to obtain subsidies and that it is possible to green urban space in such small-scale initiatives. Interested persons have to know or obtain the information from an already informed person to be able to apply. (C1) describes the Real

⁹ 4H - Head, Hands, Heart and Health. International NGO committed to youth work. See <https://4-h.org/about/what-is-4-h/> and <https://tampere.4h.fi>

Estate Department as “really open-minded” towards these approaches and (M₃) states that there is a “very high chance” that funding is granted and initiatives are supported by the city.

“There is also another small gardening initiative in the big house blocks. They just do gardening together in their back yard. All other block houses have huge parking areas for cars and they have their garden”. (C₁)

Regulations

Storm water management was taken out of the water services act. It was instead included in the land use planning act. This means that storm water experts need to be present in any development project pursued by the municipality. According to (B₂) this strengthened the overall position of SUDS. Although, according to (B₂) “until now” only “storm water quantity issues are addressed in legislation”. Storm water quality is neglected in legislation. It is “considered clean and can be discharged without further treatment and without adding up costs” (B₂) to house owners etc.

In 2012 a Finnish guideline on SUDS was established which gained popularity among municipalities. (A₂) states “There is a famous ‘handbook on storm water management in Finland’, released by the Finnish Water Forum. “The handbook was a major push of the overall SUDS agenda and gave the topic broad publicity”. According to (A₁) “these technical guidelines were clearly some kind of starting point [of a broader uptake of the concept], because until then every municipality was working on their own small-scale experimentation and knowledge was not formally accessible - they needed some kind of guideline”. Also “for the guidelines 2012 was a good starting point, because they needed a lot of reference cases. So they just gathered all of the small-scale experiments from all the municipalities” (A₁). (B₂) confirms that it was the handbook which “helped a lot” and that before its publishing “municipalities had no reference in Finnish”. In accordance to this comprehensive guideline a special guideline on the maintenance of SUDS in Tampere was elaborated by the maintenance department in 2016 and distributed among city officials.

Cooperation

To (A₁) also the cooperation changes happening at the moment are a key factor to success. He states that “before people working on storm water systems were in different departments. But now there is a structural change. And this change is very new”. He sees the “change in applied infrastructure” as so strong that “it is also changing the organisations”. (A₁) see the development “peaking just now” and that “the change is very hot just now” - “the change from the experimental phase to a much bigger scale is just happening”.

In terms of standardisation and building codes the so-called “RT-Card process is just happening and they negotiate which elements should be included in the building regulations”. ¹⁰

(M₂) states that control measures are in place and that “if the builders do something wrong, we can punish them, but this tool is rarely used” .

According to (M₂) “a lot has developed and people like land-scape planners are more aware of SUDS”. Also the discussion about endangered species

¹⁰ The ‘RT-card’ is a system of building and construction guidelines. In the guidelines legitimate solutions for newly constructed buildings are included. See <https://www.edilex.fi/data/rakentamismaarakset/a2e.pdf>

passively supported the implementation of [SUDS](#) as more public awareness about the benefits of green sites in the city was created. “The legislation around endangered species is so tight” that this provides a strong legal argument for the incorporation of [SUDS](#) in development projects.

New Ideas

Excess snow is collected off the roads in the inner city in winter and driven to a collection site outside of the town. The snow usually is “quite heavily contaminated”, e.g. through salt, grit, rubbish or animal residues and has to be “cleaned thoroughly” (M2). To accomplish this the municipality installed a biofiltration plant. Planning and supervision of the functioning of the plant was achieved with the help of the Finnish national research institute SYKE (*‘Suomen Ympäristökeskus’*). According to (M2) everybody in the municipality “is very happy” with the plant, because it is functioning well and the planning and construction was “quick and easy”. Reasons for the success of this project were the relatively small investment costs of 80,000 EUR and the “easy negotiations”. (M2) remembers that “we just contacted the persons in charge of the snow maintenance and explained the water quality problems to him. He then just hired someone to make the planning and together we made it happen”. (M2) stresses that this was “not part of the official planning process and was just done sideways” using informal networks and personal contacts between the departments. “The building department, they are in charge of the maintenance of streets and piping and snow maintenance etc., and they have a rather big budget compared to us”. According to (M2) the building department and personal motives of employees are the driving factors for [SUDS](#) implementation.

A Question of Timing

(A1) states that in the discussion about climate change adaptation there was a momentum generated for [SUDS](#). In 2018 the municipality of Tampere introduced a stormwater fee for private households. It consists of an annually paid lump sum. (A1) “The storm water fee is so new we do not actually know the consequences”. It was this year the possibility was given to municipalities to levy that fee and Tampere decided to go for it. (B2) “The storm water fee will go directly in storm water protection. That is one way of coping with the extra maintenance costs”.

(B1) sees it as great advantage that at the time and due to the [UNaLab](#) project the same people are involved throughout different projects. “For the people who got to know me, ecological expertise is then easy to get. They just approach me when they have a question. This feels very nice”.

According to (A1) another success factor could be that “private land owners are the minority. Most of the land is owned by the municipality”. This can be used in favour of [SUDS](#) implementation.

5.2.5 Arguments for [SUDS](#) Implementation

The interviewed mention several benefits [SUDS](#) already provide in the city. All of the interviewed persons see [SUDS](#) as a way to advance city planning towards more sustainable practices.

(C1) stresses the argument of urban biodiversity in the promotion of [SUDS](#). As other countries in Europe Finland suffers from a “great loss of bees” and

other flying insects in urban settlements and this development should be "taken action against".

(M2) mentions also natural values of urban space like the flying squirrel in the case of Tampere which is under pressure by urban development. To her "we have a park area to entertain people, so we should have the same area to take care of storm waters with SUDS and take care of our endangered species".

(B2) as an expert from the private sector sees low costs as a positive argument for SUDS. He states that "the implementation cost is not that big compared to other infrastructure projects. For example, if we build a new park, it would cost basically the same with or without the integration of SUDS". Referring to the Biofiltration Plant also the initial costs were reported as low by (M2) while the impact of the site is perceived as very beneficial.

(B2) states that there is a lot of value added by health benefits, reduced heat stress etc. where until now little connection is made to SUDS argumentation(which should be used to argue in favour of Suds).

Considerations about stormwater are included in the formal landscape planning process. (M2) stresses that "water quality issues should be included", because the lakes are still in "such good shape" although "very vulnerable". (M2) sees SUDS as tool to provide quality aspects to achieve high water quality.

To (A1) "the private companies clearly see their opportunity now". The design of the stormwater systems "is the product of many companies" and also "in the green-roof sector [...] new companies are evolving". So the implementation of SUDS is a factor of income generation.

(M1) states that "green in general is always nice to look at, that is why we have the people behind us".

(M1) states that the "moment to act is now" because a lot of public infrastructure reaches the end of their lifetime just now.

According to (B1) there is a lot of pressure from national regulation to work on sustainable storm water practices . "They have been very active in terms of determining the national guidelines and they have been working together very well with all the consultancy firms".

(B2) sees momentum in including SUDS in other city projects. He mentions "for example the people designing the parks [...] are very much interested in green-blue infrastructure".

5.2.6 Barriers to SUDS Uptake

Lack of Space

In general (M2, B1, M3, B2) see the limited space in the downtown urban areas as most pressing challenge. There are "so many interests to consider" (M2). With increasing inner city densification "things will get even more complicated - we have 3,000 people moving in every year" (M1).

Lack of Guidance and Vision

The city struggles with the role it should give the development of SUDS on its agenda. (M2) mentions that the phrase 'sustainable' often "implicates that things are seen as a kind of luxury version which can be implemented only if there is enough money". She highlights that "this is always something extra" and reserved to special projects and not to the mainstream development. It is "all about the branding of a project" (M2). Others also mention

that **SUDS** have not reached the mainstream development yet although it might seem like it to the outside world. The example projects of Vuores and Hiedanranta are advertised to the outside. They also play a special role in the city administration. (A2) points out that the city uses “these lighthouse projects but simultaneously [...] invests...” in the old structures and traditional solutions”. (B2) sees “the main barrier [...] that we do not have enough districts like Vuores and Hiedanranta. We need to talk more about retrofitting and about the mainstream approach. Green roofs and permeable pavements can be retrofitted almost anywhere.” To (C1) the general view on **SUDS** and **NBS** is an obstacle. She sees the city as not open for new ideas such as urban gardening. She reports that “people in the municipality just cannot imagine urban gardening as a means to green the city” and that they “imagine the parks in a more traditional sense.” But “in Hiedanrantha it’s an exception - the whole project is a big exception, I think that’s sad. It’s just so limited.” Having the view from inside the municipality, (M1) confirms this and sees this as “a problem in our organisation because everything new - we say ‘put it to Hiedanranta’... and it’s not our only district. In parallel there are so many other things happening”. “It’s just easier to carry on how they always been doing it”. To (M1) “the planners are planning on plots and projects too small. They cannot see the bigger picture.” According to her planners cannot “see how these small projects have an impact on the whole development.”

Clash of Interest

(B2) stresses that with this new complex approach “of course there is a clash of interest”. He thinks that **SUDS** development is problematic because “there is not an overall image that Tampere should get greener in the city”. To (M1) **SUDS** are underrepresented in the master planning of the city and she wishes that the city “incorporate **SUDS** more in the bigger masterplan.” To (B2) it is a problem that the agendas are not aligned.

Role of the Civil Society

in the lighthouse projects the implementation of **SUDS** is happening quickly in Tampere and the change is perceived as “big” because the “organisation is handled top down [...]” to (A1). Although the management process around **SUDS** has not changed according to (A2) and the city tries “to integrate these new stormwater solutions in those old management practices - they are just doing new things in an old way”.

According to (A2) in the “top-down”-approach citizen’s involvement is under-represented. (A2) emphasises that **SUDS** are “a totally new infrastructure. They set some bumps and some stones in the city and some kind of metals - they make it like in the old days. They think it through and build it and nobody is to interfere with it”. (A2) sees that “they stayed the same old city planners but now they wear green glasses - it’s completely new stuff pressed into old regimes and ways of working”. (A1) emphasises that “the techniques and approaches are completely new but the approach towards citizens is not.”

Finnish legislation makes citizen involvement a prerequisite for all development projects in the city. A full-time employee is dedicated to the co-creation of projects. But (M3) notes that this co-creation process “was not changed for years” (M3). Mostly co-creation is done by information gathering in the evening when “hardly anyone participates” (M3). Also (M1) sees

that "if the citizens were prepared better about those new projects and about the chances of the new solutions they would maybe participate better" (M1).

According to (C1) the respective city officials "see themselves as enablers but not as promoters of a green development". (C1) stresses that they are not "active" and that any "action should come from the citizens themselves". (C1, M1) draw comparisons to other cities in Finland where more is done to actively support and initiate citizen commitment towards a decentralised implementation of SUDS and GI. (C1) sees path dependency as a big problem in the municipality. She states that "they cannot imagine urban gardening as being part of the solutions. All they see is new problems. And those people who are open-minded towards these solutions are just too shy to speak up. They stick to their nine-to-five job."

Flaws in Organisation

When new projects are planned it is a question "about the branding" (B1) of an area if SUDS are included. When existing systems are to be renovated, upgraded or maintained the question on whether to incorporate SUDS is sometimes dependent on the will of single persons. (M2) states that "if the person in charge in the Building Department does not think environmental issues are important then there is no progress in the projects". She says that "most people in this department do not really care about environmental issues - and that is a huge problem". With 'this department' she refers to the Department of Infrastructure. Also, according to (B2) the Infrastructure Department is "a bit more pipe-oriented".

Exchange between Sectors

To (A1) the municipality also underestimated the role of the private sector in the past. He sees that "the city just got to recognise the role of the private sector. In the beginning they thought that they are able to do everything themselves - which is still a widespread belief, especially in Finland". "Now they know that companies are needed and civic action is needed etc. With those new solutions it's impossible for one actor alone". He mentions that "city officials just cannot gather enough knowledge to compare between cases. It's the private companies' employees who do projects in different cities and transfer the knowledge between sites." (A1) sees that "the knowledge about new procedures, drainage models and how to predict the impact of stormwater lies in private consulting companies and not in the municipality".

Lack of suitable Regulations

(M1) mentions that even existing rules cannot be enforced effectively due to lack of personnel. She mentions that the city "would need some building inspectors more" and they "should check every plan thoroughly but there are just not enough" (M1). (C1) sees that "the city is not acting forcefully enough on landowners to engage in SUDS". To (M2) it is problematic that quality regulations are only applicable to some types of water. She states that "in Finland we have the problem that only the large lakes are protected by EU-legislation. But we have numerous small ones which do not fit into the EU-regulation. There are no quality goals or anything for those". Roughly two thirds of the municipal area is owned by the municipality (Valtonen et al., 2017). (M1) states that if the municipality is owning the land it

"should say more and make more regulations. But the political will is not well developed."

Lack of Knowledge and Awareness

According to (A2) the "beliefs and paradigms about nature" which prevail in the city should be thought over". He asks "what is urban in urban nature? There were so many decades of a certain view on a modernised city. It was about scientifically based biodiversity management and about allocating it to green areas and not seeing it as part of the overall development." To him, "this changed now." He sees, that "there is a change in the view of biodiversity happening." (A1). And further explains that "in the old sense it was about protecting, in the new sense it is also about creating". To him "the municipality is not updating their view on biodiversity and nature protection". The outdated view on biodiversity management manifests itself in the position nature protection officers have in the planning process of SUDS. When the guidelines was drafted "the municipal officers who are responsible of nature conservation and biodiversity were not involved in the process" (A1). "The green and recreational planners are working closer to the land-use planners here" as (A2) recounts and together "the storm-water experts and land-use experts with park-planners formed a group" (A2). Municipal nature conservationists and biodiversity officers were allowed to "give some comments but they were generally external to the process" (A1). This situation is persisting as "even if they are planning on those new SUDS, these people mainly do protection of current biodiversity but do not introduce new nature in the new projects" (A1). As belonging to the nature conservation department (M1) confirms this and expresses "I always hope to be involved from A to Z but this rarely happens." (M1)

An Exclusive Development

To (A1) the SUDS development in the municipality is "totally expert driven, consisting only of expert engineers" which is a "problem for further development". They see that even in the private companies the generation of knowledge was "completely expert driven" and that it were "single specialised technicians who predicted the development and not the company leaders."

Also (B1) thinks that more people should be integrated in the process. She states that "We are still kept too much in our silos even though we are doing a lot of cooperation. We have goals for the storm water planning and then we have goals for the park planning, for the green structures etc. etc."

Lack of Knowledge

The complexity around the SUDS implementation is also perceived as barrier to a wider uptake. (B2) stresses the cross-cutting nature of SUDS. While incorporating multi-functionality the new solutions also bear the problem of involving many different competences. "There is much more to do than just incorporating nicely looking and functional solutions - we have to discuss with so many different departments". But according to (B2) it would not be beneficial to implement a special department only targeted to the development of NBS or SUDS. It "will not work" as this department "still would have to discuss with all the other departments". (B2) sees it as more beneficial if "storm water or SUDS related people" are "placed in the different departments'. Then they are able "to communicate with the outside world

and also educate the other people in the department". "Another department would just create another possible entry point of a clash of interests", but "by educating single persons in the departments we can even get the pipe-thinking people on board"."

Lack of Funding

As in most development processes insufficient funding is perceived as barrier by the interviewees. (B1) sees that "in the end it's all about money". She wishes that the engineers were able to "prove that SUDS are in 90% of the projects more cost-effective than traditional solutions in the long run". Then they "could really make a difference and build up a strong argument to incorporate those". Also (B2) experiences that "getting the funding is a huge problem. The maintenance of these new solutions was not there before and the city is not collecting any new taxes - so where should the money come from? - That's the concern of the maintenance guys and this is also a point why they see SUDS development very sceptically [...]. So in the short term they'll just need the money". (B2) sees that the barriers to implementation lie "more in the post-development phase" as "maintenance cost will of course increase if SUDS are included".

Also to (M1) the problem lies in the lack of funding for actual implementation of SUDS. To her the municipality alongside with the contractors is able to "make good stormwater plans but when it comes to implementation there is a lack of money." She thinks that "when the constructors are doing their work they need more guidance and need to be controlled better. They want to go for the cheapest and easiest solution - so it will always be the plastic container underground." By 'plastic container underground' she is referring to a water retention solution achieved by placing large plastic containers underneath newly developed buildings. The containers are a good example for single-purpose oriented engineering solutions.

(M2) sees that monitoring should be given more awareness and funding to ensure and measure possible achievements of SUDS. She summarizes that "it's always an economic question. We need more finance and awareness".

Lack of Political Support

In the eyes of the interviewed municipal workers they themselves lack assistance and support from politicians. They see little awareness and interest of politicians to the topic of SUDS and GI. (B2) sees that "It's these municipality technicians, they basically themselves force these things and look into the city storm water issues". (B2) adds that "in each and every project they are the ones who keep asking about the design work incorporating SUDS". He confirms that the municipal officers are not pushed by politicians to work into this certain direction. He sees that "policy has little role in this" (B2). Also from a research point of view (A1) confirms that SUDS are "not at all politicised until now." (M1) notices that "after the last elections [...] more conservative people" entered the local parliament. But to her this does not change much of the situation and politicians neither support nor oppose the topic actively. All in all "the politicians not keen on this subject are in the minority." (M1) More important are again questions on funding. She states that "things slowed down a bit after the last elections. But I think this is mostly because of our poor economic situation at the moment." (B1) is more critical towards the role of politics in SUDS. She sees that "urban development is still seen as kind of contrary to nature" by politicians and

that "for them city thinking is linked to thinking about concrete or grey stuff and nature is linked to rural areas outside of the city." In general she sees that it has to do with "the technical thinking as well. Bringing solutions to the urban environment is always connected to the technical sphere". She states that in Tampere "if you want good quality and something stable then it should be something grey" (B1).

Lack of Private Sector Inclusion

The private sector which consists of construction companies and development companies has not taken up widely on SUDS solutions until now.

(B2) sees a "fear of the unknown" by private developers as well as by private land owners. He states that mostly "public land use-planners are ready to make space for these new solutions in public areas" but there is "quite a lot of privately owned area in each project and we need to involve them in the whole concept as well." (C1) recounts that there is little will in the municipality and with house owners to enable rooftop gardening. Although there were "several attempts" on "several buildings" by interested citizens and businesses to develop rooftop gardens with food production in the city. In all of the "three attempts" the initiatives did not succeed because the building owners did not let them. Technical arguments were used to inhibit the initiatives, e.g. it was argued with the static equilibrium of the houses. This argument could not be proven right or wrong as no structural engineers or other experts were consulted.

(B2) states that "the property developers are not on board with SUDS". In general, most interviewees express that they see largely a lack of knowledge in the private sector on construction and maintenance.

(M4) agrees to this. To her also the "big problem are those private sector builders, who are afraid of these new solutions" (M4). (M2) also confirms and states that the private developers "just don't have the knowledge. If we tell them that they have to treat the process water in a certain way they just don't know how to do this."

(B2) sees as one possible problem behind this development that "the land-use process is getting more complicated every year" and "every year there are new things to assess." Also to (M3) the lack of suitable guidance for the private sector is a problem. She says that "the [municipal] handbook is around 300 pages long, we just need shorter and more pragmatic informations. Short and specific guidelines for the private companies."

(M2) states that the "building companies often make mistakes", especially when it comes to water issues. To her it starts with basic requirements as clarifying process water from the building sites. "It often happens that they drain contaminated water. They do not do this purposefully but they are just lacking the proper techniques and knowledge" (M2). (B1) sees that "the non-understanding might sometimes even be purposeful" to avoid SUDS implementation and expensive cleansing techniques. She sees that the only motivation of private developers is "to keep the built area as large as possible" and that SUDS or anything "that takes away even a tiny bit of the buildings is tried to be pushed away" (B1).

(A1) recounts that private investors "are still relying too much on international concepts." And for those international concepts "it is unclear if it will be possible to gather enough funding." He sees this as possible obstacle for innovations and states that "it is important to keep the development open all the time and not be fixed on some approaches." To (M4) the business case model behind private investors and development agencies is a barrier.

"They build the houses but they do not care about the maintenance or later use. They don't care if the maintenance of the SUDS is easy or not. If they are working or not." She sees that the municipality "should have more regulation and more information on how to maintain those." (M1) confirms and states that private investors "think about their profit and want to keep costs low". "I understand that but I would hope that there would be some builders who think ahead and start doing things a bit differently". According to her "the whole sector is not really keen about the new solutions".

(B2) highlights the importance of the private sector because "most municipalities" do not do the design work of development projects on their own. "They buy it from us", and "that is why the knowledge about SUDS has to be spread among the privates."

Until now it was only possible to make "the private actors agree on the most basic options. Some basic retention with underground plastic tanks that basically take the retention part into account but miss on all the other subjects SUDS can provide." (B2)

Lack of Knowledge and Awareness among Citizens

Lack of knowledge is a barrier not only limited to the private and municipal sector. Citizens are not aware of the new concepts, too. (M4) stresses that "private households know nothing and get no information whatsoever - maybe they don't even know that they have a SUDS system on their house" and that "this very basic information needs to be transported to the people". (B2) sees it even more severe and that "everyday people probably don't even know the term stormwater. They just see there's an extra tax coming from nowhere - they think 'oh well, now I have to pay for the rain that is coming out of the sky'". He sees that the municipality needs "to educate them about the whole infrastructure which is behind water management". in the urban gardening community there is also no consciousness about the connection to SUDS or NBS and how urban gardening can also work to improve the urban water cycle. This connection is not used as argument to promote the concept.

(A2) confirms that citizens are not informed enough. From his experience "people often just do not understand these systems and see only a blue space in the planning. Afterwards they ask 'where is the water?' Which is totally right to ask!". He sees a need in changing communication and participation". But "there is some movement in this field, so they want to talk to people in Vuores and Hiedanrantha now." - Again this movement is limited to the two lighthouse districts. He sees that "citizen participation has been around for two decades in land use and city planning but these SUDS are just now coming in the market".

Local Circumstances

Many interviewees express that SUDS have not been tested enough in the special local conditions. To (M4) "it is a challenge how they will work during winter time - we have such a different climate here". Also the local climate limits single solutions as (M4) states. E.g. Tampere did not use "permeable pavement a lot because during winter time we bring out a lot of gravel. It clogs on the permeable surfaces and seals the ground" (M4).

(B2) expresses that this lack of knowledge about the feasibility adds to the "fear of the unknown". He continues, "especially in our northern climate there is a lack of experience". Because the systems are new it is impossible

to say “what happens with [them] in the long run?” (B2). He stresses that in general “It’s not feasible to work just relying on SUDS. Even under SUDS we still need piped solutions” (B2). He also sees that integrating SUDS in new development projects is easier than “retrofitting SUDS into existing districts” which “is a real challenge” (B2).

To (M1) the lack of technical knowledge and testing is only used as an excuse. To her the practitioners “are afraid of ghosts” and use this ignorance to avoid acting. She insists that “technical problems always could be solved in the past” (M1). (B2) agrees and states that “if the benefits cannot be shown in Euros they are overlooked by the private sector” (B2).

As belonging to the technical feasibility the lack of space is also mentioned by several interviewees. (C1) notes that “the city centre is located in between the two lakes which makes it difficult space-wise”. Also (M4) and (M2) see that “We have a lack of space in general in the public area - I would love to have a lot of green. [...] But now with the city growing so fast it becomes a challenge how to fit in everything [...] I’m afraid we cannot use those new and fancy stormwater systems when we lack the space” (M4). To (B2) there is a challenge in the lack of political will behind the promotion of SUDS. He emphasises the guiding role of politicians and that “if politics decide on a new agenda to provide housing for 10,000 people more - it’s the land-use planners who have to deal with it and realize a planning in this limited space. Afterwards we interfere with water management and SUDS and whatnot”.

The problem according to (B1) is that when smaller solutions are implemented “they bring less of the benefits they are targeted to bring. It does not bring you all the services it could”.

And (M2) sees that “the landscape planners should learn that there should be more space reserved to these systems”. Especially in the case of SUDS she sees a problem with the limited space as “sophisticated systems bringing a large benefit also need a greater area than other forms of water retention” (M2). ”

(A1) sums up that due to the lack of space in the urban environment the sustainability agendas concerning city densification and storm water protection “have to meet”. (A2) adds that urban water management is “in the middle of a huge transition” and that until now “we cannot tell about success or failure factors enough” (A2).

5.2.7 Incentives for the Future

(B2) wishes for the future that the municipality incorporates SUDS in the mainstream development for the city. (B2) states that there is a “strategy where Tampere should evolve in the next 30 years and SUDS are part of this” and the city aims at improving - “Hiedanranta storm water management has to be of higher value than the one in Vuores” but still these projects remain “special” (B2). There are the “special projects but then on the other side the city-wide strategy, the mainstream. And in these documents they are not too clear that e.g. GI or SUDS are a main concept of city development. There should be an overall goal on how to have better environment and how to adapt and counter climate change and so on. There are no goals”. To him it is about “illustrating the benefits” (B2).

(M1) hopes for the future that the municipality will be “able to work on further regulating the private sector”. She clearly sees that “if they want to make money on different plots they should incorporate SUDS”.

Regarding private land and house owners(B2) sees that especially in privately owned land there "are too many technical questions behind". And that it is easy for landowners "to object with so many reasons like soil properties or other special circumstances". He "would not recommend to go with the stick but use the carrot - like tax incentives" (B2).

(M2) mentions that politics should be better included and that "the decision makers [should be provided] with knowledge" and the municipal officers should "work on making them aware". She sees that the politicians "do not have SUDS on their radar. To her "SUDS can be the perfect vehicle to make them aware of the importance of green urban development". The role of politics is also highlighted by (M3) she sees that "it all starts from decision making - if they do not put pressure on landscape planning then nothing will change."

(M2) highlights that if the municipality does not act now "we will postpone the problems to a later point and everything will be worse" (M2). To her it is about creating positive awareness on the topic. Also (A1) see that there is a "need to politicize the topic more. It has to become subject of political discussion and not only an expert case." Helpful could be to "achieve more than just the adoption of international concepts, we need to come up with our own. I wish for some more bottom-up processes." (A1).

(M4) sees that "it is still us at the municipality who should move. That's the easiest way - We should just go ahead and start making appointments with private companies. "

5.2.8 Summary

The following section summarises the results of the expert interviews from Tampere and outlines the most important points.

Definition: The concept is well known to the interviewed persons. For the interviewed experts in Tampere the aesthetic aspects are a major feature of SUDS. The green colour and its benefit for the urban areas is mentioned several times. Also the mimicry of natural processes is seen as a property SUDS include. The provision of ESS and in general the provision of multiple benefits besides drainage are what SUDS incorporate. Tampere is a growing municipality and in need for new urban development areas for incoming inhabitants. In this context interviewed person mention that grey infrastructure cannot handle the urban water management alone and there is a need of supporting it through SUDS.

Local SUDS development began in the district development of 'Vuores' in 2005 which according to the interviewed persons 'sparked a movement'. This district development made people more aware of the topic of sustainable urban development. Knowledge of these new systems was imported to Finland with the help of international development consultancies.

New SUDS are nowadays implemented mostly in the new development area of 'Hiedanrantha'. in this area new ways of co-creation and citizen involvement are implemented. Also new concepts of SUDS are put in place.

In 2012 the national Finnish Water Association developed a guideline book for the design, construction and maintenance of SUDS. These were the first guidelines issued in Finnish. It was taken up quickly by the municipalities around the country. The municipality of Tampere adapted it and issued a local maintenance and guideline book in 2016. Since the district development in Vuores SUDS found their place in land planning and are incorporated in most of the newly developed areas. The overall city strategy

was not adapted to favour SUDS. Most SUDS development is limited to the outskirts of the city. They are put in place in Vuores, Hiedanranta or other new development districts. In total there are 40 different kinds of SUDS solutions in place.

Arguments for SUDS Implementation: SUDS are seen to advance urban planning and urban development towards more sustainable practices. According to the experts they help in tackling local biodiversity loss by introducing new species into urban areas. They help in terms of water quality to preserve the natural condition of the surrounding lakes. Also for inhabitants of the city they are 'nice to look at' and provide health benefits. Several experts see that SUDS incorporate lower costs than traditional solutions. The interviewees see several current circumstances as supportive for SUDS development. A lot of public infrastructure reaches the end of its lifetime and the question is whether to replace it with SUDS or to renovate it in a traditional way. This would postpone the installation of SUDS to a much later time. Climate change and national pressure to advance in urban planning in a different way assist the use of SUDS. The knowledge of SUDS in development lies in a few private companies which can use their knowledge to generate income. The municipality owns most of the land resources and is in an advantageous position towards private developers as Tampere is a growing city.

Barriers: The interviewed experts mention the exclusiveness of SUDS to the new development districts. Those districts are labelled as experimental. Most of the activities around SUDS are limited to these experimental areas and are excluded from the mainstream planning approach. The project planning is described as being too limited to small local plots and the overarching master planning does not take SUDS into account. There is no overall vision for the city development which incorporates SUDS, as the interviewed persons mention. Although the municipality is the main driver behind the local development, not all departments share the same enthusiasm about the new techniques. Several interviewees describe the Infrastructure and Building Department as problematic to discuss with.

The municipality is characterised with problems referred to as 'silo-thinking'. Several interviewees explain that the new concept of SUDS was integrated in old management concepts. This enabled a fast uptake of the concept in certain planning procedures, but also excluded several possible benefits. SUDS are cross-cutting through sectors by definition and cannot be fit into specific departments. One interviewee mentions that in every department municipal workers should be made aware of the new concepts and should be made advocates of the measures. The experts note that new integrative management practices are needed. The method of citizen participation is described as outdated by several interviewees. A representative of a local NGO describes the municipal officers as passive towards the initiatives. The interviewees also describe the cooperation with private stakeholders as not well developed. In the past the municipality did not involve enough private actors, which is 'now changing'.

The demands towards biodiversity management and natural protection have changed but the municipality does not answer to this change according to three interviewees. The interviewed experts see SUDS as a way of introducing new nature into the cities and not only as a way of protecting what is there. Natural protection and biodiversity city officials are excluded from important planning projects and the overall SUDS development. The local introduction of SUDS is described as being 'expert driven by land-planners and

stormwater engineers'. The process should be opened to other participants according to the interviewees.

In politics there is little to no support of these new concepts and politicians 'do not have the concept on their radar' as one interviewee mentions. Developing companies and private developers face at least some regulations related to stormwater. Those regulations are perceived as being not effective. They yield the 'cheapest solution available' for urban water management, which in most cases are single-objective oriented grey infrastructure solutions. They make no statements on stormwater quality.

The private sector struggles with the uptake of the new solutions although they bring possibilities of revenue generation. Development companies are not interested in incorporating SUDS due to a 'fear of the unknown'. The companies look for immediate profit. They want to 'build as cheap as possible'. They fear that the possibly higher costs of setup cannot be fully passed on to future buyers. Also the companies usually take care of the construction of the buildings and leave the projects alone after they have been sold. They cannot profit from any future benefits that possibly occur due to SUDS. Several interviewees see problems in the lack of knowledge about correct construction and maintenance procedures with contracting companies. The used SUDS interventions are described as being imported from an international context and several interviewees express that SUDS in general need more testing in Nordic conditions. City staff sees that there are too little persons assigned with monitoring tasks to ensure existing building codes are obeyed.

Private house owners lack awareness for the topic of urban water management. According to the interviewed persons they do not value the urban water services the municipality provides. The newly introduced rainwater tax did not receive positive feedback from the population.

Several interviewees express the lack of funding and the current poor economic situation as barrier to an introduction.

Incentives: The interviewees wish for an uptake of the concept into mainstream vision and planning. Politicians should be included and made aware about new ways and alternatives to technical solutions. This could lead to new legislation. The interviewees see that local examples should be used and worked on. Also citizens should be included better in the process of urban water management. Most interviewees demand for better regulation of the private sector - either coercive or by incentives.

6

CASE STUDY: EINDHOVEN

In the next chapter the results of the case study of Eindhoven will be presented. In the first section a quick overview of the Netherlands as context to the case study is given. Key information on the political system and organisation of the municipality are given. This is followed by the formal properties and the results of the expert interviews. The chapter closes with a summary of the case study.

6.1 THE DUTCH CONTEXT

The Netherlands are located in the Northwest of Europe. Figure 6.1 shows the country with the regional demarcations in dark green and the location of the Municipality of Eindhoven in red. Together with Belgium and Luxembourg, the Netherlands form the *Benelux Union*. The Netherlands are a founding member of the *European Coal and Steel Community*, from which the EU evolved.



Figure 6.1: Map of the Netherlands with the Dutch Regions and the location of Eindhoven

The geography of the Netherlands is mainly determined by two factors: The location in the Rhine-Meuse-Scheldt Delta and the fact that half of the country is below sea level. In spite of these difficult circumstances the country is among the most densely populated in the EU. The history of the country has been shaped by the struggle between man and water. That explains why the Dutch have a unique relation to water. Since its foundation the country has had to deal with challenges associated with water management. Over half of the area of the country is either below sea level or prone

to flooding. 95% of all polders in Europe are located in the Netherlands. The reclamation of new land from the sea and the protection against too much water demanded for major hydraulic engineering projects in the past. For example, the Delta Works¹ or the Enclosure Dam² separating the Wadden Sea and the IJsselmeer, are just two of the biggest interventions. Those constructions were put up after major flooding events or catastrophes.

The upcoming climate change poses again new challenges for the Dutch. In the European context the Netherlands can be seen as frontrunner nation in questions of climate change adaptation. Sooner than others the Dutch parliament realised the need to respond to the challenges. In 2007 the so-called Delta Programme was put in place and has received its own budget of one billion Euro annually since then. It coordinates climate change mitigation and adaptation on a state level. The development of a new strategic approach valuing the role of nature in climate adaptation measures was characteristic for the Programme. Also its anticipating character is something new in the Dutch approach.

Dutch Political System

The Netherlands are a constitutional monarchy, although de-facto organised as a federal parliamentarian democracy in a decentralised unitary state.

The Dutch administrative structures are characterised by a tripartite structure. Besides the Empire ("Rijk") as central power, there are the provinces ("Provincies") and finally the municipalities ("Gemeenten") as subsequent levels of the state (VNG, 2007). The individual levels have the right to so-called "*open huishouding*", which grants them large autonomy in decision-making on their areas of responsibility (Tigges, 2018).

Head of the central government is the Crown represented by the acting King. All ministers together form the Council of Ministers with the Prime Minister as President. There are currently thirteen ministries in the Netherlands.

In addition to the Crown and the Ministries, the central state administration also includes the Dutch Parliament ("Staten-Generaal"). They are all responsible for the development and implementation of Dutch policy. In the administrative structure the level of provinces ("Provincies") follows under the general government level. They are headed by three bodies - the provincial King's Commissioner ("Commissaris van de Koningin"), the Provincial Parliament ("Provinciale Staten") and the Committee of Deputies ("Gedeputeerde Staten"). The King's Commissioner is appointed by the Crown for a term of six years after prior consultation with the Provincial Parliament. It is both an organ of the state and of the province and serves as link between the central government and the province (Wielenga and Wilp, 2015). Together with the King's Commissioner, the Provincial Parliaments run the administrative business. The Committee of Deputies is elected from among the members of the regional parliaments. The Committee prepares the parliamentary decisions as executive body and co-administrates the province. It instructs the provincial administrative office with its subordinate departments.

Special for the Netherlands are the "*Waterschappen*" (*in the following referred to as 'Waterboard'*) - regional authorities which administrate the public water-related infrastructure. They operate in areas defined by the river courses and watersheds and thus are not limited by provincial or municipal

¹ see: <https://www.deltawerken.com/Deltaworks/23.html>

² See <https://www.asce.org/project/zuiderzee-enclosure-dam/>

borders. The history of the Netherlands is closely linked to the development of the Waterboards. The foundation of the first Waterboard dates back to 1255. Today there are 22 Waterboards in the Netherlands. Also budget-wise they are able to operate independently of state- and of municipal authorities as they levy their own taxes. The Waterboards also receive their own democratic legitimation. The board-members who supervise the organisation are elected every four years. The board is headed by the "Watergraaf". Eindhoven lies in the area of the "*Waterschap de Dommel*", named after the river "*Dommel*" which flows through the city centre ([OECD, 2014a](#)).

6.2 EINDHOVEN

Eindhoven is a municipality. The city is the largest municipality of the Province Northern Brabant ("Noord Brabant"). The history of the city is closely linked to the Philips company which shaped the city during industrialisation and which is still a large employer today. At present a total of 223.209 people populate the city, 420.000 people live in the agglomeration and around 2 million in the metropolitan area. Eindhoven is the third largest business hub of the Netherlands. The technical university has a good standing and is well-known in Europe. The local companies together with the university attract many foreigners and Eindhoven can be described as multi-cultural. The city is steadily growing with roughly 2,000 new inhabitants per year ([CBS, 2018](#)). The rivers Dommel and Gender cross the city. The Gender was canalised and sealed in the 1950s and the city is pursuing a daylighting programme at the moment to bring it back to surface.

6.2.1 Municipal Organisation

Towns and municipalities ("Gemeenten") are the last and third stage of the Dutch administrative structure. The municipality is governed by the mayor, the municipal council and the 'Council of the Mayor and the Deputies'. The municipal council ("Gemeenteraad") is elected by the people. It elects the Deputies (*Wethouders*) who together with the mayor form the 'Council of the Mayor and the Deputies' ("College van Burgemeester en Wethouders", commonly known as *College van B&W*) as executive board of the municipality. The mayor ("Burgemeester") is not elected by the people, but appointed by the Crown. He is the head of both, the municipal council and the mayor's council. He manages the mayor's council together with his deputies. The three administrative bodies of the municipality are followed by the actual administrative apparatus with its civil servants. ([Wielenga and Wilp, 2015](#)). The municipal administration is subdivided in four service domains ("Domeinen"). Namely in general management ("Domein Bedrijfsvoering"), social services ("Sociaal Domein"), the spatial domain ("Ruimtelijk Domein") and the miscellaneous domain ("Domein Overig Inhoudelijk"). Those service domains are again subdivided into different departments. For the [SUDS](#) development mainly departments belonging to the 'Spatial Domain' are important. In the year 2015 the municipality changed the general municipal organisation from a classical top-down organisation type into an "organisational web". The 'Spatial Domain' was divided into the four sectors of 'Programme and Area Management', 'Spatial Expertise', 'Societal Real Estate and Sports' and 'Realisation, Administration and Supervision'. Plans for the city development are drawn up in the 'Programme and Area Management' sector. The

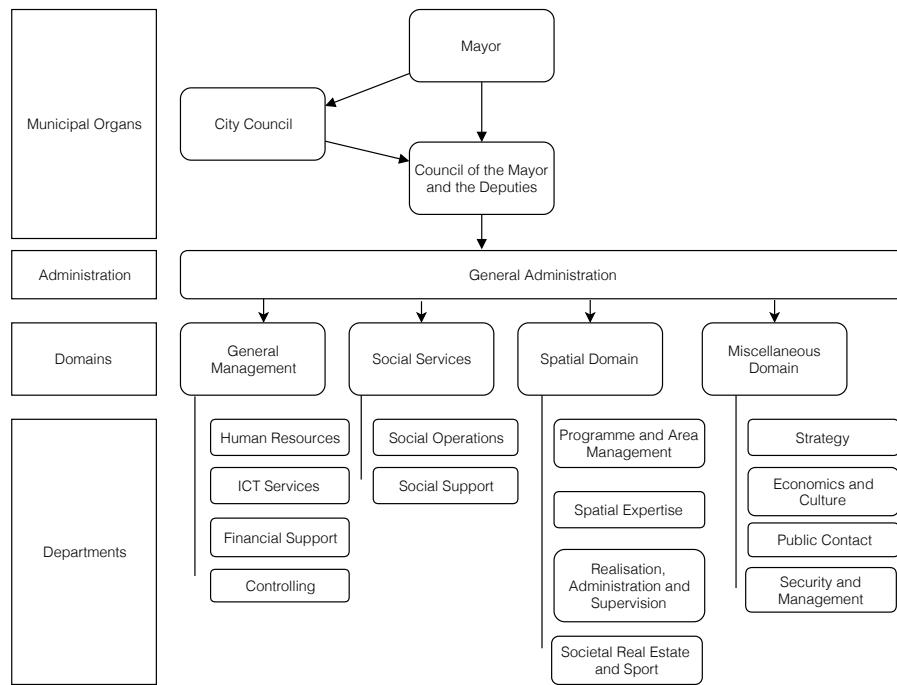


Figure 6.2: Organisation of the Municipality of Eindhoven

'Realisation, Administration and Supervision' sector is assigned with the realisation of new projects in public space and the maintenance of the existing infrastructure. The 'Spatial Expertise' sector houses different specialised teams on 'Water', 'Green', 'Traffic and Infrastructure' and 'Public Space'. Across those sectors different '*programme leaders*' were nominated. Each expert team and each individual sector has its own *programme leader*. If a city development project is worked out, e.g. the renovation of a street, the 'Programme and Area Management' sector prepares a development plan. This plan now goes to all different *programme leaders* who add their notes to the initial plan. They act according to the legal requirement of their field of expertise and their individual ideas. An assigned *programme manager* supervises the project and integrates all different notes into a final project paper.

The municipality devised a '*spokesperson-model*' to integrate citizen participation and mediate conflicts at an early stage of project development. In the field of SUDS the organisation '*Trefpunt Groen*' is important. The municipality pays a full-time employee of this organisation who acts as *spokesperson* for civil organisations related to urban green. Those are e.g. nature conservationist groups. Plans about the city development are passed on to the *spokesperson* who himself distributes them across the different member groups. The *spokesperson* collects and mediates across all the different interests which exist in the different civic organisations. He integrates those in a recommendation for the *programme manager* who then again tries to integrate them into the final project paper.

This final paper is then handed over to the 'Realisation, Administration and Supervision' sector which is responsible for the actual realisation. The *programme manager* remains in a supervising position and keeps track of certain performance indicators such as costs or building progress. The installation of *programme managers* and the involvement of the different *programme leaders* guarantees that all sectors can have their say in each development project. Additionally, six *district managers* have been nominated to keep



Figure 6.3: Flooding of downtown Eindhoven in the summer 2016³

track of the city development on the district level. Every month the different programme managers and leaders and the district managers meet and discuss the current development projects (von Radecki et al., 2017). In these meetings they are advised by an 'Integrated Strategic Advisors Team' which tries to analyse 'trends and developments in Eindhoven and beyond' (von Radecki et al., 2017, p. 15).

Like most places in the Netherlands Eindhoven has a mild oceanic climate. Compared to cities closer to the seaside the winter is slightly colder. There is rarely a long lasting snow cover in winter with average temperatures around 3°C. Summers are also mild with average temperatures around 15°C.

The city faces challenges related to air quality, urban heat island effects and challenges regarding the local urban water cycle. Air quality issues were identified mostly in areas of heavy traffic. Urban heat island effects can be noticed in areas with more sealed surfaces than green space. The IPCC predicts a faster temperature increase for the Netherlands than the global average and a general increase in annual precipitation for the area around Eindhoven. Due to a general increase in precipitation for large areas of Middle- and Western Europe a subsequent increase in peak discharges from rivers in the winter is described as 'very likely' (IPCC, 2014). This will most likely also affect the rivers flowing through Eindhoven. Increasing numbers of summer storms and a following increase in extreme rainfall events will most likely occur in the years to come. This will more and more challenge the existing water infrastructure. The summer flooding of 2016 shown in Figure 6.3 (a) and (b) revealed the shortcomings of the present equipment. It was a striking example of possible future events.

Eindhoven takes part in several climate change adaptation and mitigation networks and is committed to various sustainability related goals. The city takes part in the EU Covenant of Mayors initiative where specific sustainability-related goals are set⁴. It is also part of the 'Urban Water Agenda 2030' initiative of the EC and the International Council for Local Environmental Initiatives (ICLEI). In the agenda Eindhoven committed to an "integrated urban water management" agenda which brings together the sectors "health, environment, green, water, mobility and public space" for a sustainable de-

³ Photo Source: Municipality of Eindhoven, L. Postmes

⁴ See: <https://www.globalcovenantofmayors.org/cities/eindhoven/>



Figure 6.4: Depaving of the *Parklaan* street in Eindhoven⁷

velopment⁵. In the EU research project Roadmaps for Energy (R4E)⁶ the city developed an ‘integrated urban water management plan’ and a roadmap to steer a sustainable development for the future (den Ouden et al., 2018).

In the field of SUDS the city has already implemented several sites. SUDS are namely mentioned in the ‘integrated urban water management plan’ and in the roadmapping document (den Ouden et al., 2018). With the publication ‘Eindhoven Goes Greener’ MoE (2014) show how the city actively fosters the development around SUDS. The Green Policy Plan (*Groenbeleidsplan*) collects the past development of urban green and blue in the city. The plan sketches the future vision for the development around GI and BI (van Haeff et al., 2016). The publications want to raise awareness among municipal staff and inhabitants. The city is following a depaving strategy along cycling paths and roads. Figure 6.4 shows the result of depaving the sideways along the *Parklaan* street. Figure 6.5(a) shows the renovated *Bonifacius Park* with a newly introduced retention pond. Figure 6.5(b) shows a swale realised next to a busy road.

Several SUDS implementations for the near future are in the planning. Figure 6.6(a) and (b) show the current state and the planned development for the *Bilderdijklaan* street. The river Gender was put underground in the 1950s. The river is to be daylighted throughout the city in the upcoming years. The daylighting has already succeeded in some parts. This project is completely planned and construction will start in 2019. Several municipal buildings around the city including the town hall are to be renovated introducing green walls and green roofs. The main square is to be renovated introducing SUDS like permeable pavement and rain gardens. Here the city experiments with a new way of contracting with the private sector. The tender for the

⁵ See: <https://urbanwateragenda2030.eu/eindhoven/>

⁶ See: <https://roadmapsforenergy.eu/>

⁷ Photo Source: Municipality of Eindhoven, L. Postmes

⁸ Photo source: Municipality of Eindhoven, L. Postmes

(a) Retention pond in the *Bonifacius Park*

(b) Swale next to a busy road

Figure 6.5: Realised SUDS in Eindhoven⁸

(a) Photo taken in 2017

(b) Vision for development with SUDS

Figure 6.6: The *Bilderdijkstraat* street in Eindhoven⁹

project involved the request to work out a new co-working concept for all participants before working on the actual design of the project. This project was the first to involve this 'Shoulder to Shoulder' concept.

6.2.2 Expert Interviews Eindhoven

Twelve persons were interviewed in Eindhoven. From these, three work directly for the municipality. Among those, one expert belongs to the Department of Water, one expert works for the Infrastructure Department and one expert works as cross-departmental project manager. Three persons belonging to the business sector were interviewed. Two of those were employed project-wise in the municipality while also working for the private sector in the field of urban water management and urban planning. One project leader of an urban development engineering company was interviewed. From the public sector, three persons belonging to a regional water management organisation which only exists in the Netherlands - the '*Waterschaap*' (*referred to as Waterboard in the following*) - were interviewed. Additionally an university professor teaching 'Urban Water Management' at the University of Delft while also working for 'DELTARES'¹⁰ was interviewed. All interviews were conducted on site and face-to-face. Except one interview, all the interviews were conducted in the English language. One interview was conducted in German. The statements made in this interview were literally translated into English.

⁹ Photo source: Municipality of Eindhoven

¹⁰ DELTARES - applied-research institution and think-tank in the field of water management, see <https://www.deltares.nl/>

Table 6.1: Interview Contacts in Eindhoven

#	Alias	Cluster	Position
1	A1	Academia	Urban Water Management Professor
2	B1	Business, Municipality	Project Manager, Entrepreneur
3	B2	Business	Director Engineering Consulting
4	C1	Civil Society	Volunteer
5	M1	Municipality	Project Manager Water
6	M2	Municipality	Department Leader Water
7	M3	Municipality	Interdepartmental Project Leader
8	M4	Municipality, Business	Urban Planning, Design, Consulting
9	M5	Municipality	Program Leader
10	R1	Regional Water Authority	Program Leader
11	R2	Regional Water Authority	Project Manager Wastewater Treatment
12	R3	Regional Water Authority	Program Leader

The interviewed persons alongside with their cluster affiliation (Public sector, Business, Academia, Civil Society) and their hierarchical position are noted in table 6.1. Table 6.1 also mentions the specific reference code which is used to allocate the given statements to the different interviewed experts in the following chapter.

6.2.3 Local Understanding of the Concept

The interviewees from Eindhoven speak a lot of the “green colour” (M₅, M₃, M₄) aspect and the multi-functionality of SUDS that conquer “so many problems we are facing downtown” (M₅). Interviewees from the municipality state that for them SUDS mean “looking at urban drainage in a different way than we used to” (M₂, M₁). “In the old days it was all about getting rid of the water in the city” (M₂). Now “it is more about finding localised and more decentralized solutions” and about “keeping the water where it falls” (M₁). (A₁) agrees that the view of water in the SUDS approach has changed a lot. He says that in the past water had to leave the urban space “as silent and as invisible as possible” (A₁). To him this is “a huge change” (A₁). To (M₃) “sustainable” means to act “in a more natural way and look for new ways which do not take too much effort - let the water find its path”. Sustainable for him is also about a continual exchange with the users of the new solutions. Coming from a more regional perspective interviewees from the Waterboard speak about SUDS being the “whole set of water-related solutions to work towards a better and more sustainable world”. (R₁) sees that

there is no difference between "the concepts in the blue-green infrastructure realm, they are all **SUDS** and they are all **NBS**". For (R1) a less profit-oriented financial approach is "essential" to the **SUDS** approach. There should be a "better balance between people and profit" (R2). To (R2) it is about "learning from the past and about not creating new problems in space and time like we did with some concrete structures" and so it's about doing "the task thoroughly and thoughtful". In the realm of **SUDS** effectiveness also plays an important role for (R1) and that "the centralist and scale-oriented thinking" which is expressed e.g. through large waste water treatment plants has to be overcome.

Two experts also understand the separation of storm water and wastewater with the help of an additional underground pipe network as belonging to the **SUDS** realm (B1, M3). Both focus very much on the definition of the term 'sustainable' and argue that a "grey and concrete version has also its benefits and can be sustainable" (B1). One expert mentions that to him "sustainable means going from one pipe to two pipes, so just separating storm water" (M3).

6.2.4 Local Implementation and Success Factors

To (A1) the city of Eindhoven and the Netherlands in general are "in the middle of a fundamental transition" which interferes "with all areas of our society".

Local Institutions

The Water Department plays an important role in all development projects. This is to a great extent due to the commitment of one person. The expert of the Water Department has been working for the municipality for over 25 years and has established a dense network of "water guys and girls" (M5) who work together. in this network (M2) mentions that "it is most important that we all know what we want". This core team of "working together on the future solutions" is sharing "one vision about the whole picture" (M1). (M2) underlines that in their unit "everybody is on the same page". Several interviewees mention that they appreciate the good relationship among the people working in the field of **SUDS**. "We know each other, we have each other and we have good ideas as a team" (B1). To (M4) this also simplifies the cooperation with other departments.

To (M4) the way of "working together changed". She points out that "especially in the Department Green, we try to work together and speak with one voice to the others". To her "it is something which is happening at the moment". (M4) recounts that in the past there was often confusion between a lot of "little pieces" of advice and comments on design and development plans. She stresses that in their department they "try to come with one single and easy to understand package". This procedure of discussing more among themselves before commenting on plans already bears fruits as they can "recycle comments and statements on problems that pop up frequently" (M4).

Also the position and reputation "of water-related administration" in the municipality is "very strong" (B1). The experts belonging to the Waterboard are also partly included in the water team of the municipality. They "maintain a good relation" and work "together in a coalition" (R1) with the municipality (R1, R2).

Several interviewees explicitly emphasise the strong position of (M2) in the municipality as beneficial for the development of SUDS. "(M2) has been with the municipality for so long and he knows all the leaders and is working strongly towards water and sustainability". This special person "has made our point clear to the important people so that there is always somebody looking through the eyes of water in every project".

(B1) describes the cross-departmental work as well functioning. "We have a team Urban Green (trees and green) and us, the team Water. When the green team doesn't have enough money to incorporate their project we see if we can e.g. include a swale and then finance their project."

(B1) explains that "the big advantage [of Eindhoven] is that the elected persons trust the municipal technicians". Again he mentions that especially the word of (M2) "weighs a lot. When (M2) approaches the mayor and says 'it has to be like this' - the mayor agrees and instructs the persons to do it like planned by (M2)". "There is a bond of trust between politics and us" and "of course the Eldermen are critical and they have questions, , but they are not sitting on our chair" (B1).

The special Dutch features in the water sector were also perceived as an asset by several interviewees. "We do not have to beg for our money, we collect and spend it ourselves" (M1).

Relation with Citizens

The relations to the organised part of Eindhoven's citizens is perceived as "very good" (B1) as the municipality can rely on one elected spokesperson, speaking for all the civil organisations. The municipality of Eindhoven has established this paid position "about 10 years ago" (M2). The spokesperson is elected among the civil society organisations. According to (M2) "There are maybe 40 or 50 organisations that want to do good in the city". With this spokesperson the municipality "makes sure all the different organisations come with one advice about a project". Since then "there were basically no lawsuits any more against development projects of the city" (M2).

In this way former informal networks "are formalised bottom-up initiative networks in the spokesperson-initiative" (M3). (M3) sees it as "sign of the time that people want to be involved and want to know what we are doing with their taxes". This "role of the government changed a lot" in comparison to the past. (M3) emphasizes that "in the old times we acted like we know what's good for the people".

Depending on the situation , citizens are included project-wise. "Sometimes when we think it's necessary we ask them what they want. , but for some areas there are just higher regulations, e.g. for monumental areas - and there we do not speak to the people what they want"(B1). In the past when "citizens were displeased" (M5) with the work of the municipality, "they use the vice-mayors to express their discomfort and pressure us" (M5). In the past this "caused some projects to be halted completely."

Private Sector Integration

(B2) says that as the "tenders are more and more changing towards SUDS implementation", he highlights that "the country and the cities are asking and demanding for it". "It is getting more and more part of our job" (B2).

Green roofs are no novelty in the Netherlands. Being called 'Sedan' the green roofs exist "since the millennium" (B2).

According to (M5) the municipality has made “good experience” (M5) with extending the contracting time with service providers for the green areas. The municipality “doubled the contracting time” to six years instead of three years with an option to extend. in the six years the gardeners can “have higher initial investments in durable plants” and “save on maintenance in the long run” (M5).

For the development project of the town hall and the square around it, the municipality changed their project tender system. Instead of directly asking for companies to apply with finished concepts on how to renovate the roof and the square including SUDS and green solutions, the municipality asked the companies to come up with thoughts on how to cooperate in the project. The total tender phase “was extended considerably”. “We came up with establishing an alliance concept between our company and the municipality” (B2). So first we agree on how to cooperate and work it out together, we formulated the ambition document together. The municipality only granted money for the planning of the actual project.” To (B2) “this approach was quite new , but yielded great results”.

This alliance approach does not suit all kinds of projects. According to (B2) “several parameters have to be met”. The project has to be “big and complex enough” and spanning over “an extended time frame”. For small projects “pursuing this strategy is not worthwhile”. He highlights that “some things we cannot do as a contractor , but rather do as a partner” (B2). in novelty solutions “complexity is always given” (B2). “This can be a role model to other municipalities” (B2). “In order to make a big change” tenders using this extended phase and elaboration of concepts are needed”.

According to (B2) the main “push for the development of SUDS are the local ambitions”. From his point of view local governments and municipalities themselves “are really getting things done”. For him, “the state government is too high over” and “the main drivers behind SUDS development are the local governments”.

The relations between elected persons and municipal technicians also “changed in terms of formalities” (M1). In a coalition agreement formulated after the last elections in 2015 between municipality staff and the Eldermen it was “explicitly noted that we are permitted to make mistakes” (M1). This was perceived as “something really innovative and promising to us technicians - especially for the implementation of new concepts like SUDS”.

Ties with Politicians and Colleagues

In general (M1, M2) see the relations to politics as well established. Although there is “mostly one person who is the driving force” (M1) behind a demand for SUDS and GI in the city. (M4) also sees this person as their “most important contact”. This Elderwoman is pursuing a suitable approach for the city of Eindhoven. She tells the public the narrative of “Eindhoven as a garden city” (M4) arguing with the traditional values and assets of the city. (M4) sees that “people really started liking it”. The story “helps to explain why we do what we do”.

Cooperation with politicians works in an “informal way although it should be formal”(M1). This one dedicated elected person “approaches us directly about her development wishes” (M2).

At the moment elections are held in Eindhoven and it is unclear whether this one committed person will stay in power. (M1) does not know if the next person will be as “inspiring as her or more conservative”.

"The second part in advancing with SUDS and GI" is about "convincing the colleagues" (M2). (M1) and (M2) state that they "always want more than we get" (M2).

(M2) himself is very committed to the topic. Of his own accord he created several information brochures and material around SUDS and GI. (M2) developed a game for municipal workers to play and experience the different life times of urban structures - emphasising the importance to change procedures. (M2) also developed the information brochure 'Eindhoven greener' in which he presented and explained the different solutions and approaches in the city of Eindhoven. He repeats how important it is "to visualize and make it easy to understand" for citizens and his colleagues. The brochure doesn't only show examples and photos , but also price calculations and comparisons with old practices (M5, M3, B1) describe him as "change agent" and as "essential for the municipal development". "Since over two years he has been pushing the topic and making people aware wherever possible" (B1), one interviewee recounts. To (B2) "the whole development is about ambitious single persons who are 'believers' ". "The municipality itself" is "no barrier for" (M3). He says: "I have all the resources and all the cooperation I need" and that is "thanks to (M2), he is a pioneer". (B2) states that "these little bit crazy people willing to try out new things" are needed for a movement. He also sees in (M2) a main driver behind the development.

A Changed View and Structure

(A1) states: "We used to look at water like something you have to get rid of, now we are valuing it". The old grey-infrastructure systems were made to transport water out of the city "as quick as possible" (A1). , but the new way of valuing water requires a management "stragey including new technologies and a new modus operandi" (A1). To (A1) a focus should be laid on valuing water more as "profit is always an important driver of change". What is a key factor in understanding the new systems is that maintenance has gained a much bigger role than in the concrete-based approaches. "Optimizing the systems for the everyday use" (A1) should be the guiding principle.

(A1) underlines design and aesthetic aspects. They were were often "completely neglected in former times while creating the technological grey solutions to water management". Now, SUDS are about "creating something beautiful". (M3) adds that the "main argument is that mostly they look nicer than the traditional solutions".

(A1) "Visible effect of climate change help us", as e.g. the flooding in 2016 mentioned in Chapter 6.

(M3) Some experts mention the organisational change which took place as beneficial for SUDS development. The new organisation "is more integral, making it impossible to forget about a subject". in old organisational structures it was possible that e.g. "a traffic designer receiving a traffic project" sometimes " just forgot about a discipline, e.g. about water or green etc." (M3). He also sees the physical proximity as a factor that made the organisational reform successful. "Before all the disciplines were separated" and to him, "it was hard to get hold of people". The different departments were transferred into one building and since then "it is so much easier" (M3).

Nevertheless other experts have mixed feelings about the organisational changes of the municipality. To (M4) "there have been so many reorganisations and people were put in different boxes". To her it is a good thing that "it has been quiet now for the last years" and municipal workers "are

starting to find each other again". To her in the field of SUDS "people cannot answer the questions on their own" and are "naturally forced to work together". The different departments and the employees working in those departments depend on each other.

Recently, in February 2018, the municipality of Eindhoven introduced new climate regulations. From now on climate considerations are a basic principle in all municipal development projects and must be respected. "In every project I have to be aware of how much water I get in the ground, how much green I implement etc." (M3). From now on "all the plans in the municipality have to be climate-proof" (R1).

To (M4) it is "interesting how fast people adapt in this organisation". The mode of city development changed "drastically" and e.g. the Building Department is not "allowed to build any more shiny buildings", , but they have to take "greenish structures" into consideration much more (M4). To her understanding it was also a "lucky" circumstance that the elections were held in March. During the election campaign the politicians did not "dare to oppose green development" and so "they let us do our work" (M4). She "clearly sees a window of change now". At least the fact that the politicians did not want ' to be the one who is against" green development made a strong point for the agenda of SUDS.

6.2.5 Arguments for SUDS Implementation

To (A1) SUDS are all about valuing water in an urban context. The usage possibilities are "almost limitless" (A1). He points out that it can be used for cooling, energy recovery or food production. (B2) reinforces this: "We have so many opportunities. SUDS in the form of green roofs provide cooling in summers and isolation in winters." he notes. (A1) mentions that "urban heat islands are caused by too little evaporation", and so more open water courses should be created. (B2) supports that argument, to him SUDS are one of the solutions for urban space as the issues get "more and more pressing the longer we wait". From his personal experience Eindhoven faces "a massive problem with heat-stress".

Using the SUDS solution of permeable pavements "gives you the most basic and easy to implement version of all NBS" (M1). According to (M1) depaving urban areas has "only advantages", it "makes people healthier", it is "good for biodiversity, infiltration and heat stress". The strongest argument to (M2) is the cost factor. For Eindhoven the two experts have calculated the life-cycle costs of green meadow-like, depaved areas in comparison to paved areas. "We already figured it out - it's cheaper!" (M2). The cost calculation should be "overthrown" (M2) and a new calculation "considering the life-cycle costs has to be introduced" (M2).

(M2) gives importance to the need and the urge to act now because of the long life cycle of public infrastructure projects. (M2) notes that "if we do not act differently now we get the next chance in 30 years". To (M5) it is "not only about doing the right thing, but also using the right moment".

To the understanding of (A1) there is a "widespread debate about climate change in Holland". According to him "The state undertook a lot of measures especially in the field of water policy" although "the main stimulus has to come from the municipalities themselves - they need to work on the ground". To (A1) it is a combined effort and there "should be done more by both, municipalities and state".

The overall economic situation works in the interest of the municipality. The municipality of Eindhoven is an “aspiring and growing business hub” (M2). According to (M4) this “put us in an advanced position to the developers”.

(M4) sees multi-functionality as the most important advantage as this gives the technicians working on SUDS so many leverage points to “piggy-back on projects of the other departments” (M4). The multi-functionality gives (M4) and the other technicians “more reasons to talk to [their] colleagues”. However, she points out that “these little hooks are sometimes hard to find”.

The municipality is incorporating innovative budgeting concepts. If a tree is removed a value is calculated. The green department has to be compensated for any losses.

The personal motivation of municipal personnel plays a strong role in local SUDS implementation. (M2) expresses that he wants “to have more green space in the city, that’s the thing I truly want”. (M2) does “not care about the organisation” for his work, he “only needs the right people and no organisation”. He summarises his work as “completely informal”. Also (R1) describes his work as “working sideways of the normal paths to convince and inspire people”. According to (M2, R1,R2,R3) informal networks play an important role. “I can tell the right stories to the people, that’s all I can do personally” (R1).

These informal netwotrks are described by different experts during the interviews. The municipality should work on “formal ways to access and exchange information” (M4).

6.2.6 Barriers to SUDS Uptake

The Missing Links

To (A1) the Netherlands has “the right policies to promote SUDS and the ‘right’ infrastructure for the future”, but “the rest is missing” (A1). To him there are “not enough rules and basically no laws at all” (A1). The Dutch government “lacks experience in SUDS to turn the policy documents into hard regulation”. In addition to this “the private sector lacks the knowledge how to implement and maintain” the new solutions. To (A1) “errors are made on each step of implementation”, meaning the construction and the maintenance of SUDS. , but in order for the approach not “to be condemned” (A1), “functioning and beautiful SUDS” have to be put in place “for everyone to see” (A1). , but there are “little to no incentives for private house owners” and “in our tax system it is not possible” (R3) adds. To (A1, R1, R2, R3) there should be possibilities to compensate private house owners for investments into SUDS made on their premises. According to (R3) due to “ridiculously low drinking water and waste water prices” there is no awareness of the infrastructure the state is providing the citizens with.

(M4) summarizes that the main barriers are “just like in any other project time and money”. The barrier to overcome for her is “to make people talk to each other and share their time and money” (M4).

To (A1) there is a “clear distinction” between the designers and the staff working on the plans and the technical municipal employees. He sees “the technical employees and Water Management staff” taking “the lead role” in the implementation of SUDS.

Lack in Awareness

Most interviewees agree on the argument that more awareness not only about SUDS should be created among citizens (B1, M2, M5, M3). (B1) recounts that in his opinion “most people in Eindhoven are not aware of the problem that they are living in one of the most air polluted areas” (B1). (B2), too, sees lack of awareness and knowledge of the possibilities as a barrier. From his experience the “main demand is for energy producing roofs”, but not for water-related solutions around or on top of the buildings.

(A1) points out that some people are “not yet aware of the new solutions” and that “they are the ones looking to solve the problems by increasing old infrastructure”. They need to be made aware that “this was something we did maybe 10 years ago” and that “there are better ways now” (M4).

“The wallet is always the tallest barrier” according to (M3). Companies in the private sector, private individuals and the municipality all “struggle with funding” (B1). Most interviewees agree that there is little funding dedicated to SUDS. Until now, “you cannot earn any money from NBS, so why should you invest?” according to (B1).

To (M4) “the debate about sustainability” started when she “finished [her] studies at the end of the nineties [in Eindhoven]”. She personally describes her experience with the concept of sustainability as a change from “the thing that everybody has to do” to “something you can score with” (M4). At the beginning it was more an “unpleasant necessity”. According to her SUDS “partly already passed this phase”. She mentions that in presentation brochures of new buildings and construction “there is much more green and blue” and she sees a “vast difference” between the material of “15 years ago and now” (M4). Although the plans get greener (M4) criticises that motives of private housing companies are only driven by profit concerns. Also the 2016 flooding event “did not trigger the private housing companies” (R1). According to (R1) private companies should be dealt with in a “you-have-to way” (R1).

Also according to (B1) it is hard to motivate the private sector with incentives only because “they do not have any relation to the region or the city”. Besides the factory of Philips most companies in Eindhoven are international conglomerates and to (B1) it is impossible to convince them “to do good. And we have no Dutch investors to talk to”.

To (A1) it is the “industry which should be regulated”. And there should be “more investment in the expertise of private companies”, he gives importance to the fact that “they need test cases and training material” (A1).

General Knowledge Gaps

(A1) emphasises that there are “just so many approaches and different types of SUDS”. In his institution they work with “at least 60 different approaches” (A1). To him, keeping the overview over what solutions there are in total “is too complicated even for the storm-water technicians”. They need to be equipped with the right tools in order to choose the right “solution for the right spot” (A1). These tools partly exist, but also come with “time and money intensive guidance procedures” (A1). (A1) explains that “often it is not clear why a particular SUDS approach was undertaken at a particular spot in Eindhoven” and that it is important “to make and share experience in an understandable way”.

In the Netherlands and especially in the region of Eindhoven “it is very popular for people to pave their front- and backyards” (R1). The municipi-

pality established the initiative "Steen Breuk" to sensitise its citizens to the topic. The initiative did not bring the desired outcomes. "It's just easier to brush the tiles than to mow the lawn" (M3) expresses. He sees the role of the municipality in informing people about the question. They should learn to answer the question "if they want water in their house or if they want to brush the tiles" (M3).

(M4) recounts that from her perception the citizens in Eindhoven are divided "in two halves". The first half "really wants to do something", while the rest sees climate change as something for the future generations". She thinks that it is "quite easy" to set up meetings and to motivate citizens to come to development gatherings about SUDS, but usually [...] only people belonging to "the first half" (M4) show up in those meetings. So to her the difficulty is "getting and communicating to those people" (M4), to people who are not yet convinced that something should be changed.

As belonging to a development office in the private sector(B2) states that "it is not [his] job to convince people of SUDS".

The municipality itself and public ground is "well regulated and managed" (M2) on the different layers of administration. , but it "represents only one third of the space" (M2). When people engage in "paving their garden" they "shift the problem of storm water to the municipality" (M2). (M2) describes the situation with investors and developers as difficult as "we do not own the land, so we cannot demand for too much" except for "what is regulated" (M2).

Technical Issues create Drawbacks for the Movement

A lot of SUDS solutions cannot be implemented technically in Eindhoven due to clay soils under the city (M2, B1). Infiltration capacity is very low and the SUDS have to be "intensively monitored if they are functioning alright" (M2). (B1) mentions that "in Holland we say the bottom doesn't work" , meaning the infiltration capacity differs and can be close to zero at some points. (B1) mentions that he does "not want to have the discussion about infiltration again", to him it is a proven fact that "it is not possible" (B1).

If the SUDS are not planned well they can work as "push back for the whole concept" (A1) notes. In Eindhoven there were several "negative examples"(R3), i.e. permeable pavements and swales which didn't work. The water did not leave the systems as anticipated and led to a "mosquito plague" (R3). This was a result of "poor planning" and "led to skepticism among the citizens towards SUDS" (R3). So to (M2) the "SUDS development is at full speed and should not be sped up much more" to ensure careful planning. Also to (M3) it is "going at the right speed and should not somehow be accelerated any further". (M3) mentions that the municipalities "need a new tax system" to support SUDS development further, , but to him "it will come in time" (M3). One "should not hurry and not worry" (M3).

(R1) opposes this view as changed management practices take a long time until there are visible results. This process is"extremely slow". According to (R3) the policy of decoupling of stormwater and sewage water systems was put in legal obligations, but "we are still working on it" (R3).

Compared to e.g. parking spots, SUDS show up in the municipal calculations only as a cost factor. A parking spot in Eindhoven generates an income of "around 20,000 Euro" (M5) yearly. Placing a rain-garden onto a set of parking spots then "not only costs the 20,000 Euro ", but "burdens the budget with additional expenditures for maintenance" (M5).

Old infrastructure and the capital bound to maintain it is “one main factor in the Netherlands” (A1) which hinders the installation of more **SUDS**.

The organisational changes towards a more interconnected municipal organisation are perceived differently.

(M2) mentions he “works despite the organisation of the municipality” and sees “no advantages in the new form”. To him “we just need some tweaking and no renovation” of working together. He has been staying with the municipality for a long time and has “seen all kinds of different organisational forms” and notes that “every couple of years we overthrow the organisational scheme”.

A strong argument is the general approach on organisation procedures. “Until last year we did not have an organisational chart” (M2) mentions. To (B1) effort has to be put in the elaboration of this chart and its description. (B1) highlights that this chart is helpful for inside as well as for outside communication.

Varying Viewpoints

In terms of openness towards new **GI** the different departments have varying viewpoints. To (M2) it is the Infrastructure Department which is “pedantic about their regulation”. “They can fill any space you give them with differently paved lanes - bus lane, car lane, cycling lane or a parking lane” (M2, M5). Also the regulations “around Green are perceived as softer than around e.g. the number of car lanes in a street” (M4) confirms. (M4, M2, M5) describe it as difficult to agree on compromises in “strict infrastructure regulation” (M5), “they are not giving up very easily on their regulation” (M2). “People dealing with traffic and the city planners have been working together for a long time” (M4) recounts. To her understanding this does not “make things easier for us” (meaning the Green Department). She also confirms that “infrastructure” is seen as a “more rigid piece compared to green space and biodiversity - which it is not” (M4). She insists that “when looking at a longer time space” the sustainable development of the city should be enforced “as rigidly” (M4) as infrastructure and building. It is not only “us we have to convince to look at the long term”, but “also citizens and developers - so everybody” (M4).

(M3) sees the “mindset barriers should be easy to overcome” as “we are made to love nature, not concrete and steel”.

Also the situation in terms of staff cooperation in the different departments is described as varying by (M1). As (M2) says, “we here in the Water Department are very well connected and we know what we want”. The next important specialist area for the development of **SUDS** in Eindhoven is the Green Department. As (M1) describes it “some are working on trees, some are working on biodiversity - they are very divided” (M1). (M1) specifies that in the Green Department “they are not fighting, , but they are not really connected to each other and pursuit an overall mission” (M1).

(M4) sees the speed of construction and building development as barrier to the **SUDS** development. During and after the economic crisis in 2008 building activities “basically halted” (M4) in the Netherlands. “We built almost nothing, there was no development of the urban area” (B1). Now building activity was taken up again and architecture offices and development companies start “pulling out old plans” (M4). (R1) confirms this, they have also experienced that the developers “start coming to us with their old plans”.

A barrier to (M4) is any hurry in this transition process. The scope for her is to thoroughly explain the **SUDS** to all the persons involved and all

municipal technicians so that “people see the new solutions as good because they understand them” (M4). To her this seems “logical , but is the most difficult thing” (M4).

To (R1) “the whole municipality has to become climate-proof” and up to the present day people who have an “awareness of sustainability” are in the minority. (B2) sees “the building branch is conventional and changing only slowly” (B2), he describes his branch further as very “risk-averse” (B2).

National Will Needed

To (B1) it is also a problem of national funding. To him “the government talks about sustainability and about being green , but does not invest any money in SUDS” (B1). From his point of view the Netherlands “are missing the whole transition” in comparison to the neighbouring countries.

According to (B1) in the current political debate (during the election campaign) thoughts on sustainability don’t play a role. Also to (B2) there is little awareness for SUDS in politics, but “it all starts with politics” and politicians “should set a certain goal and the rest will follow” (B2).

More Regulation Needed

Historically water has a strong position in Dutch legislation. , but many interviewees stress that legislation should consider green roofs and incorporate them in the building requirements. (M2) states that one should “try to get people moving , but [...] we have nothing to force them to”.

According to (M5) “we need to work on the hard regulations”. He sees it as problematic that “almost every” department is following “hard regulations” on e.g. the width of a cycling path, of a bus lane, of a paved area, etc. “We want to have green in there , but we have no space”, as the “planning process as it is consumes everything in between the houses” (M5). The main challenge for (M1) is to “convince the other departments to give up on their space in order to integrate some green”.

The role of car traffic still plays a “huge role in the heads of the people” (M1). Still the city is mainly “built to facilitate cars” according to (M2). He emphasises that even in the new movement of “favouring walking and cycling” the amount of roads is not reduced, sometimes even increased . Another challenge here is to “convince the citizens” as they “keep demanding for a car-friendly city” (M1). (M1) remembers an example when “one car lane was taken out and transformed to a bus lane” and there was “a lot of objection to those plans” (M1). Municipal technicians receive a lot of objection from the citizens articulated through politicians in Eindhoven. (M1) sees the role of the public as barrier to SUDS development and states, they only “demand for SUDS as long as it does not affect them”.

To (M1) “it is very strange to regulate SUDS and green roofs on the local level” because “every city is struggling with it” (M1/M2). A national regulation “would save us so much time and so much trouble” (M2).

According to (M2) it is “hard to set the right goal and benchmark”, throughout the interview he continuously asks the question “what is the ultimate goal?”. To his understanding “nobody knows” and “nobody ever tried to define it” (M2).

More Research Needed

(B2) sees that there are research gaps in terms of the financial and other benefits SUDS provide. He asks “what do they really do to the air? - we do not

know". Also (M1) expresses that from what he knows the municipality "is far from a perfect system". He states that "with every new implementation we are also learning" (M1). (A1) sees that academia can provide the discussion with "new suggestions", but is "unable to influence our government" enough and to convince it of the advantages of Suds (A1).

Adapt Planning Procedures and the Organisation as a Whole

(M1) also stresses the fact that planning procedures should be adapted to enable designers of public space "to think more about the future". At the moment thinking about the future "is not at all common in [the] designing" (M1). The procedures only take into account the current projects and measures that have to be incorporated. According to (M5) a lot of money could be saved if "more thoughts would be given to possible future development". E.g. if a sewer is placed under a certain road , the road cannot be turned into green-space with trees on it later. The same is true for underground cables, subway tracks and "many other things which should be incorporated in designing" (M5). "It is about making people to think ahead" (M1).

In Eindhoven the social services and the Social Departments are not connected to the other departments. There is only a "very thin "connection between Water, Green and the other development departments and the Social Department. (M2) recounts that there is also no connection to the Health Department and to the health services of the city and of the state.

Basic supportive services like the ICT department or the service department which organises meetings and caterings etc. "suffered under budget costs" (M2). in those departments also "too many people are trying to make their own job easier" (M2) which shifts "a large number of tasks in our responsibilities". Problems which seem easy to solve when seen from the outside cost "a lot of my daily work performance" (M2).

I.e. the different software solutions are only available on different computers. The municipal staff must frequently go from one computer to another . The computers are placed at different sites all over the building.

Catering and organisation are not handled by a central contact any more. If external partners are invited the meetings have to be organised individually by the technical staff.

There is "no one to complain to - things like this 'are decided'. , but who decided them - I do not know" (M2). To the understanding of (M2) the management layer "should streamline the organisation better". Starting with the Organigram and a public description of the different departments, units and tasks. (M2) mentions that the organigram was developed "only recently".

(A1) sees the "different vocabulary around SUDS" as "misleading". To him basically "all concepts around blue-green infrastructure lead in the same approach" (A1).

To (A1) "common planning is not sufficient" - "it is about common implementation". Municipalities outsource a lot of their planning capacities to private contractors or plan projects with shared responsibilities. Downstream implementation is not part of expertise of the municipality. To (A1) "planning is not the problem".

6.2.7 Incentives for the Future

How to Get Enthusiastic about SUDS

To (M2) “icon projects help a lot”, meaning that the Municipality has to implement attractive and visible solutions that inspire others.

(M2) mentions that the municipality “need[s] to have something more than just workshops on climate change. Something to get people thinking”. He highlights the wording used to promote SUDS. To him it “makes no sense to talk about climate adaptation, it is more “about liveability”. while arguing only for the one goal on climate adaptation “it might be too costly”, so “we need to add more benefits - like liveability”.

(A1) reiterates the importance of thinking about “the right solution for the right spot”, so about designing and managing each SUDS intervention “individually”. He sees “a lot of examples where thinking changed completely, e.g. in Utrecht, the questions there is not if SUDS, but where and how SUDS.”

(M3) proposes the use of “local heroes and celebrities” to advertise the topic of climate change and GI.

Good examples help in setting the right incentives for the future. “It was really helpful with the flooding last year that there were no problems in the new districts” (A1) which had incorporated SUDS already. When projects are not properly planned they can “turn the wheel around again and fuel arguments of the traditionalists”. The event of 2016 “made a lot of people realize and created awareness” (R2).

To (M3) it is “all about creating awareness on the inside and on the outside by personal relations” (M3). He sees the “workshops and small-scale information meetings” he attended as “the method of choice” (M3).

To (M4) the challenge for the municipality is “how to build a community of practice around SUDS”.

“We are in the middle of the transition” according to (M4). “Designers, maintenance and construction firms have to grow together” (M4). Since in the SUDS approach the correct maintenance has gained a bigger role, the Maintenance Department “should be informed and integrated better” (B1). If the Maintenance Department is unable to maintain the solution they “will halt any development plan of SUDS”.

Data Gathering, Processing and Sharing

To (M4) it is very important to “incorporate all this digital information”. (M5) agrees with this idea. To (M5, M4) often “blocks of texts”(M4) are produced while “a map makes things so much easier to understand” (M5). The GIS-services as well as the overall IT-administration is “a neglected child” (M2) in the municipality. The IT department is “making my work harder instead of easening it” (M2). Also the existing GIS-services are “poorly used by the employees”, but could bring notable benefit to the daily work and discussion according to (M4, M2, M5). Working in the field of NBS is also about finding “smart ways to work together in general” (M4). The Green Department started working on maps “in the last year” (M4). To her it is a “development programme for the whole municipality” to make information easily accessible. Also (M3) sees this as a way forward. He describes that “when we have all the information of the different departments about one spot ready” it is easier to “imagine and pursue our own projects” (M3).

(M3) “We as municipality need to practice what we preach and make our buildings greener”.

Compromises With a Vision

To (M5, M4) the way of finding compromises is “a very Dutch thing” (M5). According to (M4) the Dutch do not work “with bosses and supervisors”, meaning that hierarchical structures are perceived as not too persistent. “If I have a questions or a suggestion I just go and ask” (M4), but in order to achieve progress it is more about “prioritizing” and “making choices” (M5). (M4) says, “it is something that is not happening in my view”. (M5) confirms this feeling and is complaining about “too many compromises and no real choices”, likewise (M4) “sometimes you have to choose”.

The problems around finding compromises and working not in a specifically decided direction are confirmed by (M2). He also sees changes in the Project Management layer of the municipal organisation as necessary. To his understanding “everybody has his or her own focus” and the municipality “is dealing with at least 500 projects at the same time” (M2). He emphasises that “we should start thinking about how to focus the work more in one direction and to prioritize better” (M2). The management layer should work more on focussing the organisation itself - “nobody is bringing ideas on how to develop the whole organisation” (M2). The management layer also should develop a “common vision and should give good examples” (M2). To (M2) [NBS](#) is about “convincing people to work intrinsically”.

By the example of a green lane in a road (M5) explains how difficult it is not to lose your vision while planning for different stakeholders. “We started with 1,10m of green, very simple” (M5). It was “just about removing the pavement next to the road” (M5). Then Traffic and Infrastructure Department “intervened” as there were no tiles for “the people who park their car and do not want to step in the green area” (M5). “So we placed some tiles in the design which reduced the width of the green space to 90 cm”. Then complaints by the Union for the Disabled were made as there are no tiles to cross the green area when leaving the car in a wheelchair. “So we had to place more tiles here and there in the design which reduced the green area width to 60 cm at some points” (M5). The end of this story was that “the maintenance department refused to take over the maintenance for green lanes smaller than 80cm width and we could not realise the project” (M5). A development like this can be very frustrating.

To (M5, M4) it is important to communicate that the technical concepts may vary, but it is also important to communicate that they are still “just working on public space” (M5) and “not doing something completely different”(M4).

No Other Alternatives, Use Every Possible Opportunity

(B2) sees that “there is no way around [SUDS](#) for the moment”. From his experience in the Netherlands “everything was paved to save the maintenance costs green surroundings have” (B2). Now cities face the consequences of this decision with heat stress and flooding. And see that “disadvantages are greater than the cost advantages” (B2), so “we have to move backwards actually” (B2).

To (M2) “there are some opportunities we did not use so far”. E.g. once a year there is a gathering with the complete municipal staff. This event could be “branded with [SUDS](#) or better with [NBS](#)”.

To (M2) the strongest way to promote [NBS](#) is to look “closely at every project” and then adapt solutions out of the green brochure.

(M2) also mentions that the municipality lacks “one person taking out the mistakes of the organisation”. And that “every organisation has its pros and cons”. Eindhoven “should just work on the tweaking” (M2).

More consideration should also be given to worst-case scenarios according to (A1). He stresses that in climate change unpredictable events will happen. And that there are not enough “thoughts about what happens when the system falls” (A1). He gives the examples of the flooding in New Orleans in 2016 and the flooding of Fukushima in 2011. To his understanding the “systems may fall” in historic events like those, but “without the catastrophic aftermath” which happened in the two cases. This thought has not been developed until now and “there is even a lack of knowledge what will happen if the systems fall” (A1). According to (A1) the “usual approach is to adapt the water systems to historic events”, but to his understanding there “is a great need to also think about everyday use” as first point to start with. And as third point “the worst-case scenario where the systems fail” (A1). (A1) highlights that “the SUDS should bring a positive impact for our society every day”, “it should cope with the historic events while it is permitted to fail in worse cases” (A1). “Thirdly we should at least think of what happens when the systems fail” (A1).

(A1) sees EU-funded projects like UNaLab not as the solution to solve problems. He insists that the “knowledge has to be generated locally”. EU-funded projects only “help in generating test cases” (A1).

(R1) describe that “despite the history of the Netherlands” in the sustainability debate and building codes “water is always a neglected child” (R1). Until now only energy-related issues, i.e. the installation of solar-panels were integrated in legislation.

6.2.8 Summary

The following section summarises the results of the expert interviews from Eindhoven and outlines the most important points.

Definition of SUDS: The concept of SUDS is very well known to the interviewees. All interviewed persons mention the multi-functionality as a key property of SUDS. The beneficial ‘green colour’ that SUDS bring to urban environments is mentioned several times. To the experts the new concept changes the view on urban water in comparison to the past. SUDS work by imitating nature and by using a more decentralised approach. They do not fit well in old water management thinking. Several interviewees express the opinion that ‘sustainable’ to them also means involving all different stakeholders in the planning of those new systems. Two interviewees mention that for them the concept of SUDS begins with the separation of stormwater from urban wastewater. One interviewee expresses the confusion around the nomenclature for SUDS. It should be overcome and to him there is no difference between SUDS, GI, BI or NBS.

Local SUDS Implementation and Factors of Success There is a widespread discussion about climate change in the Netherlands which works in favour of the SUDS introduction. Also due to a fairly recent flooding in the summer 2016 there is a widespread awareness of water issues in the city. For SUDS the main driver behind the development is the municipality. One expert from the private sector identified a change in the city’s tender system in the last year. The tenders incorporate now more and more SUDS and alternative approaches.

in the municipality the Department of Water plays an important role. In this department one special personality can be identified as important for the development of SUDS. This person has worked in the municipal administration for a long time and is pursuing a clear path towards the introduction of more SUDS and GI. This person has written several information materials around the topic which are perceived as helpful by other interviewed experts. Around this person a group of stormwater experts gathered who share the same vision how the municipality should develop. Alongside with the Department of Water the Green Department also has shared beliefs and together they form an alliance in the municipality for the promotion of GI. The Water Department has a good standing and a strong position in the overall city administration. There is a bond of trust between local politicians and the Water Department. One elected person is pushing the municipal experts to work in favour of more green solutions for the city.

Nationwide the topic of water holds a special position in administrative procedures in the Netherlands. Besides the strong municipal Water Department the regional Waterboard interferes directly in the urban water management. Interviewed experts from the Waterboard are in favour of SUDS. Superior to the Waterboard a national organisation alongside with a national research institution influence SUDS development. National guidelines and vision documents were thought up which influence the local actors.

Participation of civil society organisations is described as well-functioning as one elected spokesman for all citizen's groups connected to GI exists. New projects are negotiated with the different groups through him.

Arguments why SUDS should be introduced The usage of water in the cities create a lot of new possibilities. Private actors can engage in revenue generation through capturing the co-benefits created by SUDS, e.g. cooling or insulation. Citizens also profit through co-benefits like improved health conditions through improved air quality. The interviewees mention that the most basic SUDS is de-paving which already includes several enhancements of the urban water cycle. It is also an easy to implement approach. The interviewees agree that issues of urban heat island effects and worsening air quality need to be tackled now. These problems will most likely get worse if they are not dealt with.

One interviewee also mentions the life cycle of public infrastructure which demands for a quick response. If SUDS are not implemented now and instead traditional grey infrastructure is renovated, the next chance of interference might come as late as in 30 years.

One interviewee mentions the sectoral cross-cutting nature of SUDS as a benefit to their development. This enables SUDS to create a lot of synergies in between the different departments in the municipality and with outside actors.

Barriers to SUDS Implementation According to several experts the long debate on climate change yielded several well elaborated policy and ambition documents. Besides these documents, barriers can be found on all steps of the SUDS value-chain. No regulations to support the uptake of SUDS exist. Neither tax incentives nor coercive regulations are in place to include the private sector in the development. The demand side for SUDS interventions consists mainly of the municipality and the regional waterboard. The flooding of 2016 did not trigger voluntary action in the private sector. Private development companies are not active in SUDS development. The municipal employees see a great need for national regulations as the problems with regulation exist throughout the Netherlands.

In negotiations in municipal development projects several experts share the experience that other regulations are seen as rigid in comparison to the demands of GI and SUDS. Compromises to the disadvantage of GI and SUDS are often made. In general facilitating automotive traffic in the city is still perceived as important.

Citizens are described as divided. There is a large group of active citizens open for grassroot greening initiatives and SUDS. But there is an equally large group who are not aware of SUDS or other topics related to climate adaptation and GI benefits. This second group has 'paved backyards' and to the experts it is difficult to approach this group or convince them of their ideas.

Several experts see the development of SUDS in Eindhoven as led by engineering experts and as closed to other disciplines.

The general topic of SUDS is diverse and complex. Due to the large amount of different solutions it is difficult to keep an overview of chances or problems, even for experts in the fields. The municipal contractors and maintenance companies lack experience with the new solutions. If flawed SUDS are implemented they create push-backs for the overall development. This happened with permeable pavements and a swale system in Eindhoven.

There is a system for the evaluation of the value of trees in place. But, in general the system of municipal budgeting does not allow to integrate the benefits of SUDS. In the calculation SUDS turn out as costly because their benefits are difficult to measure in terms of money. They create costs in the calculation which cannot be offset by the created benefits.

Several interviewees report flaws in the organisational structures of the municipality. There are no employees dedicated on improving the workflow in general. Also the guidance of the management layer is seen as not developed enough. Interviewees report that there is no overall image or vision the municipality pursues. The SUDS development is coming out of the organisation by individuals and single departments. In general too many small projects are pursued at the same time.

Incentives for the Future

The interviewees mention the need for more overall focus and vision. Finding compromises is described as being a local competence. , but several interviewees report that the organisation should work on a more focussed work towards an overall image, i.e. a greener city. There should be a better 'prioritising' towards GI.

There is a lack of interdepartmental work despite the organisational restructuring. It is seen as beneficial that there was no organisational reform for the past years. , but several interviewees express a need for further connecting the departments of health and social services to be integrated with GI and SUDS development. Also the maintenance department should be included better to make sure the new concepts can be maintained.

GIS and ICT systems should be reworked to be more user-friendly and the digitally collected information should be accessible more easily. Information and maps with cross-departmental information on current development projects should be prepared centrally.

Creating more awareness is perceived as really important. E.g. during events for the municipal staff the concepts could be explained. Several interviewees mention the importance of easy to understand and visually appealing documents. For the citizens the town could make use of its local heroes, i.e. the famous soccer players as one interviewee expresses.

The planning regime in general has to be adapted for SUDS. Urban water management structures are usually designed to mitigate worst-case events and not to improve day-to-day value. Also considerations about possible scenarios worse than worst-case should be made.

The local utility companies and contractors should be given enough cases to train in order to build up competence in the field of SUDS.

7 | COMPARISON OF THE FINDINGS OF TAMPERE AND EINDHOVEN

The next chapter summarises the findings from both case study in bullet points. The findings are clustered according to the topics discussed in the expert interviews into five tables. Table 7.1 gives an comparison of the local understanding of the SUDS concept, Table 7.2 summarises the local implementation and success factors, Table 7.3 compares the stated arguments, Table 7.4 gives an overview of the experienced barriers to SUDS uptake and Table 7.5 collects the different incentives for the future.

Table 7.1: Comparison of experts definitions of SUDS in Tampere and Eindhoven

<i>Tampere</i>	<i>Eindhoven</i>
Multi-functionality	Multi-functionality
Aesthetics, green colour	Aesthetics, green colour
Mimicry of nature	Mimicry of nature
	Stakeholder involvement

Table 7.2: Comparison of local implementations and success factors of SUDS in Tampere and Eindhoven

<i>Tampere</i>	<i>Eindhoven</i>
Climate change debate happening. Ambivalent local opinion on climate change adaptation.	Climate change debate promoted development but also ambivalent public opinion. High competence in water management in general.
Local development started in one particular district development project	No exact event can be identified.
Small group of active citizens demanded for new solutions for the single development project and experts seeing a need for change.	Demand raised by experts from in the municipality.
International concepts were imported and adapted.	Not possible to identify where the concepts initially came from. Today several local actors exist.
Development today expert-driven from inside the municipality.	Expert-driven from inside the municipality, mainly from one particular department. Personalities important.
Municipality as driver of demand Guidelines for SUDS in Finnish.	Municipality as driver of demand GI inspiration booklet.
Little involvement of private sector No demand and little support from politics	Little involvement of private sector Ties to and support from politics
Limited to outskirts and new development projects	No clear 'hot-spot' identifiable. Retrofitting and integration in existing infrastructure happening as well as inclusion in new development projects.
Formal citizen participation described as old and outdated. Existence of informal networks between municipality - staff. Ambivalent citizens - active and passive. -	Formal citizen participation well established. Large share of passive population. Formal networks established. Progress and further dissemination still working mainly through informal channels. Strong ties between important stakeholders.
Newly introduced water tax, local autonomy	Long history in water management, different authorities involved
Exemplary ESS evaluation in former projects.	System of monetary ESS calculation and inclusion in municipal budgeting in place (for trees)

Table 7.3: Comparison of arguments for SUDS Uptake in Tampere and Eindhoven

<i>Tampere</i>	<i>Eindhoven</i>
Support and replace grey solutions	Support grey solutions
Enhance local biodiversity	Improve air quality
Enhance water quality	Flooding remedy
Lower costs than traditional solutions	Lower costs proven with local examples
Public infrastructure reaching end-of-life, good opportunity to implement alternatives	If new solutions are not implemented now, next chance will take years to come
Municipality owns major part of municipal ground, can dictate on development	Most ground privately owned
Concerns about water quality	Effects of climate change noticeable
Growing city, after-crisis situation, new developments underway	Growing city, after-crisis situation, new developments underway

Table 7.4: Comparison barriers to uptake of SUDS in Tampere and Eindhoven

<i>Tampere</i>	<i>Eindhoven</i>
Not part of overall strategy, vision, no focus on SUDS	SUDS named in some vision documents. Lack of enthusiasm of the management layer.
Organisational flaws - disciplines not represented in planning (Nature Conservation Department, Biodiversity staff)	Organisational flaws in general and disciplines not represented in planning (Health Department, Social Services Department)
Expert-driven process of implementations. Difficult for actors outside the expert network to participate	Expert-driven, particular persons and a particular department behind the development
Visualisation of benefits not possible in current budgeting system. View, task and integration of 'biodiversity' outdated	Visualisation of benefits of other values than trees not possible
Spatial planning too limited on small plots	Spatial planning too limited on small plots and too many different projects at the same time, no focus in work
Seen as luxurious add-on. Only for specially branded districts, exempt from the mainstream	Compromise often in detriment of green solutions. Other regulations e.g. the infrastructural regulations are perceived as stronger
Little private actor involvement, demand driven by public sector	Little private actor involvement, demand driven by public sector
No regulations on private sector	No regulations on private sector
City acting passively towards citizens, mainstream of formal networks is not taken up by the citizens, informal networks for particular procedures	City actively engaged in formal networks with the citizens. Large share of the population passive and unaware
No effective regulation to foster involvement of other stakeholders	No effective regulations/incentives on private house and land owners
Lack of knowledge: Experience in construction and maintenance, contractors. Technical feasibility in local climate	Lack of knowledge: Experience in construction and maintenance, contractors. Technical feasibility for local soil conditions.
Little to no political support	-
Import of international concepts and knowledge slows down local acquisition of competence	-

Table 7.5: Comparison of incentives for the future

Tampere	Eindhoven
Include concept in vision and planning	Include concept in vision and planning, more focus in municipal projects and works. Better prioritising towards green solutions. More interdepartmental work with Departments of Health and Social Services
Inclusion of politics and citizens	Reach passive half of citizens
Local knowledge and local use-case generation	More local use cases to facilitate local learning processes
Private sector regulation	Better regulation of private sector, industry and private house owners
-	Adapt planning regime to incorporate day-to-day values

8

DISCUSSION

In the following chapter the results of the two case studies will be compared and discussed. The chapter begins with a discussion of the understanding of the concept. It is further structured according to the three research questions:

1. How did the municipalities of Tampere and Eindhoven integrate SUDS into their urban development projects?
2. Why did the municipalities prefer SUDS over classical grey-infrastructure solutions?
3. What barriers and which strong-points can be found in the individual implementation processes?

The first two research questions will be shortly discussed in a combined section. A focus is laid on the third research question which responds to the questions raised in the title of the master thesis: '*Which Governance Aspects Promote and Inhibit the Uptake of Nature-Based Solutions in Cities?*'.

8.1 IMPLICATIONS OF THE CONCEPT

NBS in both cities were associated with SUDS. Surprisingly even among the experts, there was often no clear distinction made between the two terms. The list of different approaches which qualify as SUDS by definition is long. This is a blurred definition and the new embracing concept of NBS is even more blurred. This work follows the argumentation of [Nature \(2017\)](#) where this is seen as an advantage. Insights from the literature review as well as from the expert interviews prove a great need for interdisciplinary cooperation between many different actors. The interviews show how important a common vision for the success of new concepts is. To create this common vision among the multitude of different actors an 'easy to grasp' presentation which embraces all different kinds of approaches is needed. Not only [Feilberg and Mark \(2016\)](#) mention that cities are looking for 'integrated solutions'. In the literature analysis it was noted how complex and diverse the related governance aspects are. In reality they prove to be even more complex and interrelated. To tackle the 'wicked problem' of climate change embracing solutions are needed and no promising approach and no department can be left behind. SUDS show to be highly relevant and promising for both case studies. And the concept of NBS proves to be a suitable vehicle in disseminating SUDS throughout the municipal organisations.

Experts from both cities highlight that there is still a need for grey infrastructure. NBS and SUDS are not the ultimate answer to modern challenges of urban spaces. They work in a supportive way and can serve as first cornerstone of a different and more sustainable city development.

The aesthetic aspect was mentioned in both cities. One can see that the definition of what qualifies as '*urban*' and what as '*natural*' is changing. In the past '*urban*' was mostly associated with grey infrastructure as the interviewees report. The new solutions blur the line to '*natural*' environments. This is an ongoing discussion that does not come without resistance. One interviewee mentions the inner part of a city is not '*a forest*', whereas other interviewees feel that the city should resemble natural environments as closely as possible. The mimicry of nature was mentioned in both cases as a property of [SUDS](#).

8.2 HOW AND WHY DID THE MUNICIPALITIES ENGAGE IN SUDS ?

The concept entered both municipalities through the respective water management structures and experts. In Eindhoven this is a regional water authority in cooperation with the municipal water department. In Tampere this is a stormwater expert team inside the land planning department. Literature confirms that [SUDS](#) are for the most cases integrated in municipal water management structures ([CIRIA, 2015](#)). Their core task is for most cases defined as (storm-)water management. Thus their planning, management and funding is allocated to the water-management structures ([Fletcher et al., 2015](#)). This led to the development of expert teams around a technical water-engineering background.

The development is in both cases driven by expert teams. They form actor networks around the subject and hold the knowledge of the concept. The experts see the need for, and the associated advantages of [SUDS](#) and create the municipal demand. They are behind the interest in [SUDS](#) in the municipalities.

In Tampere the [SUDS](#) development is limited to two city districts while in Eindhoven the concept has already partly arrived in the mainstream city development. The development in Tampere seems younger than in Eindhoven. Whereas in Tampere the development can be allocated to one exact event back in time, the experts from the Eindhoven case could not pinpoint the development to a single project. The expert network in Eindhoven is denser and larger. This can be explained through a historically strong interest in water management institutionalisation in the Netherlands ([Wielenga and Wilp, 2015](#)). Both cities are situated in frontrunning nations considering climate-change awareness but still struggle with a '*passive half*' in the society. [SUDS](#) provide a wide range of benefits to the local contexts. The new solutions are not expected to replace the existing grey infrastructure but to support it.

In Tampere water quality and biodiversity concerns are in the middle of the debate. [SUDS](#) promise decentralised and easy to handle water treatment methods and can provide habitats for all kinds of flora and fauna. Eindhoven, having already experienced an increase in flooding is in greater need for support of the traditional systems. Air quality concerns also work as argument for further [SUDS](#) development there.

Both cities have a lot of public water infrastructure reaching its end of life now or in the upcoming years. If [SUDS](#) are not integrated now, the next chance will take years to come. This is an argument for the immediate integration of [SUDS](#) into the mainstream in both cities. Public infrastructure

in the urban space usually has long life-spans (Korkealaakso et al., 2016). The existing water infrastructure in cities can be as old as 100 years (Wiesmann et al., 2006). Choosing SUDS over traditional systems can influence the upcoming decades of city development for the better.

8.3 PROMOTING AND INHIBITING GOVERNANCE ASPECTS FOR SUDS

This section discusses the third research question and responds to the title of the master thesis '*Which Governance Aspects Promote and Inhibit the Uptake of Nature-Based Solutions in Cities?*'. The governance aspects can be divided in *promoting* and *inhibiting* ones. Belonging to either category they are discussed in the following.

8.3.1 Governance Aspects Promoting the Uptake of SUDS

It was possible to define six overarching themes in the aspects promoting the concept. Those themes are '*Cooperation*', '*Knowledge and Vision*', '*Commitment*', '*Budget*', '*Research Institutions*' and '*Politics*':

Cooperation

In order to effectively take up and successfully implement SUDS an interdisciplinary cooperation is necessary. This is true both for the administration itself as well as for the relation with actors outside the administration (Matthews et al., 2015). Through its diverse benefits the SUDS concept provides multiple entry points for other stakeholders to co-develop the interventions in the city. While raising the number of participating parties the diversity of different ideas can be increased and thus the list of potential benefits (Matthews et al., 2015). The costs for installation and maintenance can be shared across all participating stakeholders and ultimately enable more SUDS interventions to be realised.

Cross-sectoral cooperation procedures must be formalised and documented in order to achieve effective workflows (Morris et al., 2017). This is done in the governance structure of a municipality.

In its structural reform the city of Eindhoven tried to formalise co-working in their municipal structure. An 'organisational web' was created to include several disciplines in the city development. The reform was a success in the sense that now more departments can have their say in city development projects. Synergies between the Departments of Water and Green could be created in the past and the concept benefits from the reform.

For an effective uptake of the concept groups outside the administration should be involved. The multi-level governance concept describes and proposes different ideas for the cooperation between those groups (Hooghe and Marks, 2003). Interaction should take place horizontally as well as vertically through the different governance levels. Horizontally between citizens, local companies, politicians, other cities and the municipality. Vertically between the municipality and regional, national or supranational institutions (Marquardt, 2017). The participation of groups and individuals must be channelled and institutionalised. Enough 'entrances' for stakeholders to participate need to be established (Raymond et al., 2017). The municipali-

ties should be active towards external stakeholders and act in the sense of an enabling governing mode.

Eindhoven institutionalised stakeholder cooperation on the horizontal level in the spokesperson-initiative and the shoulder-to-shoulder approach. The spokesperson-initiative formalises the relation of the municipality with the civil society. The initiative was fruitful as lawsuits about municipal development projects significantly got less. The ‘shoulder-to-shoulder’ tender approach formalises the creation of networks with the private sector. This attempt has been the first of its kind. Until now it is evaluated as successful by the participants. It is yet to be known what new networks can grow out of this approach. Exchange with actors of the vertical governance levels are formalised through the international city networks and EU projects which take place in Eindhoven. It was noted that especially the EU project R4E helped the municipality in working on a vision for future development. The regional Waterboard works as connection point to higher levels of governance. The regional authority is more and more involved in an urban context. Co-working with the waterboards is in general very well established.

In Finnish legislation citizen involvement is a prerequisite to all development programs. On the horizontal level Tampere has an employee dedicated to citizen co-creation. To approach citizens with classic informational hearings was reported as poorly effective. In opposite to the traditional approach the municipality thought up new ways of integrating other stakeholders in the two districts of Vuores and Hiedanranta. In the Hiedanranta district development an own vision and strategy was realised to involve private businesses and citizens. New ways of collaborative vision creation and district planning were applied successfully in the new districts (MoT, 2018a). For the two districts several prestigious architectural, engineering and design offices were consulted. These offices also work internationally and enable the import of new and innovative concepts to Tampere. Tampere takes part in several national and international city networks. Outcomes from these networks were described as beneficial also for the SUDS concept.

Both studied municipalities are forerunners in the development of SUDS. The demand for the new solutions is mainly created out of the municipalities themselves. For an effective uptake the civic and private sectors have to be integrated as well.

Knowledge and Vision

In order to disseminate the concept, more knowledge and further knowledge distribution about SUDS is the key. Information must be easily available and easily understandable. In order for a possible stakeholder to understand the functions of the new concept visually attractive materials either in print or digitally can support the process. The information material should mainly address the success stories and the provided benefits of SUDS. Then trust-building in the new solutions throughout all sectors can take place which can possibly reduce scepticism towards SUDS (OECD, 2018). SUDS need to be adapted locally. Thus the knowledge about them must be anchored locally.

Knowledge and mutual understanding is the basis for the creation of a common vision towards more SUDS implementation. If the municipal staff as a whole is informed through good and easy-to-grasp presentations it can develop a common vision and act by it. The compromises which need to be made in the public development projects can be aligned towards this com-

mon vision. If further the community around the municipal staff belonging to the private and civic sector is informed also they can take part in this vision creation. They can be convinced of the need for the new measures and that SUDS can contribute to solve current and future problems.

In Eindhoven the municipality does not explicitly rule out errors and allows its servants to make mistakes and encourages them to experiment with new tools and measures. The structure of the municipality allows this. The permission to experiment allows for the creation of test cases. This will ultimately create reliable data on SUDS behaviour and increase trust in their function.

In terms of knwoledge dissemination the 'Eindhoven Goes Greener' booklet summarises SUDS benefits in a visually appealing manner (MoE, 2014). It is possible to break down the complex and multi-stakeholder concept of SUDS to some essential points.

In Tampere two districts are exempt from the normal planning procedures. They actively foster the experimentation with SUDS. This 'exempt from normal procedures'-approach allows for the generation of test cases both for the municipality as well as for the contracted planners and construction companies. New ways of cooperation can also be tested as a side effect of these measures. The municipality also engaged in creating awareness for the topic.

In most cases SUDS have only been used to support the existing infrastructure. The planning documents for the Hiedanranta district in Tampere move a step further and envision a wide replacement of grey infrastructure by SUDS. Insights from visionary districts like the one in Tampere can be of high value for future development.

Commitment

Personal commitment can act as major driver behind the promotion of SUDS. If persons or groups feel dedicated to the concept they can act as multipliers and convince their colleagues of the need for the new concept. Their effectiveness depends on the position of these change agents in the organisation and the number of their peers and supporters. The municipal governance structures should allow for an innovation-uptake from inside the organisation and should encourage staff members to articulate their ideas (Gasbarro et al., 2016; De Bruin, 2016). The promotion driven by personal commitment works mainly on an informal level. The formation of informal networks across employees and external stakeholders can be fostered by the municipality with the help of local policy.

In Eindhoven the development is very much driven by a single department and a single personality. There is a densely woven informal network around the 'water guys and girls'. They have a good standing both in the municipality as well as towards external partners and politicians. In Eindhoven it was possible for this informal network to work on knowledge and awareness as well as on vision creation very effectively. The topic of SUDS has constant advocacy.

In Tampere the municipality itself is generating a demand for SUDS. A group of stormwater experts introduced the new concepts into the organisation and advocates for SUDS. Several committed employees form an alliance and demand for an implementation of the new practices. They have an overview of available techniques and future trends.

Budget

The economic situation and the municipal budget are important when it comes to the progress of SUDS implementation. Both cities are currently experiencing an upswing after a phase of recession. Times of growth in size and economic prosperity are usually accompanied by an increased building activity. This is a chance as new development projects bring new chances for SUDS. In new development projects the integration of the solutions is mostly easier than their retrofitting in existing structures (CIRIA, 2015).

A high municipal autonomy in fiscal and legal matters allows the realisation of locally created visions like SUDS (Bos, 2010). The municipalities can decide autonomously to generate new sources of income, e.g. through the taxation. A cross-departmental budget for the sake of SUDS or related motives like stormwater protection can work as driver of the development. As SUDS are for the most cases located in water-related municipal bodies the introduction of water-related taxes promoted their expansion in the past (CIRIA, 2015).

Both cities levy water-related taxes. Tampere decided to introduce a stormwater tax at the beginning of 2018. The taxation was enabled through an initiative of the central government of Finland. Earnings from the tax will be used to invest in water infrastructure. It can be expected that SUDS will benefit from these new investments.

In Eindhoven the regional Waterboard enjoys a high level of autonomy and is empowered to levy taxes. The strategic programme of the Waterboard addresses the expansion of SUDS.

The ownership structure of the municipal territory can work as driving force for SUDS. On publicly owned land the municipality can build itself and incorporate SUDS. Or the municipality decides on the conditions for construction developers to build on the land. In Tampere two thirds of the territory is owned by the municipality. The municipality acts in a more demanding manner by not selling to the highest-bidding developer, but to those who are most dedicated to sustainable or alternative solutions. For the new district of Hiedanranta the municipality bought the premises of a private company to influence its development and foster SUDS.

If and how ESS are calculated and assessed in a municipality can support the uptake of SUDS. Many benefits SUDS provide can be described with the help of the ESS concept (CIRIA, 2015). If the provided ESS can be integrated in municipal budgeting systems the economic viability of SUDS is improved. A powerful argument for their implementation results. If it were possible to include other benefits like e.g. biodiversity into the calculation, the cost savings of SUDS would be even higher. For the benefit of SUDS the concept could be included into existing ESS evaluations.

An individual cost evaluation and data generation about economic viability should be pursued. Insights from the literature as well as from the two case studies suggest a cost-advantage of SUDS compared to grey infrastructure.

Municipal staff in Eindhoven proved the cost effectiveness of SUDS in several calculations for local examples. Experts in Tampere know from their own experience that SUDS for the most cases show to be more cost efficient. Public budgets are chronically short in money and saving costs can open almost any door. In the case of SUDS the cost calculation of Eindhoven is even more impressive as the side-benefits or ESS like e.g. 'air-quality improvement' are not integrated in the calculation yet (MoE, 2014).

Research Institutions

Local, national and supra-national research institutions can support the uptake of SUDS. They work in improving the knowledge base and in disseminating new insights. In test cases they can provide the needed long-term data or work on proving cost-effectiveness. They can act as additional source of funding. The research can provide practical information to enable a fast uptake of SUDS, e.g. through applied research projects.

Eindhoven can rely on an extensive network of local and national research institutions supporting the development of SUDS. Tampere can as well rely on an extensive network of national research institutions. The national Finnish reserach institution Suomen Ympäristökeskus - Finnish Environment Institute (SYKE) funded the research on SUDS implementations in Tampere. The guideline provided by the national Finnish Water Association emerged as driver of SUDS uptake in Finland.

Practical guidance documents in the respective national language are a driver of SUDS in Finland and the Netherlands. It is advised for research institutions to publish research on SUDS in the national language. This helps in building up and anchoring the knowledge locally.

Politics

Politicians hold great power over the manifestation of SUDS in legislation and regulation. They need to be made aware of the concept and its perks. If they have the topic on their agenda they are able to bring in respective laws and regulation. Their will to support SUDS correlates with the knowledge and awareness of the citizens. If citizens actively demand for the new solutions they will find their way onto the political agenda. The staff in Eindhoven can rely on the support of local politicians. The expert staff can mutually work on progress towards the uptake of more SUDS with the informed decision-makers.

The example of the water tax in Tampere shows how higher levels of politics can provide positive incentives for SUDS. Nationally-binding regulations e.g. on building codes or green roofs can support the local level substantially (EEA, 2012).

8.3.2 Governance Aspects Inhibiting the Uptake of SUDS

Six overarching themes in the aspects inhibiting the SUDS development can be derived. Those themes are '*Path Dependency*', '*Silo-thinking*', '*Restriction to Experts*', '*Lack of Knowledge and Vision*', '*Lack of Regulation*' and '*Financial Barriers*'.

Path Dependency

During past decades, the belief in the efficiency of grey infrastructure was hardly ever questioned. Municipal organisations and structures around maintenance and expansion of this system developed together with it (Charlesworth and Booth, 2016). The experts working there were experts for grey infrastructure. Unlike SUDS, this infrastructure is usually placed invisibly underground and thus interferes with only few stakeholders. Among those stakeholders little cooperation is necessary as concrete structures remain static over time. The long lifespans of concrete-based structures further manifested the concept in the municipalities.

SUDS require a shift in thinking as they work in a totally different way. They are located in public space where different actors meet and different, if not adverse demands of interest groups collide and compete with each other. It is difficult to reach a fair balance of these interests (Charlesworth and Booth, 2016; Matthews et al., 2015). This renders the traditional stakeholder involvement techniques developed for grey infrastructure outdated and obsolete. While grey flood-prevention structures are built to silently and invisibly wait for their mission and a worst-case scenario to happen, **SUDS** are supposed to provide day-to-day benefits (van de Ven et al., 2016). Thus new maintenance and management schemes are needed. The local mode of urban governing must be reviewed. Whereas municipalities were for a long time only in the role of service providers in water management, they must turn into more active cooperating partners (OECD, 2018). It is difficult for the grown structures to accept deviations from the manifested paths. A process of learning new procedures and pathways has to be combined with a process of unlearning the old ones (Nygren et al., 2017). Path dependency inhibits a fast uptake of **SUDS**, as establishing the new procedures, structures and beliefs in the municipalities takes time.

Traits of path dependency in the municipal organisation exist in both cities. The stormwater and water management Departments, where **SUDS** development is located, are themselves characterised through path dependent governance structures. There are no links to other departments like e.g. Health, Social Services or Environmental Protection. These missing links impede collaborative financing or collaborative benefit capturing possibilities. Until now the two municipalities mainly work in an inward-looking, self-governing mode and do not approach stakeholders in a demanding or provisional way¹. This is due to the perceived role as *service provisioners* and not as *active partners* (OECD, 2018). Until now **SUDS** are not part of the mainstream development in Tampere. At the same time as **SUDS** are developed, the traditional solutions are further expanded. Beside the experimental approaches in the two example districts, the methods of stakeholder cooperation were described as outdated. The important role traditional solutions still play for the ‘mainstream’ of the municipality impedes the uptake of new co-creation concepts needed for an effective **SUDS** development. This path dependency has to be interrupted for an effective uptake of **SUDS**.

Silo-thinking

Missing links to other departments because of path-dependent municipal governance structures foster silo-thinking. Little interference and little interdepartmental cooperation lead to an organisation in silos. These silos are characterised by a strict division of responsibilities and areas of operation which result in individual agendas of the different disciplines. Silo-thinking impedes the uptake of an overarching strategy, the allocation of cross-cutting benefits and a shared budgeting across departments. The implementation of concepts which require large scale cooperation becomes more difficult as the different disciplines all work on their individual development goals (Charlesworth and Booth, 2016).

The integrative concept of **SUDS** cross-cuts through these silos and interferes with their individual agendas. The collaboration between different disciplines is a prerequisite for **SUDS** to provide their full range of benefits (Charlesworth and Booth, 2016).

¹ See: Table 3.3 on page 30

In Eindhoven, even after the structural reform, the budget has remained organised according to the silos. This forms a barrier towards a wider SUDS uptake, as it impedes effective cost sharing and benefit capturing across the sectors. In Tampere, while the issue is addressed in the two example districts, the mainstream development structure is characterised by silo-thinking. The silos need to be opened for a further uptake of SUDS.

Restriction to Experts

The history of SUDS as urban water management technique and their location in the water management silos led to the development of certain expert teams around the concept. They mostly stem from a technical water-engineering background (Fletcher et al., 2015; Ashley et al., 2015). The concept as such is diverse and complex as it requires special knowledge from multiple disciplines. To gain an overview of all available techniques is difficult even for the experts themselves (van de Ven et al., 2016). There is little non-scientific information available and the information is difficult to access for people who stand outside to the expert networks. The knowledge concentration in the expert networks turns them into highly influential actors in steering possible pathways of SUDS development. The speed of further dissemination is dependent on their behaviour and their decisions.

The exclusiveness of the concept to certain expert groups deters possible partners for collaboration and a wider uptake. The process must be opened to stakeholders external to the expert networks. Further development should remain openly accessible for all stakeholders. Easily accessible opportunities for collaboration must be created. SUDS are highly site-specific and need to be adapted to the locally prevailing technical as well as societal needs. An exclusion of co-operative development impedes localised adaptation of SUDS.

The SUDS development in both cities is to a large extent described as expert-driven. Experts from the municipality together with expert planners from the private sector choose the individual SUDS and their local application. Co-creation concepts like in the experimental districts of Tampere need to be integrated in the mainstream development of SUDS.

Lack of Knowledge and Vision

'Knowledge and vision' can work in supporting SUDS but their lack can impede the uptake. Since the concept is rather new, lack of knowledge can be found on all levels of the SUDS value chain.

Little long-term data on the reliability, benefits, cost structure, best maintenance procedures and behaviour in specific contexts is available (OECD, 2018). This impedes trust building and promotes scepticism in the concept on all levels of importance (OECD, 2018). The risk of implementing the new concepts is perceived as too high and the private sector does not voluntarily take it. Known, traditional solutions are preferred.

Many actors do not know about the benefits of and the necessity for SUDS. They are thus often perceived as optional and 'nice-to-have' feature (OECD, 2018). In this sense, they are used mainly for marketing purposes and for special new developments but rarely in the general mainstream. The municipality is alone on the demand side of SUDS. Due to its limited resources the development capacity for SUDS is limited. Knowledge and awareness must be created in a wider context and more actors need to be integrated.

Vision creation is about spreading knowledge and awareness among all stakeholders of the SUDS value chain in order to enable them to develop an idea about possible future developments. If the concept is unknown among key stakeholders, it cannot be taken into account as option for future development (OECD, 2018). Lack of knowledge in strategic layers excludes the concept from being part of a greater development vision. If no common vision for a cross-cutting topic like SUDS is developed, silo thinking and path dependency are reinforced and SUDS uptake is ultimately impeded. Vision creation is not only about creating and setting common goals and identifying common ideas.

A lack of a common vision leads to compromises which are detrimental for SUDS. Individual regulations and aims of siloed stakeholders show to have less leeway for compromise. They are perceived as being equally or more important while providing only individualised benefits. This leads to the stronger position of e.g. grey infrastructure in municipal discussions. Lanes for cars are not up for debate whereas a planned green stripe can be cut on in its width. There is no consciousness that SUDS will maybe show to be more important than a car lane in the future.

Both case studies show local anomalies which impede certain SUDS approaches. Private construction firms and contractors are reported to often lack the knowledge how SUDS are implemented correctly. This creates malfunctioning system which result in drawbacks for the whole concept. Further trust-building in SUDS is prevented.

Knowledge must be generated and made accessible for persons outside the expert groups. Easy-to-understand guidelines with practical examples need to be thought-up. The private sector has to be provided with enough test-cases to build up local competence (OECD, 2018).

In the two case studies lack of knowledge and awareness was reported from the private and partly from the political sector. The lack of vision was expressed in the criticism of too narrow local planning in both case studies.

From the expert interviews in both cities the topic of vision creation turned out to be very important. In Eindhoven it is the vision of the management layer that could be improved according to the experts. In Tampere the experts report that the mainstream vision should explicitly include SUDS.

Lack of Regulation

The knowledge and awareness gap in higher levels of management and among politicians result in poorly developed regulatory instruments. The private sector, unwilling to take up SUDS voluntarily, is excluded from the development (OECD, 2013).

Stakeholders from the private sector are not part of the development in either municipality. Private sector means private house-owners, development companies and maintenance or construction contractors. They have no interest whatsoever to integrate SUDS systems. They are neither forced nor given incentives to implement SUDS. No effective regulations are in place to provide incentives or demand private commitment. House-owners as well as development companies are unable to profit from the generated benefits of SUDS in terms of money. The private development companies' first interest is revenue generation and any additional cost factor will ultimately deteriorate this main goal. The created benefits cannot be incorporated by the private actors (OECD, 2013). They are benefits to the community.

Everyone of those stakeholders can be approached either in a coercive way through e.g. taxes or new building regulations or supportive through

subsidies or tax abatement (OECD, 2018). For every group of stakeholders there are functioning regulation tools available where SUDS can be integrated. For example, in existing building codes or subsidy schemes for renewable energies. Examples from the literature mention compulsory green roof installation, subsidy schemes or the supply of free material to build a rain garden (Hansen et al., 2015). Literature gives examples where SUDS benefits are captured and monetised by private actors (Elmqvist et al., 2015). The exclusion of private actors was identified as major barrier in SUDS uptake.

The lack of internal regulation of SUDS inside the municipality forms a barrier to wider uptake as well. Grey solutions are strictly regulated and follow exact specifications. Whereas the width of a lane is given, green space and SUDS lack those hard regulations. The municipalities must work on formalising requirements and minimum standards of SUDS.

In Tampere SUDS did not arrive on the local political agenda yet. There is a need to bring SUDS on the political agenda and to include local decision-makers more. Eindhoven highlights the role of national policy in the field of SUDS and especially green roofs. The lack of regulation forms a barrier.

Financial Barriers

Municipal budgeting systems are unable to fully integrate the SUDS concept. The prevailing budgeting schemes usually do not represent 'life-cycle' based costs but calculate costs annually. Costs for SUDS are lower compared to grey infrastructure when calculated on a life-cycle basis. During the first year of implementation SUDS have high maintenance costs (Charlesworth and Booth, 2016).

Additional benefits provided by SUDS can be depicted using the ESS approach (MEA, 2005; Bouwma et al., 2016). Until now the budgeting systems have been unable to fully represent them. This can create detrimental situations for SUDS. A parking lot is seen as economically promising as it creates a steady income. Compared to this, the implementation of SUDS is highly unprofitable as maintenance costs are created and no direct revenue can be derived. Both cities began in evaluating ESS for their projects. This process is still in an early phase. In Eindhoven urban trees are given a monetary value to compensate for their removal. The monetary evaluation of ESS is still under discussion in the literature (Bouwma et al., 2016). Scholars argue about the possible ways of integration into planning and budgeting regimes. The way Eindhoven implemented the evaluation can be seen as a beginning. The municipalities need to work on ways to represent those benefits.

The low awareness of SUDS results in low trust, highly perceived risks and low incentives to voluntarily take up the concept. The impossibility of representing the benefits in existing budgetary systems and the impossibility for the private sector to capture the benefits ultimately results in a low willingness to invest in the new solutions.

In the two cities other topics than SUDS dominate the discussion about sustainability. Topics like for example energy generation through solar-panels on rooftops, energy savings through insulation of houses or other concepts receive more attention. This is because technical solutions can be easily calculated and communicated. It is harder to communicate e.g. the biodiversity potential of an introduced swale (CIRIA, 2015; OECD, 2013).

The costs and benefits SUDS entail span across multiple disciplines. The several benefit categories can lead to, e.g. lower costs for healthcare. The Department of Health could profit from lower costs and co-finance SUDS interventions. In the existing budget structures this is not possible as the

budgets are divided according to the silos (Chesterman et al., 2005). There is no cross-departmental budget for SUDS. In the municipal budgeting systems the capture of benefits as well as the provision of funding for a project is in most cases allocated to a specific department.

The impossibility of calculating and effectively representing the costs and benefits of SUDS form a barrier which needs to be addressed. The example of Eindhoven can be used as starting point how to address the issue. Different examples from the literature can be taken into account as well (Kabisch, 2015). The municipalities must foster alternative budgeting schemes and work on closing co-operational links between stakeholders to overcome this barrier.

The municipal organisations show traits of path-dependency. Over the last decades the traditional grey-infrastructure manifested certain structures and beliefs in the organisations. SUDS are located in the public space which itself is subject to sometimes contrarating demands of different user groups. Path dependent structures impede the uptake of SUDS to the advantage of traditional solutions.

9

CONCLUSION

This master thesis set out to answer the question '*Which Governance Aspects Promote and Inhibit the Uptake of Nature-Based Solutions in Cities?*'.

To do so, an inductive research approach was pursued. The research data was gathered in a literature analysis and in semi-structured expert interviews in the cities of Tampere and Eindhoven. The choice of cases was defined by the [UNaLab](#) research project which determines the framework of this thesis. The study is limited to a sub-concept of the Nature-Based Solutions ([NBS](#)) field — the Sustainable Urban Drainage Systems ([SUDS](#)). The investigation answered the following three research questions:

1 – How did the municipalities of Tampere and Eindhoven integrate [SUDS](#) into their urban development projects?

The concept entered both municipalities through the **respective water management structures and experts**. In Eindhoven this is a regional water authority in cooperation with the municipal water department. In Tampere this is a stormwater expert team inside the land planning department.

In Tampere [SUDS](#) are limited to two city districts while in Eindhoven the concept has already partly arrived in the mainstream city development.

2 – Why did the municipalities prefer [SUDS](#) over classical grey infrastructure solutions?

The demand for [SUDS](#) is generated through **expert-networks** in both cities. The development is still very much driven by these. They are the reason *why* the municipalities pursue the uptake of [SUDS](#). They identified the shortcomings of the existing grey infrastructure and see the advantages of the new systems.

[SUDS](#) provide a **wide range of benefits** to the local context. The new solutions are **not used to fully replace** the existing grey infrastructure **but to support** it. Both cities struggle with climate change impacts on their urban water cycle. Eindhoven already experiences an increase floodings and the failure of the existing systems. In Tampere the development is also driven by concerns about water quality and biodiversity.

3 – What barriers and which strong-points can be found in the individual implementation processes?

For the two cities it could be shown that promoting and inhibiting governance aspect exist. Both cities have successfully built [SUDS](#) but experience governance structures that hinder their wider uptake.

Promoting Governance Aspects to the Implementation of SUDS

Knowledge distribution and **awareness creation** is a prerequisite of a further uptake of the concept. Confidence in the performance of SUDS encourages the municipal staff and increases general acceptance.

The experts in Eindhoven have created different publications and so raised awareness of the topic. National **guidelines** on SUDS development in Finnish helped for the uptake in Tampere.

SUDS require **cooperation among different stakeholders**. They interfere with the public space and its users and should be designed to meet their needs. SUDS deliver a wide range of benefits to various stakeholders. Their costs can be shared among them.

Eindhoven introduced an 'organisational web' to address issues of collaboration in a governance reform. A new way of cooperating with the private sector was established with the shoulder-to-shoulder tender approach. Co-creation with citizens is formalised in the spokesperson initiative.

Tampere tests new ways of stakeholder integration in the two city development districts. In addition, the city has an employee dedicated to the involvement of citizens.

The cooperation of informed stakeholders can enable the creation of a **common development vision** which was reported as beneficial for the SUDS uptake. A common vision can steer the development towards more SUDS implementation. It strengthens the position of SUDS when compromises have to be found.

In Tampere a vision for the district development of Hiedanranta was collaboratively developed with stakeholders from the private and the societal sector. The district serves as positive example for future developments.

Personal commitment can be an important driver. In the case of Eindhoven individuals in the municipal staff are main drivers of SUDS uptake. Those individuals form a web of experts around SUDS and work together on informing their peers.

The **provision of sufficient funding** fosters SUDS uptake. Both cities raise water taxes and thus generate funds dedicated to their water infrastructure. The calculation of ESS can generate further funding possibilities for SUDS. If a tree is cut in Eindhoven the Green Department is compensated with a certain amount of money.

A great proportion of **municipal ownership** makes it easier for the administration to demand that SUDS are installed. In Tampere, the city owns the largest part of municipal ground and can sell it to investors who are willing to incorporate SUDS. In Eindhoven ownership is predominantly private which reduces the municipal influence.

The **support of research institutions** helps to create knowledge and awareness of the concept. Both cities cooperate with national research institutions in local test-cases for SUDS.

The **support of politicians** enables awareness creation in higher levels of governance and fosters a formal regulation of the concept. In Eindhoven ties to local policy-makers create support for SUDS.

Inhibiting Governance Aspects to the Implementation of SUDS

The cities experience obstacles to the uptake of SUDS. Traits of **path-dependency** in the municipal organisation exist in both cities. Over the last decades the municipal structures evolved around grey infrastructure solutions. That means that it is sometimes not easy to make them give up

procedures they are good at and make them try different paths. So path-dependent structures impede the uptake of SUDS to the advantage of traditional solutions. SUDS require a **shift in thinking** as they work in a way different from the traditional approaches. Urban water management is traditionally located in certain expert groups and certain departments. If SUDS are integrated into the grown infrastructure and they are silo-ed in those structures. To deliver their full range of possible benefits, SUDS need greater collaboration across disciplines and stakeholders. If they are **exclusively dealt with in expert groups**, possible and desirable other partners for cooperation are deterred.

Little knowledge and awareness of the concept as such outside the expert groups was described as barrier to further uptake. Lack of knowledge in the private sector, be it private households or businesses hinders the uptake.

If one wants to convince people of the advantages of SUDS more **reliable long-term data** on their behaviour should be gathered. Without this, trust-building in those new solutions is hampered.

Higher levels of management also experience a lack of knowledge and awareness. This results in a **lack of vision** and a **lack of clear strategy** which can ultimately lead to unfocused development and the promotion of path dependent decision-making. Path-dependent structures are characterised by **siloh-thinking** which impedes cross-sectoral collaboration. There are **no effective regulations** in place to either offer incentives for private commitment or demand it. The **private sector is thus not integrated**. House owners as well as development companies do not profit from all the benefits of SUDS because the various benefits SUDS provide **cannot be quantified in money terms**. This is a general problem of ESS evaluation and assessment.

9.1 LIMITATIONS OF THE STUDY

NBS and SUDS are a rather new concept on the research agenda. Although some experts believe that the implementation of the SUDS concept reached a peak during the last year it is rather new in the studied municipalities. So far only the experts really belonging to an inner circle of the city development and planning do really know about the pitfalls and benefits of the new concept. This limits the study in the sense that no long-term experience is available on how the concept will 'fit' in the context of the two studied cities. It remains unclear which benefits SUDS can provide in the long run and if the concept can spread throughout the societies in the two case studies as projected. At present the only actors on the demand side of SUDS are public actors.

There is a common ground of understanding what SUDS are but still all definitions remain vague and leave room for interpretation. The individual understanding of the topic varies from person to person. The qualitative data collected during the semi-structured expert interviews can be seen as biased in the varying personal definitions and ideas. The interviews reflect the individual and personal viewpoints of the interviewees and cannot be directly transformed into a universal truth. Also the local, highly individual governance-, cultural- and spatial- contexts in which the municipalities are embedded limit the possibility to generalise the research findings. In this research only a limited number of persons could be interviewed. If the sample size had been bigger, the individual arguments could have been backed or criticized better. This might have led to more significant arguments.

Most of the interviewees from the respective municipalities are working in middle-ranged management positions. It was not possible to conduct interviews with representatives from the political and high-management sector for both cities. Persons belonging to these sectors work more on creating common visions and steering the bigger picture. This study recognised the influence of actors on a national and supra-national level. It was not possible to speak to representatives of these levels. Thus their influence cannot be assessed. Data collection in these layers of the multi-governance concept would have enhanced the study findings further.

This was different for persons interviewed in the business sector. Both in Tampere as in Eindhoven the business area directors could be interviewed. Both showed to have a very good overview of the developments. They were very interesting interview partners and provided details about the trends that can be expected. Other employees could not be interviewed. A major barrier to a wider [SUDS](#) uptake are the uncertainties of their maintenance and the construction process. It would have been interesting to talk to people who actually construct [SUDS](#) or work in their maintenance.

The two case studies were the '*frontrunning*' cities of the [UNaLab](#) project. Many of the interventions which turned out as successful were already implemented in the two cities several years ago. Both cities are located in countries which show above-average climate-change awareness. The results of the research are highly context sensitive and site-specific. When taking up the ideas in other contexts they need to be carefully assessed and adapted.

9.2 RECOMMENDATIONS FOR FUTURE RESEARCH

The changes the [SUDS](#) concept implies for the organisational and management structures of municipalities are far-reaching. But the reality of climate change leaves no other option. Even though the two studied municipalities are frontrunners in the development around [SUDS](#) they struggle with their uptake. The approaches they started to pursue can only be the beginning of an even more far-reaching transformation. This thesis has shown how important a combined effort of practice and theory is to foster a wider uptake of [SUDS](#). Technical as well as questions of organisation and management need to be further addressed.

This study has examined governance and [SUDS](#) in two cities in the Netherlands and in Finland. It shows that geographical and site-specific conditions and the historically grown structure of the municipal administrations shape the mode of [SUDS](#) uptake. The scope of the study did not cover the relationship between higher levels of governance and the municipalities. Communication between research institutions, politics and urban administration is another field of research.

Most important seems the collection and analysis of comparable and compatible data on [SUDS](#) performance. This would help in the establishment of common objectives. Future research could take the development of administrative tools and organisation patterns into account.

Future research could also address mentioned limitations of this study. Selecting more interviewees from different hierarchical levels will provide more diverse points of view, which ultimately leads to a greater data basis.

The lack in vision which was expressed as barrier to [SUDS](#) uptake could be an objective of future research. Also thoughts of how the knowledge and

awareness gap in the different sectors could be addressed is an interesting question for the future.

The two municipalities as research subjects are constantly evolving. Some regulations are fairly new. Future research could repeat the study after a certain time has passed.

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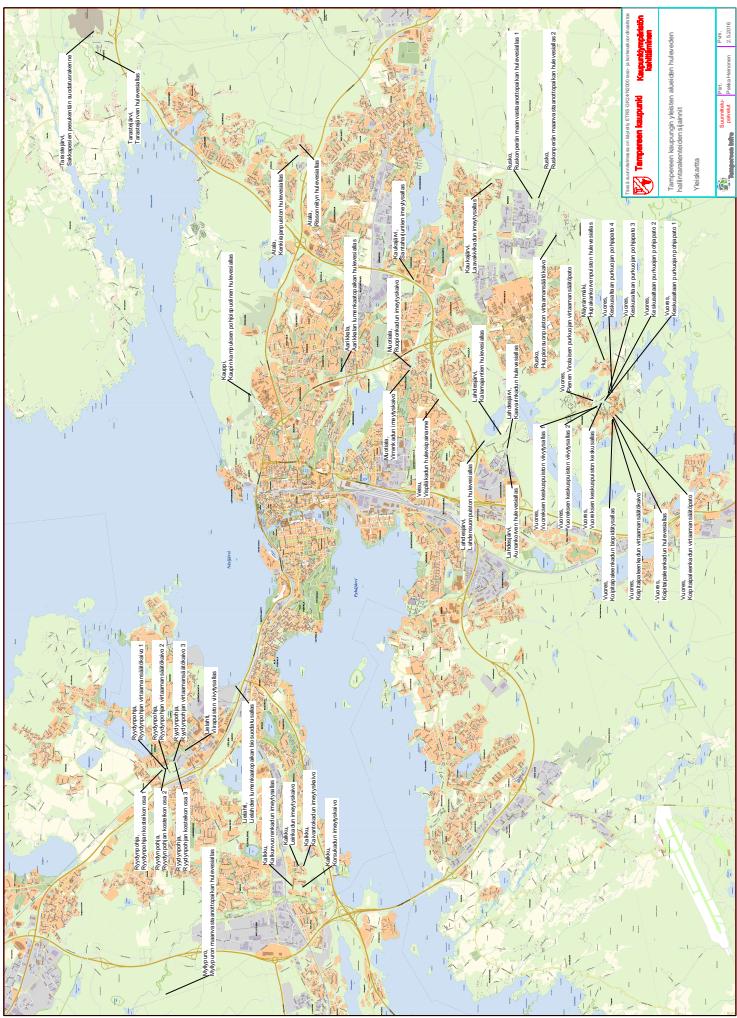
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B | APPENDIX

B.1 SUDS LOCATION IN TAMPERE



B.2 SEMI-STRUCTURED INTERVIEWS QUESTION GUIDE-LINE

¹



Urban Nature Labs

– Nature Based Solutions to Urban Challenges

Sustainable Urban Drainage Systems in Tampere

QUESTION FORM

Feb. - Mar. 2018

¹ Note: The same guideline was used in both case studies.[]



Cities worldwide are growing fast. Over half of the global population lives in urban areas already. Nature Based Solutions (NBS) form promising approaches to climate change related challenges. The concept of Sustainable Urban Drainage Systems (SUDS) is one of those promising alternatives to traditional grey infrastructure approaches to urban water management.

The interview guideline mentioned below for our semi-structured interview should guide our talk about the topic. You have been identified as a key individual in the development of NBS and SUDS by the UNaLab Project partners in Tampere.

The Interview will be recorded and transcribed. It is scheduled to last approximately one hour. If desired, every interviewee has the possibility to stay anonymous.

The interview will follow these three basic questions and groups of topics:

- 01- *How did the municipality of Tampere integrate SUDS into their urban development projects?*
- 02- *Why did the municipality prefer SUDS to classical grey-infrastructure solutions?*
- 03- *What barriers and which strong points can be found within the individual implementation process?*

The author wants to find out the main factors (hindering/facilitating) behind an effective innovation uptake within the urban governance structures.

Results of the study will be used within the UNaLab Project. The interviews will help in thoroughly assessing the decision-making processes regarding SUDS and NBS within the municipality of Tampere. The aim of the study is to understand better the development of Tampere to enable mainstreaming of processes. Results of the study will be shared with the municipality's working group on the UNaLab project and with all interested interviewees. Also, the possible outcome of the study will be used in the assessment and consultation of the other UNaLab partner municipalities.

The aim is to create insights of importance to the municipality of Tampere as well as to the other municipalities interested in the field of SUDS, Nature-Based Solutions and related approaches.

Ultimately, the results of the study will be presented in the form of a master thesis submitted at the University of Hohenheim.

Thank you for participating and for sharing your knowledge!

Niklas Effenberger , Student



General questions

- *Can you explain your position, function, role?*
- *How would you define the term "Sustainable Urban Drainage Systems"?*
- *Where do you see the biggest challenge for public space?*

Specific questions on the SUDS development – Barriers/Innovations/Incentives

- *When or within which project did the SUDS development started in Tampere?*
- *What barriers to the implementation of SUDS are the most important in your point of view?*
- *What strong points do you see in the past implementation processes in your city? Which SUDS approach would you see as best example so far?*
- *How could the implementation of SUDS be supported and incentivised?*
 - *What kind of changes do you wish for? (E.g. in legislation, National Adaption Strategy ...)*
 - *What overall advantages/downsides of SUDS compared to conventional drainage systems do you see?*

B.3 DECLARATION

Declaration*

I,

Surname, First name

Matriculation number

declare that I have followed the Principles of Good Scientific Practice while writing the present

- | | |
|---|--|
| <input type="checkbox"/> Bachelor's thesis. | <input type="checkbox"/> Master's thesis, |
| <input type="checkbox"/> seminar paper. | <input type="checkbox"/> Diploma's thesis. |

I have written the paper/thesis independently and have used no other sources or aids than those given and have marked the passages taken from other works word-for-word or paraphrased.

Supervisor

Topic of the paper/thesis

Semester

I furthermore declare that the submitted unencrypted electronic document exactly and without exception corresponds to the contents and wording of the printed copy of the paper/thesis. I give my consent to this electronic version being checked for plagiarism with analytical software.

Place, Date, Signature

* This declaration is to be included into the independently written paper/thesis as an annex. Papers/theses not including this declaration will not be accepted.