Transition Pathways for Sustainable Urban Water Management

Towards long term circular water availability for the urban green infrastructure functions sport and recreation

The outdoor sports fields Rotterdam case study

MSc Industrial Ecology Thesis

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Transition Pathways for Sustainable Urban Water Management

Towards long term circular water availability for the urban green infrastructure functions sport and recreation: The outdoor sports fields Rotterdam case study

By

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Summary

Worldwide, sustained water availability for urban areas is considered as a huge challenge. The majority of urban areas lack the capacity to cope with the impact of climate change through extreme weather events, and together with the growing population of urban areas this is putting pressure on water resources and infrastructures, as well as on water management in cities. There is a broad consensus that specifically in urban areas sport and recreation facilities are becoming more and more important. The pressure that these green infrastructure functions sport and recreation put on the security of sufficient quantity and quality of water is increasing tremendously. This critical urban water management situation is recognized mainly as a governance crisis.

The need for sustainable urban water management (SUWM) is recognized and understood on a broad scale. Yet, a transition towards more sustainable water management has not been sufficiently realised. There is a gap between observing that there is a need for SUWM, and the actual implementation of such a transition towards more sustainable water use and water management. When the aim is to achieve a governance transition regarding urban water management for the green urban infrastructure functions sport and recreation, multiple stakeholders are involved, from different organizations, all inventing their own visions and perspectives on how a transition should be realized, leading to fragmented knowledge on the context. This results in communication and knowledge boundaries that hamper joint action to realise such a transition. In order to realize change, these boundaries must be identified, after which it can be examined where there is room to span these boundaries, and what roles the involved stakeholders could and should play in this. This thesis aims to reveal opportunities for transitions in governance that support sustainable water management, and focusses on a sports fields case study in the Municipality of Rotterdam.

The main research question stated in this thesis is: *What governance transitions according to relevant stakeholders contribute to ensure long term circular water availability for the green urban infrastructure functions sport and recreation?*

Based on literature, two concepts play an important role in answering the main research question: boundary spanning theory and the integrated Pestel framework. In order to find boundary spanning activities that ensure the realisation of a transition, stakeholder perspectives related to the Pestel characteristics on the transition are identified using Q methodology. Opportunities for boundary spanning towards a transition are identified in a focus group. A stakeholder analysis has been performed to identify relevant stakeholders, their relation to the Pestel characteristics and the relation between the stakeholders, as a bases for the identification of boundary spanners. Due to the roles stakeholders are playing in the transition towards SUWM on sports fields, an analysis between various stakeholder groups and boundary spanning activities has been carried out, answering the main research question.

The main conclusions of this research are:

1. To create a consortium in order to realize a platform for stakeholders to exchange knowledge and develop new knowledge, both a small and a broader spatial scale.
2. To explore joint investment to create an opportunity for an initial step towards the transition.

3. The Pestel framework has proven to provide a useful basis for identifying stakeholders viewpoints, opinions, knowledge, experiences and values.
4. Boundary spanning theory is necessary to get a deep insight in the barriers towards sustainable urban water management.
5. Policy makers seem to be the most equipped to initiate a transition.

The scientific contribution of this study is the integration of boundary spanning theory, the Pestel framework and Q methodology. The societal contribution focuses on promising future pathways towards long term circular water availability for the green urban infrastructure functions sport and recreation.

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CHAPTER 1 | INTRODUCTION

This chapter introduces the problem context of this research. In addition, the study relevance is discussed. The thesis outline of the report is presented at the end of this chapter.

1.1 | The effects of climate change on urban water management

"Cities around the world are facing a range of pressures resulting from population growth, climate change and deterioration of urban infrastructure systems. As water demand keeps increasing, an increasing number of cities are facing challenges of managing scarcer and less reliable water resources in an efficient way" (UNESCO, 2020, para. 1).

The relation between human activities and climate change became indisputable since the Brundtland Commission published its report 'Our Common Future' (World Commission on Environment and Development, 1987). Nowadays, more than half of the world's population is living in urban areas and the number of city residents is expected to keep increasing in the upcoming decades (Simmons, 2012; Vardoulakis & Kinney, 2019; World Bank, 2010). This makes urban areas extremely vulnerable to the effects of climate change (Alirol et al., 2011). Urban areas provide a major contribution to the global GHG-emission rate (Ghaemi & Smith, 2020). Extreme weather events, heat stress, air pollution and water scarcity are examples that pose great risks on urban areas and its dense population (Handmer et al., 2012). These effects are expected to become more and more extreme over the coming decades, for example by increased frequency, as well as increased intensity of heavy rainfall and longer periods of drought (KWR, 2016; Tsavdaroglou et al., 2018).

A major effect of urban development has been the change of surface cover, disrupting the natural hydrological cycle in urban areas (Zölch et al., 2017). Worldwide, sustained water availability for urban areas is considered a huge challenge (Johannessen & Wamsler, 2017). Specifically when it comes to management of fresh water resources, cities play a significant role, due to changes in both water quantity and quality through land-use change, overexploitation, and contamination (Marsalek et al., 2007; OECD, 2011).

This critical urban water management situation is recognized mainly a governance crisis (OECD, 2011). According to Dewulf (2019, p.6), governance "involves attempts by public or private actors to provide collective organization and action, thereby steering society in one direction rather than another". The negative effects of urban development create a strong pressure on governance transition strategies towards a more circular water management (OECD, 2011).

In the Netherlands the majority of the inhabitants live in urban areas and about 60% of the land is falling below sea level (Rijksoverheid, 2015). Therefore, climate adaptation is inevitable to become a water robust and climate proof country. As a result, the Delta Plan on Spatial Adaptation is developed in collaboration with municipalities, district water boards, provinces, and the central government, aimed at rendering The Netherlands climate-proof and water-resilient by 2050 (Rijksoverheid, 2020a).

1.2 | Water management on sport fields in the Netherlands

The Ministry of Health, Welfare and Sport is the Dutch Ministry responsible for public health, health care, quality of life, social work and sport. It encourages people to adopt healthy lifestyles e.g. by exercising more and eating healthily. Sport promotes health, provides social contacts and contributes to self-development (Rijksoverheid, 2020b). The 'sports mission' of the Ministry is to make it possible for everyone to play sports(Rijksoverheid, 2020b). However, as more and more people are living in cities, the pressure that the green infrastructure functions sport and recreation puts on resources such as water availability increased tremendously. Therefore, management of green urban infrastructures is a major challenge (Phillips & Turner, 2014).

In 2018, a national sports agreement has been signed by among others the Ministry of Health, Welfare and Sport, the sports bond NOC*NSF, and numerous municipalities (Kenniscentrum Sport & Bewegen, 2018). The agreement includes ambitions to make sport available for each and everyone in the Netherlands, now and in the future. One of the ambitions is based on a well working and sustainable sports infrastructure, where sport clubs, sports associations/unions and municipalities are supported by the so-called 'Routekaart Verduurzaming Sport' to achieve a climate resilient sports environment. However, ambitions and objectives outlined, based on this Routekaart, by among others NOC*NSF and the Groene Club seem to be mainly focused on energy savings, where they highlight the reduction of costs and CO2 emissions that comes with energy savings (De Groene Club, 2020b). The necessity for climate-adaptive water systems is not yet seen as relevant (De Groene Club, 2020; RVO, 2020).

In dry periods, when there is not enough fresh water available to cover the water need for all functions, fresh water is distributed based on the national 'Verdringingsreeks' (Rijkswaterstaat, n.d.). The Verdringingsreeks indicates which functions are still allowed to use water, and where water restrictions are applied, to realise an efficient and effective fresh water distribution. The Centraal Bureau voor de Statistiek (CBS) in The Netherlands states that the amount of fresh water used for sports and recreation sectors, among others for watering sports fields, is remarkably high (CBS, 2016). There is not an exact number for the amount of water used for irrigation of sports fields, as this depends on among others the type of sports field, the geographical location and weather circumstances. However, regarding fresh water use, in 2012 a total of 1070 billion liters of fresh tap water was used in The Netherlands. In the same year, 13 billion liters of tap water was used by the sports and recreation sectors (CBS, 2016). This means that more than more than 1% of the total fresh water use was covered by sports and recreation functions, which is the third highest water use when it comes to the use of tap water by economic activities. However, watering sports fields is not known as a priority within the Verdringinsreeks (Rijkswaterstaat, n.d.), meaning that in periods of drought sports fields will not be playable and sports can no longer be practised, resulting in a major influence on the sport capacity within a city. Due to effects of climate change it is expected that water scarcity problems will become bigger in the future (Mekonnen & Hoekstra, 2016; Vörösmarty et al., 2015).

About five percent of all urban surface area in The Netherlands consists of sports fields (Lenders et al., 2011). In 2016, the Municipality of Rotterdam counts 82 municipal locations with sports fields for organised outdoor sports activities (Gemeente Rotterdam, 2017a). As sports fields need a lot of water to maintain the playability of the outdoor sports fields, it is important to use (fresh) water effective and efficient. Sportbedrijf Rotterdam is a private organization that manages the vast majority of the

outdoor sports fields in the Municipality of Rotterdam. They "operate, maintain and support sports venues throughout the city" (Sportbedrijf Rotterdam, 2020, para. 1).
Due to the drought and high temperatures within the summer of 2018, and little possibilities to water the fields, the natural grass fields were generally not playable. Sportbedrijf Rotterdam decided that outdoor sports fields could not be used for a whole month (Sportbedrijf Rotterdam, 2018). In 2019, Sportbedrijf Rotterdam designed temporary solutions for the sports clubs that were effected most by water scarcity for the irrigation of the sports fields, to keep the fields playable. The solutions consisted of the placement of silos and irrigation installations. However these solutions seem to be not future-proof for all playing fields in Rotterdam (Sportbedrijf Rotterdam, 2019).

1.3 | Study relevance

The importance of sports in general is at the base of the societal relevance. Municipalities spend more than 1 billion euros annually on sports. More than 71% of this concerns the construction, maintenance and operation of sports facilities. The Netherlands is a country with a high aim, to be in the top 10 of elite sport rankings. And at the same time The Netherlands is striving to make it possible for all inhabitants to participate in organised or unorganised sport and physical activity, as the general thought is that playing sports make people healthier and happier (De Groene Club, 2020b).

The study relevance of this research is especially covered in the field of Industrial Ecology. The three pillars of Industrial Ecology focus on environmental, technological and social perspectives. In this research the social pillar is the important connecting perspective to the environmental and technical pillars, because of the crucial perception of the multiple stakeholders involved in the activities and governance processes around water management on outdoor sports fields. The technological pillar plays an important role when it comes to the water infrastructure of these outdoor sports fields and the focus on sustainable urban water management touches the heart of the environmental pillar. The pillars are inseparably connected and when one pillar is neglected, realising circular urban water management will be impossible.

To guarantee sustainable and future-proof urban water management, it seems critical to research the water availability for outdoor sports fields. The Municipality of Rotterdam is one of the major cities in the Netherlands that has faced multiple water problems in the previous years (Keunen, 2019b; Rijnmond, 2020; van Heel, 2018) and is chosen as a case study. The main problem includes the security of sufficient quantity and quality of water in future periods of drought to make sport fields playable all year round, possibly in combination with the storage and reuse of water surpluses.

1.4 | Reading guide

This thesis consists of 8 chapters. Chapter 1 introduces the problem statement within the scope of climate adaptation and urban water management on sport fields in the Netherlands. Chapter 2 describes the literature review, which is at the service of finding the knowledge gap to be researched. Chapter 3 explains the research design, including the research questions and the research approach. Chapter 4 presents the theoretical framework. Chapter 5 explains the research methods applied to collect the required data. Chapter 6 presents the results of the research. Chapter 7 reflects the discussion on the overall results and their limitations and contributions. Finally, Chapter 8 answers the research questions and synthesises the overall findings.

2

CHAPTER 2 | LITERATURE REVIEW

A literature review is conducted to validate the relevance of this research. In this literature review, the core concepts are explained, operationalised and defined. Furthermore, a literature review about water management for the green urban infrastructure functions sport and recreation and the opportunities for a transition towards long-term circular water availability on sports fields is described.

A literature review is carried out in the database of the TU Delft repository. The database covers a wide range of data across all disciplines, ensuring the value of the output from searches. Documents are assessed on their relevance and validity to the academic knowledge gap and based on this a selection is made. Search criteria were combinations of 'urban water management', 'circular water availability', 'urban green infrastructures', 'Nature-Based Solutions', 'boundary spanning', 'Pestel framework', 'stakeholder participation', and 'implementation sustainable water management strategies', when needed narrowed down with for example the Municipality of Rotterdam. Other search criteria were: libraries worldwide; peer reviewed articles; papers with a focus on the past 5 years.
Table 28 in Appendix A gives an overview of how many hits the keywords gave, as well as a brief description of the results these query returned.

2.1 | Urban water management as a wicked problem

The pressure on urban water management (henceforth: UWM) in cities is considered a wicked problem, driven by uncertainty and complexity, and difficult to control (Beck, 2007). Wicked problems are "social system problems which are ill-formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing" (Churchmen, 1967, p. B-141). There are many actors involved, that have different visions on who is supposed to take decisions, and what decision criteria should be applied (Dewulf, 2019; Weick, 1995). The aim of UWM is to establish water robust urban areas, where sufficient quantities and qualities of water are preserved. The focus is on resilience, liveability and productivity, in order to support social well-being, economic development, and environmental health (Grafton et al., 2015). According to Cosier & Shen (2009), UWM is trying to ensure the most suitable distribution and use of a limited natural resource within a context of economic objectives and social needs (Cosier & Shen, 2009; Grafton et al., 2015).

Yet, the majority of urban areas lack the capacity to cope with the impact of climate change through extreme weather events (IPCC, n.d.; World Bank, 2010). Together with the growing population of urban areas this is putting pressure on water resources and infrastructures, as well as on water management in cities (Bos et al., 2013; Hering & Vairavamoorthy, 2018; Özerol et al., 2020). Given the trends towards an increase of urban population and the vulnerability of water availability, the need to develop more sustainable practices for UWM becomes increasingly important (Hering & Vairavamoorthy, 2018). Sustainable urban water management (henceforth: SUWM), with a focus on water efficiency and reuse, becomes increasingly important for urban areas to secure their water availability (Bos et al., 2013; Jeong & Park, 2020). Therefore, SUWM should be realised to allow sustainable change in order to cope with the effects on UWM caused by climate change.

The need for SUWM is recognized and understood on a broad scale. Yet, a transition towards more sustainable water management has not been sufficiently realised. There is a gap between observing that there is a need for SUWM, and the actual implementation of such a transition towards more sustainable water use and water management. It should be identified what hampers this transition, and what actions could be taken to overcome these boundaries to make a transition possible.

2.2 | The role of sports fields in urban water management

When it comes to urban water management for green infrastructures, most of the literature focuses on green infrastructures as a solution for climate adaptation in urban areas. Various initiatives are initiated by policy makers, NGO's or citizen groups to support and stimulate principles of greening the city (Liu & Jensen, 2018). Successful examples are *green* roofs, energy-efficient buildings and 'Operatie Steenbreek' (Therrien et al., 2019). A specific topic within green infrastructures is sport and recreation. There is a broad consensus that specifically in urban areas sport and recreation facilities are becoming more and more important and these facilities are in close connection with healthy lifestyles (Casas Valle & Kompier, 2013; Elmose-Østerlund et al., 2020). This research focuses on how to realise climate resilient green infrastructures for the sport and recreation functions, making use of SUWM in Rotterdam. Nevertheless, according to Phillips & Turner (2014), "the problem of drought is clearly one of global significance, and sports organisations regardless of their geographic location need to be aware of the potential impact on their sports" (Phillips & Turner, 2014, p. 376).

Searching for new developments in climate resilient water management, Nature-Based Solutions (henceforth: NBS) seem promising (Raymond et al., 2017). The Urban Water Buffer by Field Factors is a good example of such a promising NBS. The Urban Water Buffer is a nature-based water management solutions and combines biofiltration with aquifer storage technologies to turn rainwater into a reliable and high quality water source to be reused again (Field Factors, n.d.). To realise future-proof developments, circular water management, which aims storage and reuse of water, is desired (Burszta-Adamiak & Spychalski, 2020; Leong et al., 2017; Torretta et al., 2020). "NBS are actions which are inspired by, supported by or copied from nature. Some involve using and enhancing existing natural solutions to challenges, while others are exploring more novel solutions, for example mimicking how non-human organisms and communities cope with environmental extremes" (European Commission, 2015, p. 5). However, as promising as these solutions seem to be, technologies based on NBS are far from implemented on a wide scale (Raymond et al., 2017). More insight needs to be created on the current vision of various stakeholder groups, like water authorities, technology providers, technology users, municipalities and other relevant stakeholders related to water management on outdoor sports fields.

2.3 | Knowledge generation

Outdoor sports fields are known to be used by various stakeholder groups, such as practitioners who are playing games on the sports fields, family members to encourage the players, volunteers to assist with tasks, everyday management, board members, maintenance and so on. Even more stakeholder groups are connected to water management on sports fields, for example a municipality, water authorities, the sports bonds and irrigation system suppliers.
When addressing UWM, with many different stakeholder groups involved, the stakeholders will have different, specific perspectives and knowledge, that will raise questions on how to realise effective

and efficient communication and collaboration to support sustainable transitions. The boundaries between different organisations and stakeholders can be of different nature, e.g. geographical, organizational or cultural. The concept of 'boundary spanning' indicates a method that aims to "build, bridge and connect fields of different natures" (Hooimeijer & van Campenhout, 2018, p. 2). It contributes to coping with the different perspectives of a large number of stakeholders involved. Slob & Duijn (2013) define boundary spanning as activities that are undertaken to cross boundaries, such as communication and joint activities. It describes organization's communication networks that, within an innovation system, adopt the role of connecting internal perspectives and knowledge with external sources of information (Tushman, 1977). Overcoming the resistance to communicate and define innovative concepts and solutions, to be able to 'generate new knowledge' and to realise changes is vital (Mors et al., 2018). This process of knowledge generation refers to how multiple ways of knowing are processed and how new knowledge is created (Brugnach & Ingram, 2012).

An example of multiple ways of knowing can be identified regarding water management on sports fields. Sustainable water management combined with a long term vision on how to apply sustainable water systems can be crucial on the level of the municipality. Experts, such as the water authorities and environmental organisations probably support the municipality on this point and they can be part of this way of knowing. Another way of knowing regarding water management can be that circular water availability is an environmental friendly and a technological innovative way of using water. Technological and environmental experts may prefer this way of knowing. Depending on the local and cultural context potential users can be part of yet another way of knowing, not willing to use recycled water. The existence of multiple ways of knowing may cause conflicts. For example if sustainable water management is more expensive and therefore club contributions will rise, practitioners might start complaining. At the same time urban sport field managers might be aiming for as many club members as possible; local policy makers may aim for healthy citizens and are responsible for safety issues; and the residents living in the neighbourhood of the sports fields may complain about noise pollution or increased traffic.

By connecting governance, stakeholder participation and decision making processes, boundary spanners are "able to manage information exchange between external networks and their own organizations, build and sustain relationships, connect developments in the external network to their parent organization, have a feeling for the interests of other organizations and mobilize their own organization timely" (Gieske et al., 2016, p. 6). Currently, governmental decision making hardly reflect the diversity of opinions and values from relevant stakeholder groups involved. Multiple perspectives, values, expertise and interest from relevant stakeholder groups are important to jointly generate knowledge and therefore improve the legitimacy of transitions (Brugnach & Ingram, 2012; Reed et al., 2008).

2.4 | Governance transitions

In this research transitions are defined as: "long term continuous process (25-50 years) of societal change during which the structure of society, or a subsystem of society, fundamentally changes" (Rotmans et al., 2001). The transition towards more sustainable urban water management will establish changes in the roles and responsibilities of involved stakeholders, such as municipalities, water authorities, residents, technology suppliers, water companies and building contractors (Jones & Van de Ven, 2016; Roovers & van Buuren, 2016). Such a transition is hampered by the diversity of

stakeholder perspectives and stakeholder knowledge, following from a perception of complexity. The main reason for this perception of complexity are the various ways of knowing from relevant stakeholders involved and according to Brugnach & Ingram (2012) decisions made by policy makers hardly reflect the preferences and interpretations that multiple stakeholder groups could bring. A consequence of these uncertain and complex governance strategies hinder the implementation of sustainable solutions (Farrelly & Brown, 2011). Therefore, governance strategies that involve various stakeholder groups with their perspectives on the complexity of social issues, innovative technologies and environmental challenges often hamper the realization of change.

In order to realize urban innovative water systems a transition towards sustainable water management is needed. Whether there is too little or too much water available, managing water calls for new decision-making and collaboration across departments, disciplines and businesses. A shift has to be made towards a new way of designing with water. A transition has to be realised that guarantees the quality of water management on a process level. To achieve SUWM, Wong & Brown (2009, p. 674) imply that “cities need to give water due prominence in urban development through an integration of the urban design process with other disciplines responsible for provision of water services”. Cities also “need to develop social-political capital for interacting with water. Future urban landscapes need to capture opportunities and technologies to maintain the cities' resilience towards the impacts of climate change, which have already created uncertainties regarding urban water supplies and weather extremes” (Liu & Jensen, 2018, p. 126).

3

CHAPTER 3 | RESEARCH DESIGN

Within this chapter, the information from the literature review is used to get grip on the question, theory and methodology for this research. A main research question and sub-research questions are defined. Hereafter, the case study methodology and the research theory and method approach of this research are addressed.

3.1 | Research questions

There is an urgent need for sustainable urban water management (SUWM), in order to realise a sufficient urban water system that ensures availability of water and regulates surpluses. This research investigates boundary spanning opportunities for governance transitions in water management that could be realised in order to secure long term circular water availability for the specific green infrastructure functions sport and recreation. The focus in this research is on finding opportunities that will support future-proof solutions for SUWM that have an impact on the long term. Circular water availability is desired (Burszta-Adamiak & Spychalski, 2020; Leong et al., 2017; Torretta et al., 2020), meaning that water surpluses in wet periods will be used to overcome water shortages in periods of drought. The research objective will be supported by the following main research question:

> *What governance transitions according to relevant stakeholders contribute to ensure long term circular water availability for the green urban infrastructure functions sport and recreation?*

The main research question is guided by the following sub-research questions:

(1) *What political, environmental, social, technological, economic and legal characteristics (PESTEL) are relevant from a stakeholders perspective to ensure long term circular water availability for green urban infrastructure functions sport and recreation?*
(2) *What opportunities for spanning the boundaries are regarded promising by involved stakeholders to achieve a transition towards a long term circular water availability for green urban infrastructure functions sport and recreation?*

Governance transitions are about transitions in the tasks, roles and responsibilities that all involved stakeholders fulfil to ensure sufficient water quantity and quality for the green urban infrastructure functions sport and recreation. Governance is defined as the decisions and actions of the relevant stakeholders involved. Long term circular water availability is about ensuring climate resilient infrastructures. Long term is hereby defined as future-proof solutions for that have an impact on the long term. Circular water availability means that water surpluses in wet periods will be used to overcome water shortages in periods of drought. The green infrastructure functions sport and recreation are defined as green facilities used by public parties to practice sports on both professional and recreative levels, exercise activities and recreational activities.

3.2 | Research approach

The research questions and sub-research questions are investigated through a research strategy shaped by the theoretical framework and specific methodologies. First, the case study research methodology is presented. Hereafter, a short introduction to the theories and the data gathering and research methods applied is given. A more elaborated overview of the theoretical framework and methods is respectively discussed in Chapter 4 and Chapter 5.

3.2.1 | Case study Rotterdam

In this research, a single case study research methodology is used in order to analyse and discuss the current state of water management in urban areas, as well as to design first steps to achieve long term circular urban water availability, with a focus on the green infrastructure functions sport and recreation. The purpose of a case study approach is to give practical advice on how to realise a governance transition towards a secured long term water availability, with a required water quality. Yin (2009, p. 18) defines the case study research methodology as “an empirical inquiry that investigates a contemporary phenomenon within its real-life context, and in which multiple sources of evidence are used”. In this proposed research, the focus is on sports fields located within the Municipality of Rotterdam and managed by Sportbedrijf Rotterdam.

The focus on Rotterdam as a case study is promising to generalize conclusions. De Vaus (2009) states that “case studies are designed to study wholes rather than parts”, and one of the most important characteristics of a case study is triangulation of data. In a case study design, which is qualitative research, internal validation is crucial (Hendriksen, 2019). The key concept is triangulation. Triangulation of data collection methods, such as expert interviews, a focus group and a literature analysis are required to obtain valid data in a case study design and have for this reason been part of this research. The results of the data analysis have been shared and validated with relevant stakeholders involved during a focus group. Within this research the aim is to gain an understanding of the perception of the stakeholders involved in making a governance transition towards a new way of designing with water, which is obtained using multiple sources and research methods, in order to overcome the weakness that comes with single method approaches. The sources and methods used are described in Paragraph 3.2.3.
The external validity of the research means to what extend the results of the research can be implemented outside of the case of Rotterdam (Hendriksen, 2019). The external validity of this research is limited, as the results are not fully generalizable. The conclusions of this research cannot be implemented one on one in other cases, however the results exceed the boundaries of the case study of Rotterdam. Rotterdam is a unique casus, but certain results can be generalized for other urban regions in the Netherlands. Different aspects, as the multiple involved stakeholders, the water-related issues as a result of climate change and urbanisation as well as water in general which is seen as highly important are topics that also play a role in other urban areas.

The Municipality of Rotterdam

The Municipality of Rotterdam is one of the four biggest municipalities in The Netherlands. Located in the Province of Zuid-Holland, it is home to more than 650.000 residents and this number is expected to grow to 694.000 residents in 2035 (EVR, 2018; Gemeente Rotterdam, 2020). Figure 1 presents a factsheet with more information on the Municipality of Rotterdam.

More than 650.000 residents (expected to grow to 694.000 in 2035)

More than 320 km^2, of which about one-third is covered by water
40% public property / 60% private property
65% build / 35% unbuild

More than one-third of the surface area below sea level

Figure 1. Factsheet Rotterdam (AlleCijfers, n.d.; Bouwwereld, 2019; Keunen, 2019a).

The Municipality of Rotterdam is known as a forerunner when it comes to sustainability and climate adaptation. For a low-lying region in a delta, with a large part of the city that lays below sea level, spatial adaptation is essential in order to remain safe and resilient in the future (Kimmelman, 2017; Timmers, 2020). The Municipality of Rotterdam launched a climate adaptation strategy in October 2013 (Kennisportaal Ruimtelijke Adaptatie, n.d.). The International Climate Conference "Adaptation Futures 2016" with 1500 climate scientists and policymakers took place in Rotterdam. Queen Maxima was one of the speakers. The 2016 National Climate Summit also took place in Rotterdam.

Because urban green spaces and sports facilities are generally considered a valuable element of a healthy and sustainable city, they are seen as more and more important as a means of sustainable urban (re)development. In the Netherlands, Rotterdam is a good example of a city where green and blue infrastructures are carefully considered in relation to climate adaptation (Ministerie van Infrastructuur en Water, n.d.). Among others, the Municipality of Rotterdam provides grants for inhabitants for the implementation of rainwater collection and the construction of more greenery (Gemeente Rotterdam, n.d.-c), and is showing integrated ambitions regarding green blue infrastructures in the Rotterdam's Resilience Strategy (Dolman et al., 2020).

Rotterdams WeerWoord

The Rotterdams WeerWoord is a collaboration between the Municipality of Rotterdam, the Schieland and Krimpenerwaard water authority, the Hollandse Delta water authority, Delfland water authority and Evides Waterbedrijf. The aim of the Rotterdams WeerWoord is to prepare Rotterdam for a more extreme climate together, making the city weather resistant in collaboration with the residents of Rotterdam. The goal of the Rotterdams WeerWoord is a climate-proof Rotterdam by 2025. The required upscaling and acceleration is translated into practical measures and actions that are to be taken city-wide and district-based (Rotterdams WeerWoord, n.d.). A selection of these ambitions is given underneath:

- An additional 20 hectares of green surface area in 2022 compared to 2018.
- 10 sports fields will become climate-adaptive.
- Further develop knowledge on flood risk management and flooding. Gather new knowledge on other themes, partly by being active (inter)national networks.
- 225 subsidized projects by private individuals and 225 projects by companies to promote climate adaptation.

The six themes on which the Rotterdams WeerWoord focusses are land subsidence, drought, floodings, ground water, heat stress and precipitation.

When it comes to visions for social importance, Rotterdam has the ambition for 2030 to further increase sustainable participation in sports, to optimize the (social) effect of sports and exercise and to move along with an environment with rapidly changing needs, technologies and possibilities (Gemeente Rotterdam, 2017b).

Sportbedrijf Rotterdam

The vast majority of the sports fields in the Municipality of Rotterdam is owned by the municipality, but managed by Sportbedrijf Rotterdam and rented by sports associations. Sportbedrijf Rotterdam is a private organization that operates, maintains and supports sports venues throughout the city (Sportbedrijf Rotterdam, 2020). As within this research there is not aimed for a comparison between private and public management, there is chosen to focus on the biggest group of sports fields managed within the same governance structure, which are the sports fields managed by Sportbedrijf Rotterdam.

3.2.2 | Introduction to theories

The theoretical framework of this research is designed by aligning the Pestel Framework to the boundary spanning concepts.

This research aims for finding opportunities for governance transitions that contribute to sustainable urban water management for green urban infrastructure functions sport and recreation. When it comes to water management in urban areas that have more land use functions than sports and recreation, many different stakeholder groups are involved, and these have different interests and influences. Several integrated frameworks are already designed and used, necessary in order to realise such a transition (Reed et al., 2008).
The so called Pestel framework is considered to be useful to categorize political, economic, social, technological, environmental and legal characteristics to measure the impact of sustainable urban water management in general. It covers the field in which all the involved stakeholders operate. The Pestel framework is “a multifaceted approach to assess big-picture forces in order to better understand the strategic orientation of an organization and to assist in making considered and informed decisions about organizational activities” (Song et al., 2017, p. 277).

As a part of the larger urban scale, also for the specific green urban infrastructure functions sport and recreation, a diverse group of stakeholder groups are involved in the governance transition in water management. It is well known that the different stakeholder groups have different values, opinions and experiences (Hendriksen, 2019). These various perspectives cause boundaries between stakeholders, that are not easy to tackle (Dewulf, 2019). In order to realise sustainable urban water management on sports fields, boundaries related to all the different stakeholders, experts, involved should be overcome. Boundary spanning refers to activities that can be undertaken to cross communication and knowledge boundaries, and contributes to coping with the different perspectives of a large number of stakeholders involved (Slob & Duijn, 2013).

3.2.3 | Data gathering and research methods

The data gathering and research methods to answer the main and sub-research questions are presented in this paragraph. A visualisation of the structure of the research project is presented in a research flow diagram, and gives an overview of the main stages in the research and the methods used. The research flow diagram is presented in Figure 2. The diagram is based on the sub-research questions, associated methods for each step are included.

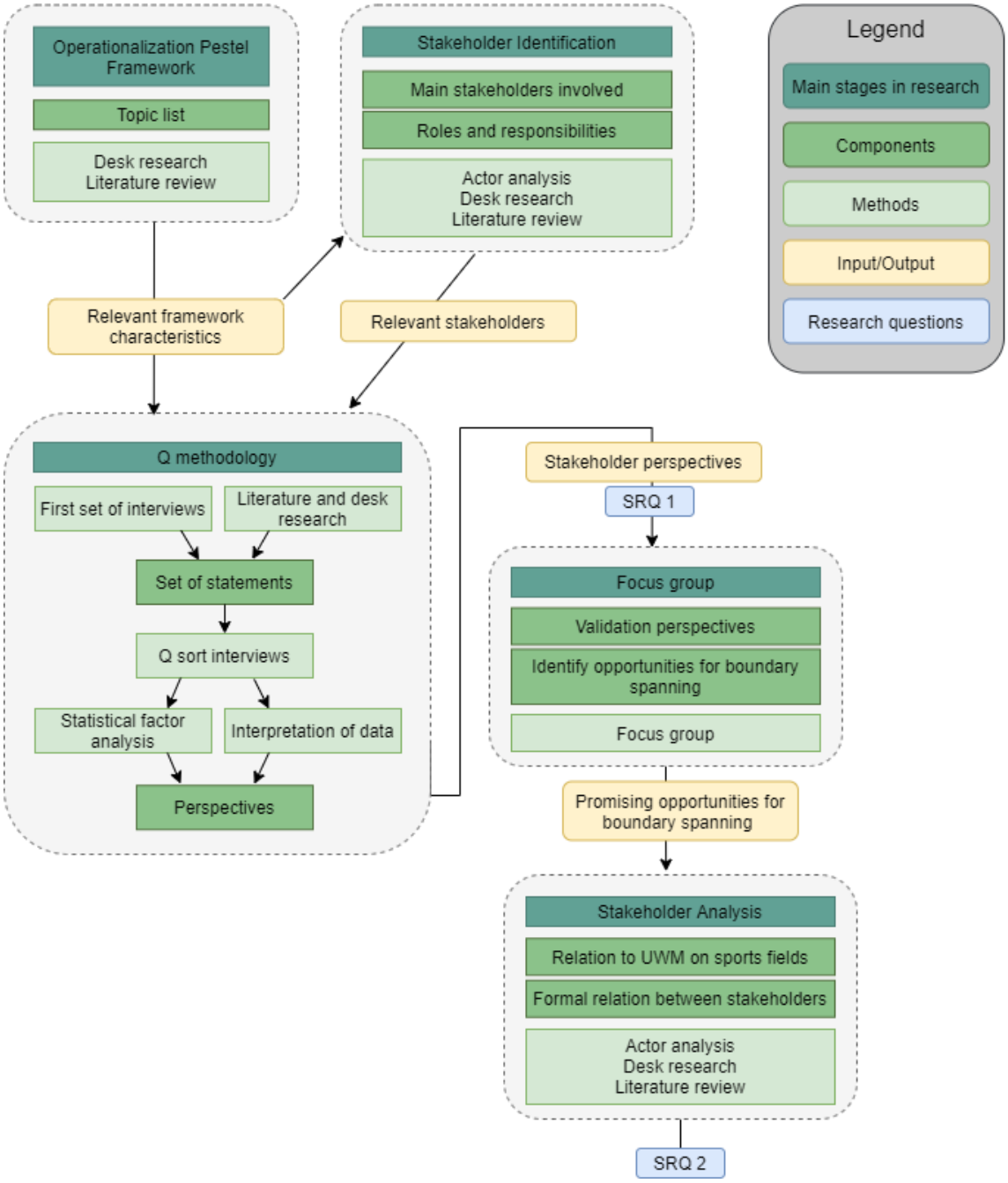

Figure 2. A visualisation of the structure of the research project (source: own image).

The aim of this research is to find what governance transitions according to relevant stakeholders contribute to ensure long term circular water availability for green urban infrastructures for sport and recreation. The transition towards SUWM is hampered by knowledge and communication boundaries between stakeholders. In order to find boundary spanning activities that ensure the realisation of a transition:

- stakeholder perspectives related to the Pestel characteristics on the transition are identified using Q methodology;
- opportunities for boundary spanning towards the transition are identified in the focus group (where is room for the transition);
- a stakeholder analysis is performed to identify relevant stakeholders, their relation to the Pestel characteristics and the relation between the stakeholders, as a bases for the identification of boundary spanners;
- the link between stakeholders and boundary spanning activities is created, to clarify what stakeholders play which role in the transition towards sustainable urban water management on sports fields.

Sub-research question 1: *What political, environmental, social, technological, economic and legal characteristics (PESTEL) are relevant from a stakeholders perspective to ensure long term circular water availability for green urban infrastructure functions sport and recreation?*

In order to answer sub-research question one, the Pestel framework is operationalized towards a topic list. The Pestel framework is used to categorize political, economic, social, technological, environmental and legal characteristics to measure the impact of sustainable urban water management. The framework is adopted as a basis for the topics that should be covered within this research. Desk research and literature review are performed as methods to operationalize the Pestel framework. A topic list is created. In the topic list, for all Pestel characteristics, topics that together cover these individual elements are designed, as well as aspects that cover these topics. These topics and aspects follow directly from the research questions and literature review. This results in a topic list, which is shown in Figure 19 and Figure 20 (Appendix B). The aspects within these Pestel elements are giving an overview of the issues/questions that come with a certain Pestel element, and are used to find where boundaries lie that hamper a transition towards more sustainable water use for urban green infrastructure functions sport and recreation.

Within the context of urban water management on sports fields, many stakeholders are involved. The first two steps of the actor analysis as described by Enserink et al. (2010) are performed to find all relevant/main stakeholders involved in the context of urban water management on sports fields and what their roles and responsibilities are. Desk research and literature review is performed to carry out the actor analysis.

Q methodology is used to identify dominant stakeholder perspectives regarding this transition. The basic method combines the collection of data in the form of Q sorts and their subsequent intercorrelation and factor analysis with the aim to understand viewpoints of relevant stakeholders in a holistic way. This way boundaries can be identified that should be overcome to realise a transition in UWM. The Q methodology combines qualitative and quantitative methods, in order to study people's 'subjectivity'. According to Watts & Stenner (2012), Q methodological research consists of six different steps. These steps are summarized and outlined in Figure 3.

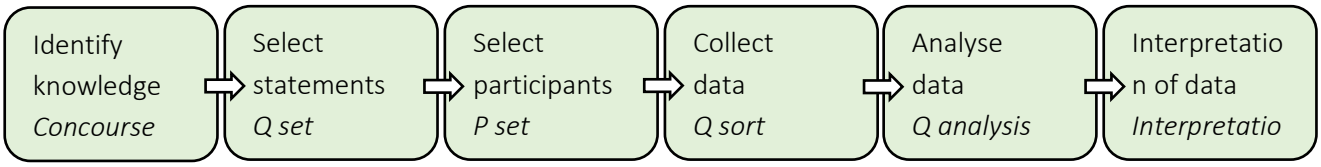

Figure 3. Six steps of Q-methodology according to Watts & Stenner (2012).

Firstly, the concourse of the study is identified. A first set of expert interviews, as well as a literature review and desk research are performed to identify the characteristics that play a role in current situation of urban water management on sports fields. These results are summarized in a set of statements. Hereafter, a second set of interviews, the Q sorts, are performed. In the Q sorts, statements are ranked and sorted by participants, to view their opinions on statements in contrast to other statements. A systematic categorization of stakeholders' perceptions is created. From the statistical analysis (a factor analysis) and interpretation of the data, main perspectives on a transition towards circular water management are defined. The distinguishing perspectives summarize the main viewpoints of a group of stakeholders.

The output of Q methodology provides an overview of the Pestel characteristics that are relevant from a stakeholders perspective to ensure long term circular water availability for green urban infrastructure functions sport and recreation.

Sub-research question 2: *What opportunities for spanning the boundaries are regarded promising by involved stakeholders to achieve a transition towards a long term circular water availability for green urban infrastructure functions sport and recreation?*

In order to answer sub-research question two, a focus group is performed, where promising opportunities for boundary spanning are identified, in order to find out which changes in urban water management are feasible to ensure long term circular water availability for green urban infrastructure functions sport and recreation. A focus group is a form of qualitative research where a group of individuals is brought together to engage in a guided discussion about a certain topic. The purpose of the focus group is to validate the results from the Q methodological research and additionally determine where there is room for spanning boundaries between stakeholders with the aim to improve water management and water usage on sports fields. The goal is to identify opportunities for a first step towards a transition to sustainable water management on sports fields, by overcoming boundaries that hamper this transition.

The third step of the actor analysis as described by Enserink et al. (2010) is performed, resulting in an overview of all stakeholders that seem to be relevant to the context of a transition towards sustainable urban water management on sports fields, their interests and influence in this context and their formal relations to other stakeholders. Based on this analysis, the roles stakeholders could take to overcome boundaries, and to realise the first steps of a transition, are identified.

The output of the identification of boundary spanning activities and the roles that stakeholders could take here provides an overview of the opportunities for spanning the boundaries, that are regarded promising by involved stakeholders, to achieve a transition towards a long term circular water availability for green urban infrastructure functions sport and recreation.
With the results from the two sub-research questions, the main research question is answered.

4

CHAPTER 4 | THEORETICAL FRAMEWORK

The theoretical framework of this research is designed by aligning the Pestel Framework to the boundary spanning concepts.

4.1 | Pestel framework

Realising sustainable urban water management is a complex issue, with many stakeholders involved, where change must take place. There is not one solution, and there is e.g. great uncertainty about what the best transition pathways would look like (Beck, 2007). Academic research is often focussed on one or two elements regarding sustainability issues. For example, Reed et al. (2008) focusses on stakeholder involvement, examining social-ecological indicators. In other situations economic and environmental elements are examined, or a policy research is conducted. This underlying research is constructed as an integrated approach to balance all elements, using the Pestel framework as a basis. This ensures the inclusion of all stakeholders involved and gives the opportunity to gain their perspectives on the larger context. The focus is on which elements related to the transition that is aimed to be effectuated seem promising and important, and which do not. If it is identified which elements create boundaries, and which ones seem to be less important in order to realise a change, there can be analysed where there is room for a transition.

The Pestel framework finds it origin in a tool for strategic planning (Aguilar, 1967). It is a model for environmental scanning for change, and is used to understand the macro-environment surrounding urban water management and the stakeholders involved (Pan et al., 2019; Thakur, 2021). In this study, the Pestel framework is implemented with the aim to indicate stakeholders' perspectives and to find where organizational boundaries lie and where these boundaries can be spanned. It is used as a basis for the topics that define the perspectives of stakeholders within sustainable urban water management for green urban infrastructure functions sport and recreation. The topics or elements of the Pestel framework give insight and overview on the characterisation of the perspectives involved. Within the Pestel framework, the elements and the relation between the elements and stakeholders in this research can be described as presented in Table 1.

Table 1. Description Pestel elements (Aguilar, 1967; Pan et al., 2019; Thakur, 2021).

Pestel element	Description
Political	Within the Political element, global, national, regional and local policy makers that play a role in or are involved in water governance on sports fields are taken into account. The focus is on decision making processes, where the roles, tasks and responsibilities are taken into account, as well as on the ambitions, what do they want to achieve. Who fulfils which role and who can decide what and why. Policy makers are part of the social element as well. They are important as they create room for transition. Policy makers can be identified as actors that are writing policy for the public matter. They are paid with tax money.
Economic	The Economic element is about income (where does money come from) and expenditure (where does money go), and is there a balance between these two. Economic elements are connected to all other element, as who makes decisions on where money goes to, who and what influences that decision and what is done with the money are all connected. Costs for construction and maintenance greatly depend on, among other things, the location of the field, the composition of the soil at place, the desired drainage system, the work supplied, the type of field, the weather, permits, etc.
Social	The Social element covers all interaction between stakeholder groups involved. It is interesting which stakeholders cooperate and which do not, as well as what these collaborations look like. Who decides or does what, why, how and when.
Technological	The focus in the Technical element is on the infrastructure of water supply. Where does the water for the sprinkling systems come from, where does water goes when there are water surpluses, and so on.
Environmental	The Environmental element includes water, energy, mobility, food, and more. However, as for this research the focus is on sustainable water management, water quantity and quality are the main objects to analyse. The focus is on sustainability on all levels, e.g. how sustainable technical systems in place are, but also where sustainability ambitions are set.
Legal	Identifying rules and procedures, looking at what is possible within the law and finding out if exceptions are made is part of the Legal element. What laws are there on a global, national, regional and local scale in the field of water use for outdoor sports fields and their playability. Policy makers are responsible for the establishment of laws.

4.2 | Boundary spanning

In order to realise the transition to sustainable urban water management on sports fields, boundaries related to all the different stakeholders, experts, involved should be overcome. These stakeholders are working for different organisations, have fragmented knowledge, use different language (jargon), have their own norms and values and have their own opinions and perspectives on how a transition should be realised (Tushman & Scanlan, 1981).

The concept of 'boundary spanning' contributes to understand how to consciously deal with the different perspectives of a large number of stakeholders involved in a situation with a boundary. Boundary spanning refers to activities that can be undertaken to cross communication and knowledge boundaries, within and between organisations (Slob & Duijn, 2013). An integrated approach should be used to ensure that individual stakeholders and their fragmented knowledge and distinguishing perspectives will be involved, and to establish supported boundary spanning activities.

The aim of this research is to find opportunities for boundary processes and objectives, in order to overcome the communication and knowledge boundaries that are there because of all the different stakeholders involved. The focus is on processes that can help spanning these boundaries. These processes lead to boundary spanning objects, and by collaboratively generating, integrating and applicating these objects, the boundaries can be bridged (Hooimeijer & van Campenhout, 2018). Star & Griesemer (1989) define boundary objects as "tangible artefacts or object-like forms of communication that inhabit several intersecting social worlds and satisfy the information requirement of each of them". Spanning boundaries with the use of boundary objects will make knowledge sharing and new knowledge creation possible, and is necessary when aiming for sustainable innovation. Boundary spanners are stakeholders that can play a role in crossing boundaries. The most important concepts within boundary spanning theory, as defined by Slob & Duijn (2013), are presented in Table 2.

Table 2. Concepts within boundary spanning theory (Slob & Duijn, 2013).

Concepts in boundary spanning theory	
Premise	Communities are separated through boundaries that hamper communication and joint action.
Boundaries	Perceived boundaries between communities that can be of a different nature (organizational, cultural, geographical, etc.).
Boundary spanning	Activities that are undertaken to cross boundaries, such as communication or joint activities.
Boundary spanning objects	Tangible products of joint activities that satisfy the involved communities, such as maps, action plans, policy notes, etc. because they contain knowledge and provoke action.
Boundary spanners	People who cross boundaries and intermediate between different communities. For instance, they are accepted in this role by the communities involved because they are "part" of the different communities.
Boundary spanning processes	Processes that are needed in order to produce the boundary spanning objects with the communities involved.

Following the boundary spanning theory and its main concepts, this research for analysing governance for urban water management should consider the following elements to realise valuable boundary spanning:

- The premise, whether there are indeed boundaries that hamper a transition
- The boundaries themselves
- The boundary spanning activities that need to be realized in order to span boundaries, based on boundary spanning processes and objects
- The role of boundary spanners

4.3 | Pestel framework and boundary spanning aligned

The concepts of boundary spanning are first made specific for the context of this research. Then the Pestel framework is used to determine/strengthen what the types of e.g. boundaries and boundary spanning objects are about, to make it more concrete.

This research studies a specific situation: a small-scale public function, sports fields, that are a part of the larger urban water system, and thus have interests both in a small-scale context as well as in a larger field. Table 3 and Table 4 represent the research done (on the base of literature) to give more insight and understanding of the boundaries withing the different elements of the Pestel.
This theoretical exercise is tested in the context of the Rotterdam sports fields case, with the aim to find out whether the premise and boundaries mentioned indeed are present in the context of water management for green urban infrastructures for sports and recreation.

There is an artificial division of the Pestel elements, meaning that if the aim is to realise a transition towards more sustainable water management, there should be a focus on all elements, and not just one. Also, as can be seen in Table 3 and Table 4, the premise and boundaries are not just part of one of the elements, they are intertwined between the different Pestel elements. For example, there is not enough knowledge on environmental innovations related to urban water management, and one of the reasons is that water is still not yet very high on the agenda. Hence, this is not only an environmental boundary, but also e.g. a political boundary, as policy could play a role in creating more awareness and ambitions to tackle these knowledge boundaries. This means that also boundary spanning activities will be overlapping these Pestel elements.

Table 3. Boundary spanning and Pestel aligned, PART I.

Boundary spanning concepts/ Pestel element	Political	Economical	Social
Premise	Policy focusses separately on each of the small-scale functions in bigger contexts. Communication and joint actions are therefore hampered.	The focus is on a small-scale, public function with interests in a larger field, dependent on public investments. Money has to be divided over all the functions within the bigger context of a municipality or province.	All different stakeholders for different organisations that are involved have different opinions and visions and ambitions related to a transition towards more sustainable urban water management.
Boundaries	There are boundaries on an organisational and spatial scale level. There is a gap between policy makers and what happens in the field, how policy is aimed to be implemented and how this is experienced by people who should act upon this policy.	This specific public function is an organization run by volunteers, which has not a lot of money and is already struggling with keeping the organisation running. Also, all individual stakeholders involved do not have the capacity, enough money to realize innovations on their own.	The boundaries lay between different stakeholders and organizations. It is difficult to work together, and maybe even to find each other, when stakeholders use different jargon, have their own cultures and ways of communicating. Organizational. There is as well a cultural boundary, as there is no consultation structure, and therefore a communication boundary between these stakeholders and others. With all those volunteers it is difficult to get into a formal platform for example.
Boundary spanning processes	It is important to search for a process that can contribute to overcome boundaries between stakeholders related to small-scale functions in a larger field. Especially in small-scale functions where many stakeholder groups are involved, examples of boundary spanning processes are: a stakeholder analysis, expert interviews, Q methodology and a focus group.		
Boundary spanning objects	Visions and ambitions	Budget	Action plans
Boundary spanners	Policy makers	Financial experts	Community based stakeholders (anyone that moves on and around the small-scale public function: e.g. people that are playing sports or doing recreational activities, and volunteers.)
Boundary spanning	The alignment with the Pestel framework shows that interests and influences between stakeholders diverge, and that depending on the transition that is aimed to be realised, but for all transitions related to small-scale public functions in a bigger field the Pestel elements are intertwined and should be all be involved, in an integrated approach, in order to realise the transition (Dewulf, 2019; Reed et al., 2008).		

Table 4. Boundary spanning and Pestel aligned, PART II.

Boundary spanning concepts /Pestel element	Technological	Environmental	Legal
Premise	New technologies are not yet implemented on a larger scale. Scaling up innovative technologies is difficult.	There is not enough knowledge on environmental innovations related to urban water management. Also, there is a lack of knowledge of the impact of the environment on a small-scale public function and how and with what impact such a functions could be integrated in a bigger context in order to make such a context more future proof.	It is difficult to change laws and regulations. This means that if the aim is to realise a transition, and definitely on a smaller scale, it is not easy to adapt legal instruments towards this transition.
Boundaries	New technologies mean that a transition has to be realised, on all areas of the Pestel elements, as these have to be implemented in society. These innovations often are risky investments, and it is always the questions who wants to take that risk, who wants to support the innovation.	Urban water management on a smaller scale is still not yet very high on the agenda (De Groene Club, 2020a; Rijksoverheid, n.d.-e).	When it comes to water, many laws are made on a European scale and do not always apply to The Netherlands specifically (Kaderrichtlijn water EU 2000). It is extra complicated since this study concerns small-scale public spaces and laws often deal with bigger contexts.
Boundary spanning processes			
Boundary spanning objects	Implementable technological innovation	Strategies	Regulations
Boundary spanners	Technological companies	Environmental research institutes	Policy makers
Boundary spanning			

5

CHAPTER 5 | METHODS

Within this chapter the methods used in this research to identify boundary spanning activities to realise a transition towards sustainable urban water management on sports fields are presented.

5.1 | Stakeholder analysis

Within this research, both qualitative and quantitative data collection methods are used. In order to perform these types of data collection, relevant stakeholders need to be identified. Based on the content of the research questions, a stakeholder analysis is carried out. For this research this means that within the Pestel framework there is aimed to find relevant stakeholders in the political, economic, technical, social, environmental and legal fields.

An analysis of all actors involved in water governance for sports fields in the municipality of Rotterdam is performed. This analysis builds on Enserink et al. (2010)., Chapter 4 "Actor Analysis, in Policy Analysis of Multi-Actor Systems". A stakeholder or actor is "a social entity, a person or an organization, able to act on or exert influence on a decision" (Enserink et al., 2010, p. 79). The aim is to identify a diverse group of relevant stakeholders, to ensure inclusiveness so that all involved stakeholder groups can share knowledge and that there is room for new knowledge creation. All the stakeholders that are found in this analysis are persons or organisations related to water governance for sports fields in the Municipality of Rotterdam in a certain way; some have a significant influence on the governance processes while others lack influence; and some stakeholders benefit, while others do not. Enserink et al. (2010) distinguishes six steps that need to be followed when performing an actor analysis (Figure 4).

1. *formulation of a problem as a point of departure;*
2. *inventory of the actors involved;*
3. *exhibiting the formal chart: the formal tasks, authorities, and relations of actors and the current legislation;*
4. *determining the interests, objectives and problem perceptions of actors;*
5. *mapping out the interdependencies between actors by making inventories of resources and the subjective involvement of actors with the problem;*
6. *determining the consequences of these findings with regard to the problem formulation.*

Figure 4. Six steps for an actor analysis performance (Enserink et al., 2010).

Stakeholder analysis methods typically focus on the dimensions of power and interests of actors. The method as presented by Enserink et al. (2010) also covers the network structure and perceptions of actors. Within this research, the network structure and the perceptions of the actors, covered by step four, five and six, are addressed by expert interviews, the Q methodology factor analysis and interpretation and the focus group, on which conclusions are based. This means that there is chosen to perform only step one, two and three for this actor analysis.

The process of identifying all relevant stakeholders is an iterative process. Throughout the research there is regularly checked whether or not the initial list of actors is still complete, whether new issues that come up require new stakeholders involved, and whether existing stakeholders have to be removed from the list as their role is not identified as relevant after all. During the research, the snowballing method is used to supplement this list. "This method is applied when it is difficult to access subjects with the target characteristics. In this method, the existing study subjects recruit

future subjects among their acquaintances" (Naderifar et al., 2017, p. 2). This form of sampling continues until data saturation is achieved.

5.1.1 | Problem formulation and inventory of the actors involved

The problem related to insufficient water management on sports fields is formulated in the introduction of this research (Chapter 1). This identified problem serves as a point of departure for this actor analysis (Enserink et al., 2010). The problem of drought touches upon multiple stakeholders and issues, matters.

With the formulated problem as a point of departure, the involved actors in this contexts are identified and their roles, responsibilities and ambitions related to water governance on sports fields are described. Literature review and desk research are used to find all relevant stakeholders involved within the boundaries of this formulated problem and the defined concepts that come with this problem. The concepts from the research questions are operationalized to formulate network boundaries, and are explained in the literature review. The actors involved play the most important role within these terms/interests.

There are multiple composed actors involved in this context. An example of a composed actor is the Dutch government. The government consists of different ministries, and in this case the Ministry of Water and Infrastructure, as well as the Ministry of Public Health, Welfare and Sports are both involved. There is chosen to include the different units of an organization as separate actors, when these units have their own roles, tasks and responsibilities when it comes to water governance and water availability on sports fields.

The stakeholders are divided in categories. The classifications used are the different spatial scales on which the actors act; Global, European, National, Regional, and Local. The inventory of all actors is supplemented with the use of expert and key informant interviews (Paragraph 5.2).

5.1.2 | Formal relations stakeholders

The third step, mapping formal relations, is based again on literature review and desk research. In addition, to gain insight in all relations, expert interviews and a focus group are used to find all dimensions of the roles of the stakeholders and the relations between the stakeholders. The extent to which the stakeholders can influence, as well as the extent to which they have interest in the different Pestel characteristics related to urban water management on sports fields is analysed. This gives more insight in the roles that stakeholders could take in the transition towards more sustainable water management. Hence, it creates a possibility to link boundary spanning activities to stakeholders, to make the transition pathways more concrete. An actor analysis map is formed, which is structured into the different classifications of spatial scales and distinguishing stakeholder groups.

5.2 | Stakeholder perspectives

Within this paragraph, the methods used to identify dominant stakeholder perspectives using the Q methodology as described by (Watts & Stenner, 2012) are explained. First the Q methodology is explained, whereafter the data collection and data analysis methods are further elaborated on.

5.2.1 | Q methodology explained

For the determination of the perspectives of the relevant stakeholders on a transition towards sustainable urban water management, and to make a first step in finding opportunities for boundary spanning activities, Q methodology is used. Q methodology has been introduced by William Stephenson in the Journal *Nature* in 1935. The basic method combines the collection of data in the form of Q sorts and their subsequent intercorrelation and factor analysis with the aim to understand viewpoints of relevant stakeholders in a holistic way (Brown, 1980b; Watts & Stenner, 2012). Q methodology combines qualitative and quantitative data generation and analysis methods. It structures the diversity of perspectives from various stakeholders by calculating variations and correlations between relevant perspectives. It provides a system of organisation and leads to holistic factor interpretations. This heavily supports the understanding of the different key viewpoints of stakeholders within the playing field of water on sports fields.

As multiple stakeholders are involved in water governance for sports fields, it is important that the experiences, values and opinions of all these stakeholder groups are captured. Q methodology facilitates a system of factor analysis that can be applied to all factors found. Stakeholders are asked to evaluate statements in relation to each other, ensuring trade-offs and revealing not only the opinions of various relevant stakeholders but also the variation and correlations in the different stages of importance. Therefore in this research Q methodology is crucial as insights in stakeholder perspectives can contribute and support to inform, improve and influence governance processes (Teisman et al., 2009; Watts & Stenner, 2012).

Q methodology studies the different viewpoints that play a role in addressing water issues. When the aim is to compare the different viewpoints of relevant stakeholders involved, the Q set can be used to get grip on the different perspectives that come with the different stakeholders, and a second study can be performed to identify what these different perspectives mean for the collaboration and decision making processes that involve these stakeholders. In this research, a focus group study is performed in order to make the step from the interpreted perspectives towards supported first steps towards a governance transition that overcomes the critical factors associated with this issue (Brown, 1996; Stephenson, 1935; Watts & Stenner, 2012).

According to Watts & Stenner (2012), Q methodological research consists of different steps. These steps are summarized and outlined in Figure 5 and will be individually discussed in the following sub-paragraphs in this chapter.

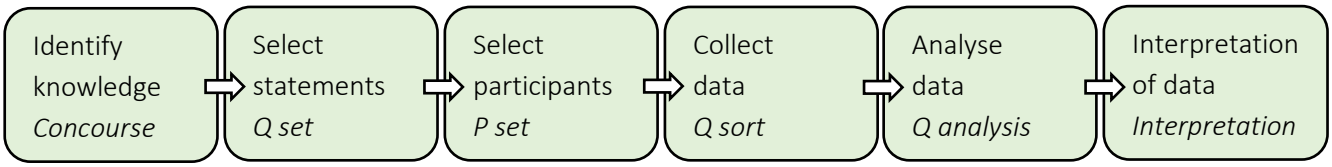

Figure 5. Six steps of Q-methodology according to Watts & Stenner (2012).

5.2.2 | Knowledge identification

The first step in Q-methodology is to generate input for the set of statements, by performing a discourse analysis, giving insight in the perspectives of involved stakeholders/individuals on boundaries that hamper a transition towards more sustainable water management on sports fields. Within the discourse analysis, expert interviews are used to fill in the topic list that is developed from the Pestel framework and the concepts in the research questions, as a basis for the statements. The topic list is further complemented by literature review and desk research (Chapter 2), to give a complete overview of the perspectives from all stakeholders for all relevant aspects in the Pestel framework. The design of the topic list is an iterative process. The topic list is presented in Figure 19 and Figure 20 (Appendix B).

An interview is a way of collecting qualitative data, and give insight into the criteria that are needed to secure long-term circular water availability for green urban infrastructures for sport and recreation. The interviews conducted are semi-structured, semi-standardized and open-ended. Purposeful sampling, meaning “sampling in a deliberate way, with some purpose or focus in mind” (Punch, 2005), is used. Expert interviews are conducted with main stakeholder groups, to gain professional knowledge. The interview design of these interviews is presented in Appendix C. There is aimed for more insight in the different stakeholder’s perspectives and visions on water management, how the different stakeholder groups work together, as well as their role division when it comes to decision making processes. Snowballing is used.

The in-depth interviews are based on selected topics in the topic list. These topics are connected to different stakeholder groups, showing possible bottlenecks and opportunities in order to identify stakeholder perspectives. The identification of various stakeholder perspectives is crucial to steer a governance transition towards possible changes of securing long term circular water availability on sports fields (Brown, 1996; Watts & Stenner, 2012).

Additional literature review shows that stakeholder perspectives on change routines can hamper sustainable transition (Chapter 2). Therefore, it is important to pinpoint the bigger picture, to confront stakeholders with a broader view of the problem. The knowledge is based on different special scales, for example sports fields, cities and regions; different stakeholder groups; and together with the aspects of the Pestel framework, the topic list covers the whole range of possible perspectives on urban water management on sports fields.

Fifteen expert interviews are conducted, where the point of saturation was leading to ensure various expert views were covered, ensuring a more complete overview of the knowledge Table 5.

Table 5. Overview expert interviews concourse.

Organisation	Function within organisation
Evides Waterbedrijf	Advisor Strategy
Field Factors bv	Commercial Director
De Groene Club (KNVB)	Sustainability advisor / Project manager
Hoogheemraadschap Delfland	Community Manager Climate Adaptation
Province of South Holland	Program manager climate adaptation
	Senior policy advisor
Newae – Adviseurs & Ingenieurs voor de buitenruimte	Projectmanager Sport / Recreation / Greenery
R.C.S.V Zestienhoven	Board Member Seniors / Technical Affairs \ Playing Member
R.V. & A.V. Steeds Hooger	Board member general affairs
Sportbedrijf Rotterdam	Project Manager
STOWA	Program Manager
Van der Meer BV	Company manager / Project manager
Van Oosten Beregeningssystemen	Technical Director

Key informant interviews with several organisations (Table 6) are conducted as well. The purpose of these interviews is to collect information from a wide range of organisations who have first-hand knowledge about the community (Punch, 2005).

Table 6. Overview key informant interviews concourse.

Organisation
GGD Rotterdam-Rijnmond
Golfbaan De Hooge Rotterdamsche
KNHB
KNVB
Nederlandse Golf Federatie (NGF)
NOC*NSF
Rugby Nederland
Vereniging Sport en Gemeenten

The results from the expert interviews and the desk research and literature review are used as input for designing the statements in the second step of Q methodology (Paragraph 5.2.3).

5.2.3 | Statement selection

The expert interviews provide stakeholder perspectives on the transition towards more sustainable water management. From this overview, a set of 93 statements is composed. This is done by identifying all subject matters that are discussed and listing all the statements made by stakeholders on the topics that are identified as relevant in the topic list. Overlap between similar statements is merged. Matters that were not yet involved in the topic list but that were mentioned by multiple stakeholders as important were included as well.

The 93 statements reflect the diversity of the stakeholder's viewpoints. The first Q set is based on these statements. Because the Q set must be balanced, all statements are either positively or

negatively formulated. This balance will ensure that the results of the Q sort can be statistically analysed.

The set of 93 statements is reduced to a set of 27 statements. Reducing is done by:

- Merging overlap between similar statements and selecting the most relevant statements. Hence, the number of statements is reduced to a manageable number, while still making sure that these statements are fully reflecting the diversity of the different perspectives. When possible, the wording of the statements is kept as close as possible to the initial wording, and thereby the original meaning of the stakeholder's perspectives. The statements are written in a promising way, rather than as a barrier, are short and capture one opinion, not a fact.
- Ensuring equal representation of the six Pestel elements. Each Pestel element covers four to five statements. As the statements cover all aspects from the topic list; and the aspects cover the topics; and the topics cover the Pestel elements; and the Pestel elements cover the research questions; it is guaranteed that the research questions are covered by the statements and therefore can be answered after the research is carried out.

Stakeholders represent various societal and expert groups with different backgrounds and knowledge. In order to make sure that all statements are understandable for all stakeholder groups, common language is used. Also, the statements are compared to statements in national and regional newspapers. A pre-test has been carried out.

The final set of statements is presented in Table 7. The original set of statements, in Dutch, is added in Table 29, Appendix D.

Table 7. Statements in Q set.

Theme		Statement
Political	1	Current policy is not regarded as an obstacle for the implementation of innovations.
	2	It is clear who has what responsibility for problems related to drought and flooding of sports fields.
	3	Criteria used in tenders for sports fields generally offer room for sustainability.
	4	A sports club is being involved in policy-making processes for a sports field.
Economic	5	There is sufficient external financial support to take sustainability measures as a sports club.
	6	The Municipality of Rotterdam makes a sufficient budget available for water-related sustainability initiatives.
	7	Irrigation of sports fields with surface or ground water is relevant to the total budget of a sports club.
	8	Drought on sports fields leads to long-term economic damage.
	9	The consequences of drought on a sports field can be expressed in monetary terms.
Social	10	Sports clubs compare themselves to other sports clubs when it comes to sustainable water management.
	11	In The Netherlands, preventive action is taken when it comes to climate change.
	12	All stakeholders are needed to realize a transition to circular water management on sports fields.
	13	Sports club members play an important role in making a sports club more sustainable.
	14	Sports clubs play a pioneering role in the transition to circular water management on a sports field.
Technological	15	Replacing natural grass and hybrid sports fields by artificial grass or water fields solves all water related problems on sports fields.
	16	Pilots are very important in the transition to sustainable usage of water on sports fields.
	17	Collecting and reusing water for irrigating sports fields is a good solution to prepare sports fields for drought.
	18	Water management in the Municipality of Rotterdam is transparent.
	19	Drought is a challenge for ensuring optimal playability of a sports field all year round.
Environmental	20	The Municipality of Rotterdam is increasingly suffering from drought.
	21	The quality of the water used for irrigating the sports fields has no influence on the health of the users of the sports fields.
	22	The quality of the water used for irrigating the sports fields has no influence on the quality of the sports field.
	23	Sports fields in cities present an opportunity to cope with the effects of climate change.
	24	I am fully aware of the effects of drought on a sports field.
Legal	25	Public organizations ensure better water management in The Netherlands by financing climate adaptive measures on private territory.
	26	Rules are needed regarding the quality of the surface water and groundwater for the irrigation of sports fields.
	27	Regulations ensure circular use of water on sports fields.

5.2.4 | Participant selection

The third step in Q methodology is to identify the relevant group of stakeholders, which is referred to as the P sample. Purposeful sampling is used to cover as many different perspectives as possible. The P sample is based on the stakeholder identification (Appendix J). There is aimed for purposeful sampling 'directed at representativeness' (Punch, 2005). The most relevant stakeholders are selected. Because of COVID-19, one group the users of the sports fields, are lacking. The final P sample is presented in Table 8.

Table 8. Overview P sample.

Organisation	Function within organisation
Evides Waterbedrijf	Advisor Strategy
Field Factors bv	Commercial Director
Municipality of Rotterdam	Advisor Climate Adaptation
Municipality of Rotterdam	Advisor Climate Adaptation & Urban Water
Municipality of Rotterdam	Process Manager Rotterdams Weerwoord
Municipality of Rotterdam	Program Manager Rotterdams Weerwoord
Municipality of Rotterdam	Neighbourhood Manager \ Outdoor Space Manager
H2Óke Water en Gezondheid Advies	Consultant / Owner
Hoogheemraadschap Delfland	Community Manager Climate Adaptation
KNHB	Senior Employee Accommodations
KWR	Project Manager Fresh Water Availability
R.C.S.V Zestienhoven	Board Member Seniors / Technical Affairs \ Playing Member
Rotterdam Sportsupport	Association Consultant Accommodations & Catering
Sportbedrijf Rotterdam	Project Manager
Stichting RIONED	Program Manager Knowledge Development
STOWA	Program Manager
Tu Delft	Associate professor
Van Kessel Sport en Cultuurtechniek bv	Consultant / Project Manager
Van Oosten Beregeningssystemen	Technical Director

The developed statements (Paragraph 5.2.3) and the participant selection (Paragraph 5.2.4) form the basis for the fourth step of Q methodology, the Q sort interviews.

5.2.5 | Collection of Q sort data

The Q methodology combines qualitative and quantitative methods, in order to study people's 'subjectivity'. Using the Q set and the P sample, the Q sorts can be performed. In the Q sorts, statements are ranked and sorted by participants, to view their opinions on statements in contrast to other statements. A systematic categorization of people's perceptions is created.

The statements are ranked on a scale from most agree to most disagree, showing the viewpoints of stakeholders. In this way critical factors for the transition towards more circular water governance based on respondents' perspectives are identified. The Q sort interviews exist of two steps. Firstly, respondents divide the statements into three categories: disagree, neutral and agree (Figure 6).

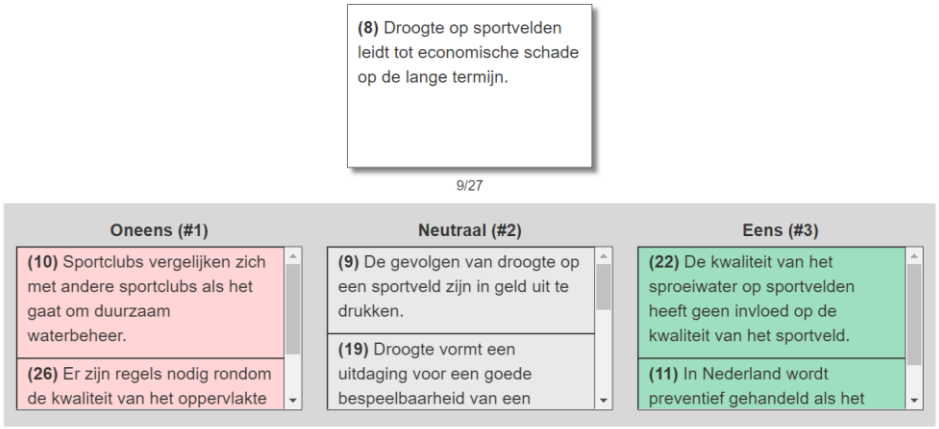

Figure 6. First step Q sort. Dividing the statements: agree, disagree, neutral (source: own image).

Secondly, the statements are ranked by sorting them on the Q sorting grid, of which an example is shown in Figure 7. The statements valued agree are ranked from most agree (+4) to the left, and the statements valued disagree are ranked from most disagree (-4) to the right. The neutral statements are ranked in the remaining boxes between the agree and disagree statements.

Figure 7. Second step Q sort. Ranking the statements in the Q-sorting grid (source: own image).

The Q sorting task is part of an interview. Participants are asked to motivate their sorting choices. The interviewer facilitates the interview process, by asking questions about motivation and ranking. Not only the 'what do you think', but also the 'why do you think this' is covered.

The interviews are conducted in July and August 2020. Because of COVID-19, all interviews are conducted online. An online tool is set up in which the respondents can sort the statements during an online, face to face interview. How this tool is set up is presented in Appendix E.

Interview design

The Q sort interview is divided into 7 steps.

1. Prior to the interview:
   The participants are asked to watch a 2 minute YouTube video (Hoogheemraadschap van Delfland, 2018) prior to the interview. This video gives an explanation of the Urban Water Buffer (UWB) in Spangen, Rotterdam. In the statements terms such as circular water management, innovations and sustainability measures or initiatives are mentioned. This video shows an example of how these terms should be interpreted, on which special scale the innovations take place. The focus is on a solid system that offers possibilities for filtering and storing water for reuse, in this case for irrigating sports fields. Multiple stakeholders are involved.
2. Short introduction to the topic:
   Suppose we are aiming for future proof solutions for water management on sports fields to ensure sufficient playability. The focus of this interview is to discover your opinion about critical factors to realise this transition.
3. Background information:
   The participants are asked to what extend they are familiar with circular water systems, as well as their role within the organisation they work for.
4. Introduction to ranking:
   The participants are asked to take into account the following two points:
   a. Rank the statements based on your expertise.
   b. Think aloud.

5. Instruction on ranking the statements:
   Step 1: Do you agree, disagree, or are you neutral on the following statements.
   Step 2: To what extent do you agree or disagree with the statements.

6. Framework during the interview:
   a. Expert knowledge about the current situation, the need and desire for a transition, responsibilities and realisation of this transition.
   b. Specifically, for step 2, the focus is on the statements ranked as +4, +3, -3 and -4.
7. Completion of the interview:
   a. Additional comments.
   b. Snowball method to identify new stakeholders

The full interview design is presented in Appendix F.

5.2.6 | Analysis of Q sort data

The data from the Q sorts is analysed using a factor analysis. The factor analysis is carried out in the online tool Ken-Q (Banasick, n.d.-b). The factor analysis is a statistical reduction technique, with the aim to find distinguishing perspectives on the topic of sustainable water governance on sports fields. Clusters are designed, that include statements that are highly similar in their rankings, showing high correlation.

The factor analysis consists of five steps, which are presented in Figure 8. The methodology and results of each step are further elaborated in this paragraph. Additional information on the calculations and decisions made in the factor analysis is presented in Appendix G.

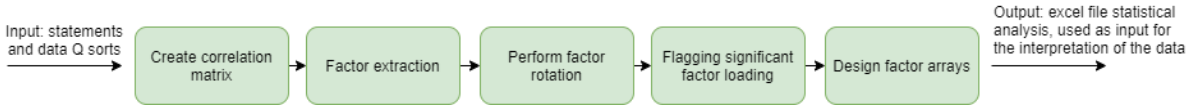

Figure 8. Five steps of factor analysis and the in- and output (source: own image).

Correlation matrix

The input for the factor analysis is the set of 27 statements and the data from the Q sorts. The correlations between the Q-sorts of all 19 participants is calculated. This results in a 19 by 19 matrix, the correlation matrix, which is shown in Appendix G, Table 31. The average correlations between the Q-sorts give more information on the heterogeneousness of the participants in terms of their ideas and opinions about circular water management on sports fields. The correlation matrix reflects the nature and extent of the relationships that pertain among all the Q sorts in a data set.

Factor extraction

The second step in the factor analysis is the factor extraction. Performing a factor extraction, patterns of similarity in the correlation matrix are identified. Factor extraction involves the identification and removal of distinct portions of common variance from the correlation matrix. This means that the first pattern of similarity found, which is then referred to as Factor 1, is removed from the correlation matrix. Hereafter, a new group of similarities is found (Factor 2), which is then as well removed, and so on. Until there is no new variance identified.

Seven different factors are extracted, as is suggested by (Brown, 1980a) as a good number to start with. For each of the factors, factor loadings show to what extend an individual participant embodies, is typical of that factor. The higher the factor loading, the more the Q sort exemplifies with the factor. The factors and the factor loadings per participant, so per Q sort, are shown in Appendix G, Table 33. In this table, also the eigenvalues (EV) and the percentage explained variance are shown per factor. These numbers show how much percentage of the variance in the data is explained by this specific factor, providing an indication of the strength and potential explanatory power of an extracted factor.

In order to decide how many factors are extracted and used in the next step, the factor rotation, both the statistical analysis and the interviews are taken into account. The eigenvalues and variances give a good indication of relevant factors. The interviews are reflected upon in order to see whether the different factors indeed seem to be different ‘enough’ to be taken into account as distinctive factors. Table 9 shows the most common methods to statistically calculate the number of factors extracted.

Table 9. Methods and criteria factor extraction.

Method	Criteria for a factor to be extracted	Amount of factors extracted following this method
Kaiser-Gutman	Eigenvalue (EV) > 1	Factors 1, 2 *and 3*
Significant factor loadings	2 or more significant factor loadings of 0.50	Factor 1
Humprey's rule	Cross product of two highest loadings > 2x SE Standard error (SE) = 0.19; 2 x Standard error = 0.38	Factor 1
Humprey's rule less strict	Cross product of two highest loadings > SE Standard error (SE) = 0.19	Factors 1, 2 and 3
Scree test	Make scree plot, number of factors until slope changes	Factors 1 and 2

The Kaiser-Gutman method, suggesting that all factors with an EV of more than 1 should be extracted, is a commonly used criterion. However, it may lead to the extraction of too many factors, but this seems to be more a problem when working with bigger data sets. As can be seen in Table 33 (Appendix G), Factor 1, 2 and 3 have an EV higher than 1. These three factors explain 50 % of the variance found in the data, the fourth factor would only add 1 extra percent. Hence, there is chosen to extract the first three factors from the list of factors found. The results of the interviews support this decision.

Factor Rotation

The third step in the factor analysis is the factor rotation. The aim of factor rotation is to find the best representative viewpoints for the perspectives, ensuring that each factor proposes the most meaningful angle from which to view the subject matter. The different factors are torn apart to see if there really are differences in the key viewpoints, and if so, how the factors that come with these differences look like. There are two ways to perform a factor rotation. The first is by means of a judgemental rotation, which is a by-hand method. The second method is a varimax rotation, which means the computer tool performs a mathematical calculation to find an optimum. Judgemental rotation is a skill that comes with practice, and difficult when the study is exploratory. It is used to project qualitative knowledge from interviews on qualitative data, when for example some Q sorts have a bigger influence in real life than others, to rotate the factor in such a way that these Q sorts represent a bigger part of the factor than others. As this research is an exploratory research, aiming to take into account the value of the viewpoints of all participants equally, there is chosen to perform a varimax rotation. With the varimax rotation, the aim is to cover as much of the study variance as possible, trying to ensure that each Q sort has a high factor loading in relation to one specific factor. A visualisation of a factor rotation is shown in Appendix G, Figure 21.

Significant factor loadings

The varimax factor rotation results in a rotated factor matrix (Appendix G, Table 34). This matrix shows the final factor loadings of each Q sort on each factor after rotation. A factor loading is significant when the viewpoints of the participant are significantly equal to the factors' representation. The significant factor loadings establish which Q sorts belong to what factor, and which Q sorts do not belong to any of the factors.

The calculation used to determine whether a factor loading is significant is shown in Figure 9. A P value of 0.05 is used. When a factor loading is higher than 1 divided by the square root of the amount of statements, times 1.96 (which is 0.38 in this case), the factor loading is significant.

$$1.96 * \frac{1}{\sqrt{amount\ of\ statements}} = 0.38$$

Figure 9. Calculation significant factor loadings (Watts & Stenner, 2012).

Factor arrays

The last step in the factor analysis is the design of the factor arrays. A factor array is "a single Q sort configured to represent the viewpoint of a particular factor" (Watts & Stenner, 2012, p. 137). To design a factor array, first a factor estimate is calculated. The factor estimate is an estimate of a factor's viewpoint, based on the weighted average of all Q sorts that belong to a factor. The contribution of each Q sort to the factor is weighted according to the Q sorts factor loading. The higher a factor loading of a Q sort, the greater the contribution of this Q sort to the factor. The weighted score for each of the Q sorts is converted to a standard score, on which the factor array is based. The final factor arrays for Factors 1, 2 and 3 are presented respectively in Figure 22, Figure 23 and Figure 24 (Appendix H).

The output of the factor analysis is presented in an excel file, which is used for the interpretation of the data (Paragraph 5.2.7). The data in this file shows the factor arrays of each of the factors, and gives statistical comparisons between the factors regarding which statements the stakeholders in one factor have ranked very different in relation to the ranking from stakeholders in another factor, and where stakeholders have ranked statements more or less similar. This can respectively be interpreted as where the viewpoints of the stakeholders related to the factors seem to differ most, and where there seems to be a consensus in the way the stakeholders see the transition towards sustainable urban water management. The quantitative data is combined with the qualitative data from the interviews, which shows the stakeholders' underlying explanation of why they have ranked the statements in a particular way. The factors are interpreted with the use of the qualitative interviews, which results in a detailed overview of the key characteristics per group of stakeholders that belongs to each of the factors.

5.2.7 | Data interpretation

The final step in Q methodology is the interpretation of the data. The clusters of distinguishing factors that are designed with the use of the statistical factor analysis are interpreted. The interpretation is carried out by a content analysis of the interview. The interpretation of a factor is called a perspective. The key viewpoints discussed in the interviews are evaluated. Key characteristics are identified and implemented to develop three distinguishing perspectives that give insight in the different stakeholder views on the current situation and on how the overall goal of year-round playability of sports fields could and should be accomplished. The perspectives summarize the main viewpoints of a group of stakeholders. The division of the stakeholders over the three different perspectives is presented in Table 10.

Table 10. Division stakeholders over factors.

Perspective 1			Perspective 2			Perspective 3		
Nr	Organisation	Factor loading	Nr	Organisation	Factor loading	Nr	Organisation	Factor loading
7	Stichting RIONED	0.8132	4	Municipality of Rotterdam – *Advisor Climate Adaptation*	0.7536	6	Municipality of Rotterdam – *Process Manager Rotterdams Weerwoord*	0.8332
15	Municipality of Rotterdam - *Neighbourhood Manager \ Outdoor Space Manager*	0.6244	12	Van Kessel Sport en Cultuurtechniek	0.7037	17	KWR	0.7083
19	Municipality of Rotterdam - *Advisor Climate Adaptation & Urban Water*	0.5722	18	Sportbedrijf Rotterdam	0.6474	14	Van Oosten Beregeningssystemen	0.704
10	H2Óke Water en Gezondheidsadvies	0.5685	16	KNHB	0.6423	3	Hoogheemraadschap Delfland	0.5506
1	Evides Waterbedrijf	0.5317	8	R.S.C.V Zestienhoven	0.5888	13	Municipality of Rotterdam – *Program Manager Rotterdams Weerwoord*	0.5463
			5	Field Factors bv	0.4123	9	Rotterdam Sportsupport	0.404

As can be interpreted from the correlation matrix (Table 31, Appendix G), there are no negative correlations between any of the stakeholders, meaning that none of the stakeholders have a very contradictory view on how a transition towards sustainable water management on sports fields should look like. So, there is a certain degree of consensus, however there are also a few very low correlations, e.g. the correlation between Q sort 8 and Q sort 9 (r = 0.07), meaning that there is little correlation between the viewpoints of these stakeholders.

The three perspectives developed in the factor analysis, that are further elaborated on in Paragraph 6.2, are distinguishing perspectives, summarizing the key viewpoints of a group of stakeholders. The aim is to interpret the three distinguishing perspectives by looking at the distinguishing statements, which are the statements that distinguish the most between one factor and the other factors, as these indicate how a factor is different from the other factors. However, one perspective does not exclude another perspective, meaning that if a stakeholder identifies most with one perspective it does not mean that this stakeholder cannot identify with characteristics of another perspective. Because of all positive correlations between the Q sorts, it will be likely that stakeholders will identify

with more than one perspective, and that the viewpoints in a perspective are not fully opposite to those in another perspective.

Table 11 shows an overview of the Q sorts that score significantly on a specific factor. The Q sort numbers are related to a certain stakeholder, of which an overview is presented in Table 32 (Appendix G). As can be seen in the rotated factor matrix in Table 34 (Appendix G), Q sorts 2 and 11 seem to possess a significant factor loading in relation to more than one of the factors, and are therefore said to be confounded (Watts & Stenner, 2012). These Q sorts will therefore not be used in the construction of any of the factors estimated.

Table 11. Q sorts with significant factor loadings.

Factor number	Q sort numbers	Total	Cumulative total
1	4, 5, 8, 12, 16, 18	6	6
2	1, 7, 10, 15, 19	5	11
3	3, 6, 9, 13, 14, 17	6	17

5.3 | Spanning boundaries towards the transition

The overarching aim of this research is to explore the boundaries and boundary spanning activities that could be implemented to achieve a transition in water governance that ensures sufficient playability of sports fields throughout the entire year. The purpose of the focus group in this research is to validate the results from the Q methodological research and additionally determine where there is room for boundary spanning to improve water management and water usage on sports fields. The goal is to give advice on what a first step towards a transition to sustainable water management on sports fields, and thus what boundary spanning activities could look like.

5.3.1 | Focus group introduction

A focus group is a form of qualitative research where a group of individuals is brought together to engage in a guided discussion about a certain topic (Silverman, 1998). In this study a focus group has been carried out following the design and interpretation of the perspectives which are based on the factor analysis of Q methodology. A focus group enables a better understanding of possible pathways towards the future of circular water management, including the role of different stakeholders and alternative system designs.

Within the focus group the different viewpoints of the perspectives towards the transition to sustainable water management on sports fields are presented. The purpose is to confront the experts, who have all participated in the interview phase, with the results from the perspectives analysis and determine whether they identify themselves with certain perspectives. This is generally known as sense making, and it additionally provides a platform to start the discussion on how these perspectives are viewed by the different stakeholders, how these viewpoints can be aligned and possibly combined. Eventually the aim is to ensure that sports fields remain playable as much as possible in the future. This is regarded as an overarching ambition for all stakeholders.

The perspectives obtained from the Q methodology are used in the focus group. These perspectives give insight in the different views on the current situation and on how the overall goal of year-round playability of sports fields could and should be accomplished, according to the stakeholders. How the stakeholders within a certain perspective view the current situation among the playability of and water governance on sports fields, becomes clear from the interpretation of the Q methodology.

5.3.2 | Focus group design

The goal of the focus group is to validate the results from the analysis of the Q sorts, and additionally facilitate a discussion to determine in more detail what initial steps and opportunities for the transition to circular water management could be. The setup of the focus group is presented in Table 12. The two main parts of this focus group setup are:

- the presentation of the research approach and the perspectives
- the discussion: divided into a discussion per perspective in breakout rooms and a plenary discussion.

The results from the discussion and stakeholders' answers to additional polls during the presentation are used to validate the perspectives. The results from the discussions are also used to design opportunities for sustainable water management on sports fields.

Table 12. Structure of the focus group.

Structure	More detail
Welcome	All stakeholders introduce themselves, state with which perspective they identify most (after reading the short introduction to the perspectives they received in their mail) and the goal of the focus group is presented.
Presentation	5 minutes introduction of the research.
	Presenting perspectives: what are the three main perspectives developed, on what viewpoints do show similarity, and where do viewpoints substantially differ.
	Polls: - Do you indeed agree on the three presented key viewpoints the stakeholders all seem to agree on? - With which of the three perspectives do you identify most?
Discussion	Break out rooms: find must-have's and nice-to-have's per perspective. What are the fundamentals of my perspective, the no-go's, the things I won't compromise on. What are nice-to-have's, if I had to make a trade-off, where would I compromise on.
	Plenary: where do we see opportunities. Evaluation discussion in break out rooms: - Must have's - Nice to have's - Reflection on recognizability perspective Discussion on opportunities
Closing	The final steps of this thesis research are discussed

All participants of the Q sort interviews were invited to participate in the focus group. Thirteen stakeholders were able to participate. The results from the focus group are deemed valid since these stakeholders cover all relevant stakeholder groups, they represent the stakeholders with high factor loadings, and they are evenly distributed over the perspectives.

Table 13 gives an overview of all stakeholders that participated in the Q sort interviews. The stakeholders that participated in the focus group are highlighted in bold. Each stakeholder is linked to the perspective that showed the highest correlation, based on the statistical factor analysis (see Paragraph 5.2.6). The Factor loading column is added to show to what extend they are correlated (1 being the highest possible correlation).

The focus group was organized on November 27th, 2020. Invitations were sent to participants beforehand by email (Appendix I). Due to the Covid19 situation it was necessary to organize an online meeting. Microsoft Teams was used as online communication platform and the focus group meeting was facilitated by Martine Rutten. A total of 13 stakeholders participated, of which 4 did not (fully) participate in the plenary discussion: TU Delft; Hoogheemraadschap Delfland; Municipality of Rotterdam – Advisor Climate Adaptation and Urban Water; Municipality of Rotterdam – Process Manager Rotterdams WeerWoord.

Table 13. Participants focus group.

Perspective	Organisation	Factor loading
Field Focus	Stichting RIONED	0.8132
	Municipality of Rotterdam - *Neighbourhood Manager \ Outdoor Space Manager*	0.6244
	Municipality of Rotterdam - *Advisor Climate Adaptation & Urban Water*	0.5722
	H2Óke Water en Gezondheidsadvies	0.5685
	Evides Waterbedrijf	0.5317
Water Wise	Municipality of Rotterdam – *Advisor Climate Adaptation*	0.7536
	Van Kessel Sport en Cultuurtechniek	0.7037
	Sportbedrijf Rotterdam	0.6474
	KNHB	0.6423
	R.S.C.V Zestienhoven	0.5888
	Field Factors bv	0.4123
Urban Ultra	Municipality of Rotterdam – *Process Manager Rotterdams Weerwoord*	0.8332
	KWR	0.7083
	Van Oosten Beregeningssystemen	0.704
	Hoogheemraadschap Delfland	0.5506
	Municipality of Rotterdam – *Program Manager Rotterdams Weerwoord*	0.5463
	Rotterdam Sportsupport	0.404
Not applicable	STOWA	-
	TU Delft	-

6

CHAPTER 6 | RESULTS

This chapter presents the results of this research. The stakeholders that play a role in the context of urban water management on sports fields are identified, and the extent to which they can influence as well as to which they have an interest in a transition towards sustainable urban water management is analysed. The boundaries that hamper the transition are identified and validated, and boundary spanning activities that are regarded promising by relevant stakeholders related to a transition towards a long term circular water availability for sports fields are designed. The roles and responsibilities that stakeholders could take in these boundary spanning activities are analysed.

6.1 | Stakeholder perspectives on transition

Within this paragraph, the stakeholders that play a relevant role in the context of water management on sports fields in Rotterdam are identified. The viewpoints of these stakeholders can be summarized in three distinguishing perspectives, where some stakeholders identify more with one perspective and other stakeholders identify more with another perspective. Differences and similarities in the viewpoints are identified, that respectively result in more insight in possible boundaries for a transition as well as in opportunities for boundary spanning.

6.1.1 | Stakeholder identification

The relevant stakeholders identified for urban water management on sports fields in the Municipality of Rotterdam, as well as their roles, responsibilities and ambitions related to sports, urban water management and climate adaptation are presented in Appendix J. An overview of the relevant stakeholders and the scale they act upon is presented in

Figure 10.

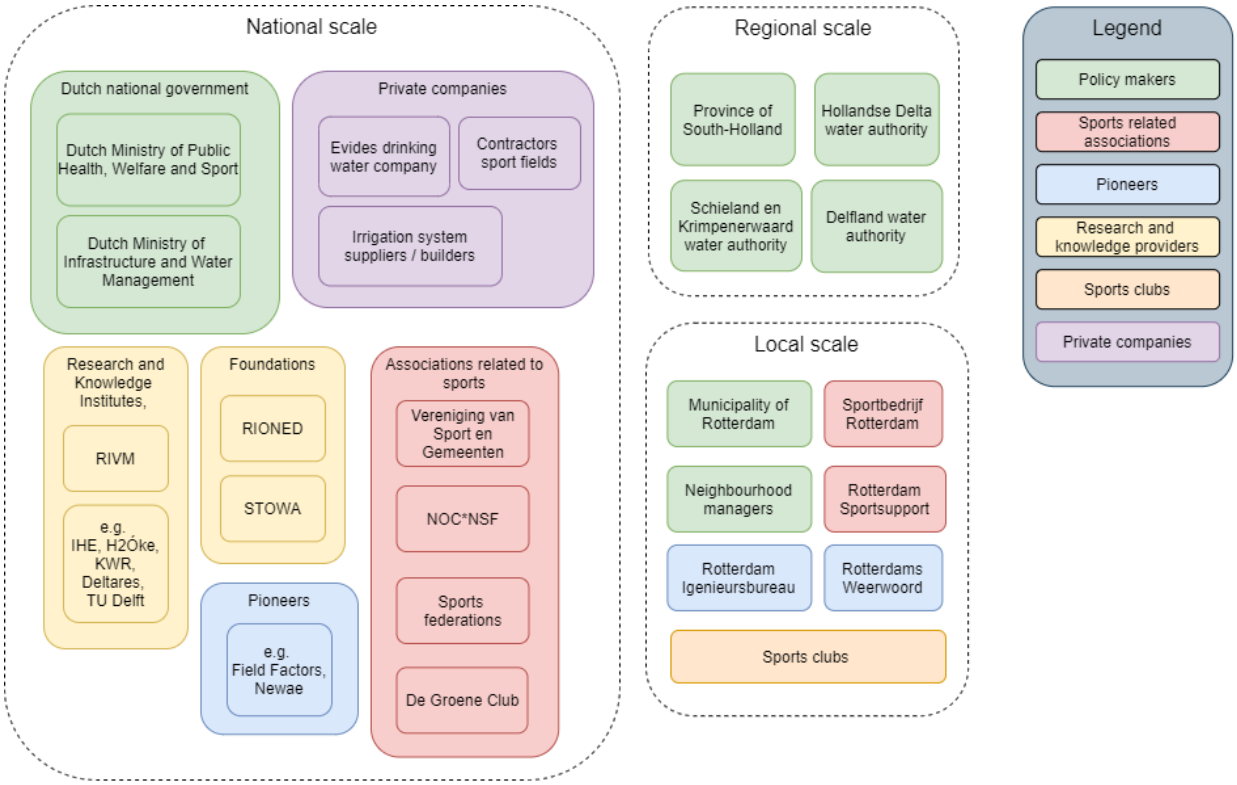

Figure 10. Overview of relevant stakeholders (source: own image).

6.1.2 | Three perspectives

Within the context of water on sports fields, three main perspectives on a transition towards circular water management are defined (Figure 11). These three perspectives are respectively *Field Focus*, *Water Wise*, and *Urban Ultra*. The different perspectives summarize the main viewpoints of a group of stakeholders. The three perspectives and their characteristics based on the Pestel elements are explained in more detail underneath.

Figure 11. Three perspectives (source: own image).

Perspective 1. Field Focus

The *Field Focus* perspective has a focus on the sports field and is characterized by an inside-out reasoning from the stakeholders' position. The emphasises lies on the opportunities and challenges related to the sports field and from this starting point find relevant opportunities outside the sports fields to relate to.

This perspective summarizes the main viewpoints of five specific stakeholders (Table 14).

Table 14. Stakeholders in Perspective 1: Field Focus.

Q sort number	Organisation	Factor loading
7	Stichting RIONED	0.8132
15	Municipality of Rotterdam - *Neighbourhood Manager \ Outdoor Space Manager*	0.6244
19	Municipality of Rotterdam - *Advisor Climate Adaptation & Urban Water*	0.5722
10	H2Óke Water en Gezondheidsadvies	0.5685
1	Evides Waterbedrijf	0.5317

The main viewpoints are:

- Political — Preventive action is important
- Social — All stakeholders needed
- Technological — Pilots are important, the more the better
- Environmental — Effects of drought on sports fields and the impact of using water differently must become clear
- Legal — Motivation for transition based on own ambitions

According to this perspective all stakeholders are needed for a transition to circular water management on sports fields. The quality of the water used for irrigation must be given more attention, which requires many pilots. The focus must be on stimulation rather than regulation.

Perspective 2. Water Wise

The *Water Wise* perspective is characterized by the approach of initially finding and analysing possible solutions for a sustainable water supply and consecutively relate these to the sports fields. Combinations with water problems in the surroundings of a sports field are included in this approach. This perspective summarizes the main viewpoints of six specific stakeholders (Table 15).

Table 15. Stakeholders in Perspective 2: Water Wise.

Q sort number	Organisation	Factor loading
4	Municipality of Rotterdam – *Advisor Climate Adaptation*	0.7536
12	Van Kessel Sport en Cultuurtechniek	0.7037
18	Sportbedrijf Rotterdam	0.6474
16	KNHB	0.6423
8	R.S.C.V Zestienhoven	0.5888
5	Field Factors bv	0.4123

The main viewpoints are:

- Political First step transition by municipality and sports club
- Economical Municipality must free up more budget
- Technological Combination with water problems in the surroundings of sports fields
- Environmental Focus on collecting and reusing rainwater on sports fields to guarantee playability of fields
- Legal Regulations concerning the quality and quantity of water required

According to this perspective large steps should be taken when it comes to securing more sustainable water management on sports fields. The initiative for the first step in this transition lies with the municipality and the sports club, while regulations regarding the quality and quantity of water use are needed. There is a need to work on a broader scale, looking at combinations with water problems in the surroundings of sports fields, and additionally approaching the problem nationwide and work in a structured way, securing that knowledge can be transferred faster and better.

Perspective 3. Urban Ultra

The *Urban Ultra* perspective approaches and envisions sports field as a part of the city, and relates to questions about how sports fields can be integrated to solve problems in the city. It is about a connection that goes beyond water use on sports fields, and deals with for example urban heat stress issues. An integrated urban approach is key. This perspective summarizes the main viewpoints of six specific stakeholders (Table 16).

Table 16. Stakeholders in Perspective 3: Urban Ultra.

Q sort number	Organisation	Factor loading
6	Municipality of Rotterdam – *Process Manager Rotterdams Weerwoord*	0.8332
17	KWR	0.7083
14	Van Oosten Beregeningssystemen	0.704
3	Hoogheemraadschap Delfland	0.5506
13	Municipality of Rotterdam – *Program Manager Rotterdams Weerwoord*	0.5463
9	Rotterdam Sportsupport	0.404

The main viewpoints are:

- Economical + Social — Tackle drought on sports fields to prevent economic damage and additional social problems
- Social — Clarify responsibilities for drought and flooding of sports fields
- Social — Everyone must be involved and aligned
- Environmental — Integrate sports fields in the city to combat climate change
- Legal — Regulations are the first step towards a transition.

According to this perspective changes on sports fields influence their surroundings and vice versa. Therefore, all parties, including the sports club itself, must be involved in policy-making processes, and it is regarded important that everyone must be aligned. It is currently unclear who is responsible for flooding and drought on sports fields, while many stakeholders are involved, either in decision making or in suffering from the effects of these problems. Sports fields are a regarded as an opportunity to combat climate change at urban level. Applying regulations is the first step towards a transition.

An overview of the extent to which the different perspectives score on the Pestel characteristics, meaning to which extent the focus of the viewpoints is on each of the elements is presented in Table 17.

Table 17. Overview perspectives and Pestel elements.

Pestel/Perspective	Field Focus	Water Wise	Urban Ultra
Political	+	+	-
Economic	-	+	+
Social	+	-	++
Technological	+	+	-
Environmental	+	+	+
Legal	+	+	+

- Low
+ High

The distinguishing perspectives show different viewpoints on the realization of a transition towards sustainable urban water management on sports fields. The different viewpoints are essential to be taken into account in the design of the focus group.

6.1.3 | A first step towards boundaries and boundary spanning processes

From the interpretation of the three perspectives, three viewpoints on which these perspectives are similar, as well as three viewpoints on which they seem to differ the most, can be identified. The similar viewpoints between all stakeholders give a first idea on a direction for possible boundary spanning processes and objects. The differences give more insight in the knowledge and communication boundaries between the different stakeholders. Both are further elaborated in this paragraph.

A first step towards boundary spanning processes

The perspectives are based on the distinguishing viewpoints, on which the viewpoints of the stakeholders in a perspective differ in relation to the stakeholders in other perspectives. However, there are a few points on which the three perspectives appear to overlap, where the viewpoints are similar.

All stakeholders, regardless which perspective they correlate most with, rank the following three points as important:

- More attention for quality of the water used to irrigate the sports fields is necessary.
- Pilots are important if we want to improve water management and water use on sports fields.
- Eventually all involved parties need to join.

Broadly speaking, all stakeholders seem to agree on these three viewpoints. However, the reasoning behind these viewpoints is different. The stakeholders that correlate with one perspective have a different view on why they rank these as important compared to stakeholders in other perspectives. Differences are for example how these points should be reached or realised as well as what the underlying goals are. These points are therefore not directly transferable into boundary spanning activities. In order to get more insight in these opportunities, a focus group is performed where these points form the basis of the discussion.

A first indication of specific boundaries

The most notable differences between the viewpoints of the stakeholders in the distinguishing perspectives that are identified are based on the following three points:

- Who should be responsible for drought on sports fields?
- What are the effects of drought on sports fields? What is the impact on e.g. the playability of the fields, or the economic damage and social issues that come with drought?
- What is the impact of current policy on opportunities for innovation?

These differences in viewpoints provide an indication of where possible boundaries lie between the various stakeholders. These boundaries provided a basis for the discussion in the focus group, in order to find what specific boundaries are present and how these boundaries can be spanned.

This research aims for finding boundary spanning activities that can be implemented as a first step towards a transition in water governance. These first indication of challenges and potential measure in this transition are further researched in a focus group.

6.2 | Spanning boundaries towards transition

The boundaries and opportunities for boundary spanning that are identified using Q methodology are used as the input for the focus group. The aim is to validate the perspectives, boundaries and opportunities, and use these to identify boundary spanning objects that can help to realise a transition towards sustainable urban water management on sports fields.

This paragraph describes the focus group results. The numbers between brackets refer to the number of the corresponding Q sort and therefore stakeholder interview (source). An overview is given in the Table 32 (Appendix G).

6.2.1 | Validate perspectives

The results from the Q methodology show that a comparison of the three perspectives leads to three points on which the stakeholders seem to agree, and that were ranked as important. The aim is to validate these three points using the discussion in the focus group, as these were interpreted from the interviews and therefore need to be validated before conclusions can be taken. The eventual aim is to validate the perspectives – that were initially interpreted from the interviews - together with the perspective characteristics.

A first step towards boundary spanning processes

The three points which stakeholders seem to agree on, found in the interviews in the Q sorts, are:

- More attention for quality of the water used to irrigate the sports fields is necessary.
- Pilots are important if we want to improve water management and water use on sports fields.
- Eventually all involved parties need to join.

These three points were presented in the first phase of the focus group, and stakeholders were asked whether they indeed agree on these points (Table 35, Appendix K). All 13 participants answered that they agree on the first two points, regardless of the perspective they correlate to.

More attention for quality of the water used to irrigate the sports fields is necessary.

When it comes to more attention for the quality of irrigation water, it is among others mentioned that “water quality should be focused on in the same way as we focus on drought” (4), as the responsibilities of both drought and water quality are not yet clear, and so more attention is needed. The stakeholders that identify with the Water Wise perspective state that “focus on quality of irrigation water is important”, and a focus on irrigation water quality also seems to be very important as of the still unknown effects of the water quality from different sources (ground water, surface water, drinking water) on the different types of sports fields; natural grass fields, artificial grass fields and water fields (9, 15). When it comes to the quality of rainwater that is reused as irrigation water, “insight into risk levels is important” (3). It can therefore be concluded that the discussion in the focus group supports the statement that more attention for quality of the water used to irrigate the sports fields is necessary. All stakeholders share this viewpoint regardless of the perspective they correlate to.

Pilots are important if we want to improve water management and water use on sports fields.

The yet unknown effects of water quality on sports fields show the relevance of more pilots (9). Pilots could especially be used to gain new knowledge, but also as a first step to "get used" to the idea that

we can also use water of lesser quality (e.g. rainwater) for purposes as irrigating sports fields (3). The stakeholders that identify with the Urban Ultra perspective state that beginning with the realisation of a consortium, where the focus is on two or three sports fields with water related problems, is a necessary first step. Here pilots can take place, where after the steps towards an implementation on a bigger scale can be realised. A good way to realise improvement of water management and water use through for example joint investment should start as well with "exploring opportunities, doing pilots, and from pilots rules and regulations can be set up, and then new pilots could be realised, and so iteratively more and more steps can be made towards an improved situation" (15). Together with the quote; "The more pilots, the better" (16); these results from the discussion support the statement that pilots are important if we want to improve water management and water use on sports fields. All stakeholders share this viewpoint regardless of the perspective they correlate to.

Eventually all involved parties need to join.

The statement "Eventually all involved parties need to join" is not answered unanimously. Eight stakeholders mention they do agree to this statement; however, the remaining five stakeholders mention they disagree. From the analysis of the discussion, it seems that all stakeholders agree that a transition cannot be realised without all stakeholders. However, there seems to be a different idea about what 'join' means and the statement is interpreted in different ways by the various stakeholders.

The stakeholders that disagree mention among others that responsibilities should be with governmental organisations, like municipalities and water authorities. Sports clubs cannot take that responsibility. However, one of the statements that shows that in the end all parties should move towards the transition is: "When the first consortia and good examples have been proven successful, regulations may be needed in the long term to get the last sports clubs on board" (3). It seems to be important to first succeed in a number of pilots with a consortium of a number of enthusiastic parties (municipality, pioneering sports clubs, water boards and other parties) that could be used as an example. In the end, adjusted policy and rules are needed to involve the remaining parties that are lagging behind (3, 5).

Within the discussion, the roles and responsibilities of all relevant stakeholders that play a role in the context of urban water management on sports fields were mentioned. The stakeholders that seem to agree that all parties are needed to realise a transition towards sustainable water management on sports fields, mention: "In the end we need society. All parties, including users" (15). If we want to realise such a transition, then we must ensure that "the responsibility for this transition is at least felt by much more parties, and everyone is needed" (16). We do need governmental organisations, however parties such as the NOC*NSF, sports bonds, the Vereniging Sport en Gemeenten and the Branchevereniging Sport en Cultuur and the sports clubs are equally important in this governance transition.

In the end, the participants agree that all parties involved should move towards the transition, whether that is because of their own motivation or e.g. by means of rules and regulations. It can therefore be concluded that the statement should be formulated differently: "All involved parties need to move towards sustainable water management".

Validating of perspectives

An overview of the characteristics of the three perspectives that are developed in Paragraph 6.1.2 is presented in Table 18. The aim is to validate these perspectives with the use of the discussion in the focus group. As an introduction to the focus group, all stakeholders received an email including an introduction to the perspectives (Appendix I). At the start of the focus group, all stakeholders were asked with which perspective they identified themselves the most. This was followed by a presentation of the goal of the research and a detailed explanation regarding the various perspectives. At the end of the presentation, the stakeholders were asked again with which perspective they identified the most. The results (Table 36, Appendix K), together with the interpretation of the plenary discussion in the second part of the focus group, are used to try validating the perspectives that were designed from the Q methodology interviews.

Table 18. Characteristics perspectives.

Field Focus	Water Wise	Urban Ultra
○ All stakeholders needed ○ Pilots are important, the more the better ○ Effects of drought on sports fields and the impact of using water differently must become clear ○ Preventive action is important ○ Motivation for transition based on own ambitions	○ First step transition by municipality and sports club ○ Municipality must free up more budget ○ Combination with water problems in the surroundings of sports fields ○ Focus on collecting and reusing rainwater on sports fields to guarantee playability of fields ○ Regulations concerning the quality and quantity of water required	○ Clarify responsibilities for drought and flooding of sports fields ○ Everyone must be involved and aligned ○ Integrate sports fields in the city to combat climate change ○ Tackle drought on sports fields to prevent economic damage and additional social problems. ○ Regulations are the first step towards a transition

The stakeholders within the three distinguishing perspectives have different interests, as presented in Paragraph 6.1.2. The perspectives are based on five different characteristics (Table 18). To validate the perspectives, an assessment has been carried out whether the three perspectives and their additional characteristics, which were initially interpreted from the Q methodology, do indeed summarize the key viewpoints of the distinguished stakeholder groups. An overview of this analysis is given in Table 38 (Appendix K).

Perspectives

The focus group discussion has led to many new insights. Within the focus group the stakeholders seem to identify themselves more with the Water Wise perspective and the Urban Ultra perspective, rather than with the Field Focus perspective. However, the analysis of the discussion shows that there are also stakeholders that seem to approach the discussion from the Field Focus perspective's point of view. The focus group discussion supports the results from the Q methodology. The basis of the stakeholder's key viewpoints indeed seem to lie in three different approaches; an inside-out reasoning, where the emphasises lies on the opportunities and challenges related to the sports field and from this starting point find relevant opportunities outside the sports fields to relate to; a focus

on water, where the approach is to initially finding and analysing possible solutions for a sustainable water supply and consecutively relate these to the sports fields; and an integrated approach, which is based on a connection that goes beyond water management on sports fields.

Characteristics

Besides validating the perspectives, it is also the aim to validate the characteristics that describe each of the perspectives. The amount of times a stakeholder discussed one of the topics from the list of characteristics is presented in Table 37 (Appendix K), and this gives the basis for this validation analysis of the characteristics.

The characteristics that describe the Field Focus perspective seem to be supported the arguments that are mentioned by stakeholders that reason from this perspective. All stakeholders are needed, and the more pilots the better. The effects of drought on sports fields and the impact of using water differently must become clear, and the first steps in the transition should be motivated based on own ambitions (15, 16). The discussion did not include any statements on preventive action, however there seems to be an overall understanding that we should act now in order to prevent the increasing of, as well as the developing of new negative climate change effects related water management on sports fields.

The stakeholders that seem to reason from the Water Wise perspective mention that a combination with water problems in the surroundings of sports fields is key. There seems to be an agreement that collecting and reusing rainwater on sports fields to guarantee playability of fields is a good direction to move towards. However, the focus of this discussion was mainly on governmental challenges and opportunities, so this characteristic cannot be fully validated. The second and fifth characteristics have not been discussed in the focus group either. It might be that these characteristics do not present a typical characterisation of the Water Wise perspective, however, as the discussion was e.g. not focussed on economics, this should be further researched. The first characteristic, that states that the first step of a transition should be made by the municipality and a sports club, does not seem to fit with the perspective. Within the focus group it became clear that the stakeholders related to this perspective, as well as related to the Urban Ultra perspective, believe that a transition cannot be guided by sports associations. It can be concluded that this characteristic does not support the viewpoints of the stakeholders within the Water Wise perspective.

The first four characteristics of the Urban Ultra perspective are more than once quoted by the stakeholders that are identified with this perspective. The last characteristic, regulations are the first step towards a transition, however is not really supported by the discussion. One of the stakeholders mentions that regulations can be used to clarify who is responsible for drought and floods on sports fields, and who should take the lead when aiming for a transition towards more sustainable water management (14), nevertheless all other stakeholders seem to agree that regulations are desirable in the first step towards the transition. Regulations could be used as a last step to ensure that the remaining parties join the transition as well (3).

Stakeholder distribution over perspectives

As can be seen in Table 36 (Appendix K), there was only one stakeholder that shifted from a perspective after the presentation of the perspectives in the focus group (5). This table also shows that four stakeholders seem to identify the most with the perspective that is as well found to be the

matched perspective in the stakeholder analysis. Seven stakeholders seem to identify themselves with a different perspective than what was found in the statistical analysis. The discussion shows that indeed some stakeholders seem to approach the transition towards sustainable water management from another perspective than what was analysed in the statistical analysis or than what the stakeholders themselves mentioned they identified most with. However, one perspective does not exclude another perspective, meaning that if a stakeholder identifies most with one perspective it does not mean that the stakeholder cannot identify with characteristics of another perspective.

Realizing a transition is extra complicated because stakeholders seem to identify with different perspectives at different moments throughout the process. This creates even more communication boundaries than if they would always identify with the same perspective. It also shows that stakeholders are not always consistent in their opinions and viewpoints.

As mentioned in Paragraph 5.2.7, Q sorts 2 (STOWA) and 11 (TU Delft) seem to possess a significant factor loading in relation to more than one of the factors. In the interpretation of the Q methodology interviews, as well as in the interpretation of the focus group discussion it can be identified that these two stakeholders view the transition towards sustainable urban water management on sports fields from a different position.

6.2.2 | Evaluation breakout rooms

After presenting the perspectives in the focus group, a summary of these perspectives, in the form of five bullet points per perspective, was presented (Table 18). In the first part of the discussion to find opportunities for improved water management on sports fields, the stakeholders were divided into breakout rooms, based on with witch perspective the stakeholders identified themselves most. As mentioned in Paragraph 6.2.1, the stakeholders that participated in the focus group seemed to identify themselves mostly with the Water Wise perspective and the Urban Ultra perspective. In particular the characteristics of the Field Focus perspective did not feel relatable. In the focus group this was solved by dividing the stakeholders into two groups, one representing the Water Wise perspective, and one representing the Urban Ultra perspective. The stakeholders were places in the group representing the perspective they identified most with.

The aim of the discussion in the breakout rooms was for each stakeholder group, based on these perspectives, to find two points within their own perspective that are identified as must-have's and two nice-to-have's. The must-have's represent the fundamentals of a perspective, the no-go's, the things stakeholders do not want to compromise on. The nice-to-have's are the characteristics the stakeholders would compromise on if a trade-off had to be made.

Water Wise

There is a mixed image on what must-have's and nice-to-have's are. All characteristics are mentioned as must-have as well as nice-to-have's. It therefore is difficult to make a top two of must-have's and nice-to-have's. It is difficult to prioritize, what to do first, what is most important. Besides that it is found that all stakeholders seem to approach the discussion from what they actually know or, more interesting, from what they don't know and acts accordingly.

The must-have's and nice-to-have's as described underneath are what seems to be the most relatable viewpoint from this perspective.

Must-have's
- A combination with water related problems in the area around sports complexes is interesting.
- More attention to the quality of water used for the irrigation of sports fields is needed.

Nice-to-have's
- Regulations regarding water quality and quantity are required
- The focus on collecting and reusing rainwater on sports fields to guarantee playability of fields & A first step of the transition by the municipality and the sports club

Urban Ultra

The stakeholders that identify with the Urban Ultra perspective agree that all parties should be involved and aligned. The alignment should be ensured by the creation of a consortium. Within that consortium there must be enough shared interest to dare and to want to work together. Sports clubs should be involved and supported, municipalities and water boards could take a leading role in this transition. There is a desire for an integrated approach, and the stakeholders mention that rules and regulations are a no-go in the first steps towards the transition.

The must-have's and nice-to-have as described underneath are what seems to be the most relatable viewpoint from this perspective.

Must-have's
- Everyone must be involved and aligned
- Clarify responsibilities for drought and flooding of sports fields

Nice-to-have's
- Rules and regulations

6.2.3 | Plenary discussion

After the break out room session, all stakeholders were directed back to the main meeting in Microsoft Teams. The main outcomes of the break out rooms were discussed, as presented in Paragraph 6.2.2. Hereafter, a plenary discussion on opportunities for circular water management on sports fields was organised. In this paragraph, the main topics discussed are presented.

Results main topics discussed

Within the plenary discussion, three main topics were discussed:

- Who should be and is able to take on the responsibility to realise initial steps towards sustainable water management on sports fields.
- Whether or not the sports associations feel the urgency to change.
- Whether there is a desire to implement rules and regulations to support the transition.

An overview of the results from these discussions is presented.

Responsibilities to realise initial steps towards sustainable water management on sports field

There is no unanimous opinion about who is or should be responsible for the water quality of irritation water for sports fields. The economic capacities of a sports club to realise a transition are first discussed. Then the different viewpoints on who should be responsible for the initial steps towards the transition are discussed. Lastly, there are different opinions identified on whether or not stakeholders accept that some sports clubs might not become as sustainable as desired. These are discussed as well.

Sports clubs currently take decisions regarding sustainability measures on energy and heating, but when it comes to water management, these measures do not add value and fail to have a direct economic impact.

Sports clubs undertake sustainability actions within their reach. When taking measures, it is generally considered what possible added value these measures have. Since measures related to energy and heating have an economic driver, there is a willingness to invest. Sustainability is on the sports clubs' agenda, but regarding water management clubs appear to demonstrate less responsibility, mainly because an economical driver or incentive is lacking. There is no immediate gain.

If sport fields would be proactively supported by the municipality in collaboration with relevant partners, sports clubs are prepared to take significant steps and innovate. The main reason for restraint is the lack of incentives and therefore a lack of economical substantiation to budget for this kind of investments.

There seem to be different viewpoints on who should be responsible for taking the first steps in the transition towards circular water management on sports fields.

All stakeholders seem to agree that a first step in the transition should at least be supported by, but rather be initiated by other parties than the sports associations. As mentioned above, a sports association does not have the financial capacity to make such a transition by itself. However, there seem to be different opinions about whether these parties should continue to bear that responsibility, or whether that first step should create awareness among sports clubs, to ensure that they themselves initiate the first steps. Should this transition be realised from a bottom-up approach, or should it be tackled more top down?

One of the viewpoints is that sports clubs should be involved but cannot take an active role in the transition. Municipalities and water authorities should, as solid governments, invest in the transition, as they are simply much firmer in the long run and can address different interests. The transition should not only be addressed from a water point of view, but also should demonstrate a focus on e.g. wellbeing, sports and health. This means that all parties involved in these themes should also be involved in the transition.
Integrating sports fields in a city is important but it is often seen as less interesting by a sports association. If sports fields should become integrated to help solving water related issues it is the role of the municipality or water authorities to realize this.

However, a different opinion is that all stakeholders hold a certain responsibility to ensure that the awareness concerning water related issues on sports fields is broadened. Currently it seems that 9 out of 10 times sustainable initiatives come from the municipality. It is seldom a sports association that is considering or investigating whether they can change the way they manage their water. But not only municipalities are needed, the roles of for example the VSG (Association of Sports and Municipalities) and the sector association (Sports and Culture) should also be considered. The focus should be much more on sustainable water management when raising awareness, and sustainable solutions in that field.
Awareness creation will ensure that stakeholders are more informed on the current situation and possible opportunities towards more sustainable water management. Among others, this gives sports associations the possibility to make more substantiated decisions, so that they can also participate in their own way in this first step towards the transition. This way sports clubs can y play a significant role in achieving circular water management.

There are different opinions identified on whether or not to accept that some sports clubs might not become as sustainable as desired.
Irrigation is seen as an essential part of ensuring the good quality of sports fields, whether it concerns the quality or quantity of the water used for irrigation, especially in order to ensure future-proof solutions.
However, there appear to be different opinions about the extent to which we should act climate adaptively on sports fields, and when we should accept that an association may not be able to fully adapt. To most stakeholders it does not occur that sports clubs can also lag behind in the transition, becoming less sustainable than desired. However, some stakeholders mention that towards the end, the sports association itself has to take care of realizing sustainable water management, and there will also be associations that cannot achieve this.

The overarching feeling in the focus group seems to be that all stakeholder and topics related to urban water management on sports fields should be involved as much as possible, and a sustainable way of dealing with water should be realized on a broader scale.

The extent to which sports associations feel the urgency to change

The number of sports clubs that feel the urgency to change, that are aware of the effects of water management on the fields, seems to be minimal and incidental. This can be related to the fact that water related sustainability measures are low on their priority list. A sports club is entirely run by

volunteers, that already have a hard time keeping their association running. Additionally, playing members and board members of the club might be unaware that water could be managed differently.

The reason for a discussion about sustainability on sports fields (hockey) now often is initiated by two things: 1) people within an association who have a sustainable mindset for example related to personal professional experience in the field of sustainability and raise attention to sustainable topics; and 2) brought to the attention because there are problems in the surrounding areas of a sports association and sustainability measures have to be taken on a wider scale to resolve these problems. The discussion seems to be stimulated from outside the sports associations, by municipalities, the neighbourhood or water authorities.

However, it is assumed that urgency is currently being felt by some sports clubs in the Municipality of Rotterdam. By starting to take the first steps towards circular water management at these clubs, the clubs that currently feel less urgency can be included later in a more structured way.

The extent to which there is a desire to implement rules and regulations to support the transition

There seem to be diverse opinions on whether it is desirable to implement rules and regulations to support the transition towards sustainable urban water management. In the evaluation of the discussions that took place in the break out rooms, both the stakeholders from the Water Wise perspective and the Urban Ultra perspective mentioned that rules and regulations should not be implemented as a first step towards the transition. Few innovations and few renewing processes get started by the implementation of rules and regulations. However, in the plenary discussion it was among others mentioned that when a first consortia and a few pilot examples have been proven successful; regulations may eventually be needed to get the last sports clubs to move towards the transition. It is also mentioned that regulations can provide a basis for the division of the responsibilities and tasks related to a transition in urban water management. Additionally, rules and regulations could support more attention to water quality and quantity of the water used to irrigate the sports fields, which could result in a safer and more sustainable sports environment.

6.2.4 | Boundary spanning activities

From the discussion in the focus group, actions and strategies that help spanning knowledge and communication boundaries between stakeholders towards achieving the preferred future can be identified and developed. Four possible boundary spanning activities that should be focussed on in order to ensure more sustainable water management on sports fields in this specific case are presented below.

Exploring joint investment (instrument for boundary spanning)

One way to work towards circular water use on sports fields is by exploring joint investment, as is currently done in social real estate in the Municipality of Rotterdam. By operating as joint parties regarding water use, consumption, supply, etc., and by defining water more as a value, it is better possible to see what this means for the quality of the sports complex and its immediate surroundings and it gives an opportunity to focus more specifically on what innovations potentially can deliver. Because the effects are looked at on a larger scale, joint investments can be made. It is approached from a 'where do we want to go' point of standpoint, looking at the vision that is set, analysing the preconditions that are associated with that vision, and identifying who has that responsibility for each precondition. This way it can become clear what the innovations yield for whom, which will make it more feasible to free up budgets.

More elaborately, until recently (about 10 years ago) governments, including water boards and municipalities, invested only in their own domain, in public space. Those boundaries were very firm. At a certain point these governments discovered that with all the climate developments that are at play, this is no longer manageable, and it might even become more efficient to invest in the domain of others.
About 50% of the private space in Rotterdam (about 25 to 30% of the whole city) is social real estate, managed by housing associations, and here it has been examined how interests can be brought together for joint investment. It started with exploring opportunities, carrying out pilots, and making the step from pilots to rules and regulations and then conducting new pilots. This iteratively approach made it possible to take more and more steps together until a new normal situation was created. Sports fields may cover a less significant area compared to social real estate, but they can just as easily play a part in such a collaboration. So, from the perspective ‘if you have something to offer each other, the one the space, the other a big challenge that comes our way’, it should be possible to find shared interests to realise joint investments.

An example of joint investment in practice is the close collaboration between the Municipality of Rotterdam and the housing associations in the renovation of the ‘Eilandenbuurt’ in Rotterdam. The municipality and housing associations signed a performance agreement in 2019, aiming for more attractive and liveable neighbourhoods in Rotterdam (Gemeente Rotterdam, 2019). In the Eilandenbuurt this resulted in collaboratively investing in renovations, ensuring that sustainable improvements could be realised (Gemeente Rotterdam, n.d.-a).

Realising a consortium (organisation of stakeholders’ knowledge and perspectives)

By realising a consortium, where the interests of stakeholders come together, a first step towards sustainable water management on sports fields can be realised. Start with two or three complex sports associations that have suffered from problems related to flooding or drought. These sports

facilities could be identified by Sportbedrijf Rotterdam and Rotterdam Sportsupport, that are in close contact with the sports associations. The assumption is that a certain sense of urgency can provide opportunity to easily get people around the table. Provide support from a sports federation or the like, that can help to support the management of individual sports clubs. Start with these two or three associations that are assumed to be open-minded, and then work your way to the next five or ten. In the end it is not feasible, nor desirable to tackle more sports fields in one go.

An important requirement for such a consortium is sufficient shared interest between stakeholders, which is a fundament for them to dare and want to work together. That does not mean that everyone should be on the same line; water people do not have to play soccer and football players do not have to interfere with water, and everyone has their own visions and goals; but interests must come together at some point. Municipalities and water boards should invest as they are simply much stronger in the long term and can tackle various interests. The transition should not only be addressed from a water point of view, but also health, sports, welfare, and other topics are very much related and important to address.

The perspective towards the future (design of a vision)

What could help to realise a transition towards more sustainable water use on sports fields is the perspective to the future. Volunteers are in charge of maintaining the sports fields, which includes the watering of the sports fields. What has been mentioned during the discussions is that the number of volunteers that participate in this maintenance determines the quality of the grass, and therefore also the watering has an impact on this quality. Where currently the maintenance of sports fields can be managed by volunteers, two trends can be spotted regarding this maintenance: 1) volunteers are becoming scarcer and 2) the climate is changing, which puts more pressure on the volunteers. This is where municipalities or governments and sports associations can find each other, in the social domain of how to keep an association running. And climate change is a great way to meet each other's needs and visions because it provides a common goal to move towards sustainable water systems.
A supported perspective towards the future ensures a clear overview of what will be encountered in the future, so that choices for future-proof solutions can be better substantiated.

To take the pressure off the volunteers, it might be good if smarter systems, more automated irrigation systems, would be used as well to improve the quality of the sports fields. By creating a perspective towards the future, it is possible to support the use of more automated water systems by identifying what challenges lie ahead of us, and what the impact of more automated water systems would be in the long term.

The jargon used

It is important to involve all relevant stakeholders in the transition towards circular water management on sports fields. In a discussing with multiple stakeholders, the words used and the associations related to those words (jargon) are important. At for example a sports club, athletes might have more association with 'not being able to play sports on the fields because they were completely dry' than with 'the effects of more extreme weather events on sports fields'. It's important to empathize with the stakeholder, the person you have in front of you, and the interests they have (Yasuoka, 2015).

6.3 | Stakeholder analysis

To find out who could, and should take which responsibilities to realise boundary spanning to enable the realisation of a transition, a stakeholder analysis is performed. All stakeholders involved in water governance for sports fields in the Municipality of Rotterdam are identified using an actor analysis (Enserink et al., 2010). An overview of the stakeholders and their roles, responsibilities and ambitions in the context of urban water management on sports fields is presented in Appendix J. Within this paragraph, the main stakeholder groups and the extent to which they can influence as well as to which they have an interest in the topic are analysed. The formal relations between the stakeholders and the stakeholder groups are presented in a stakeholder map.

6.3.1 | Stakeholders' influence and interests

The relevant stakeholders identified as well as their roles, responsibilities and ambitions related to sports, urban water management and climate adaptation are presented in Appendix J. Six stakeholder groups are identified based on their influence on and interest in the context of sustainable urban water management on sports fields. These stakeholder groups are: policy makers, sports related associations, pioneers, research and knowledge providers, sports clubs and private companies.

The extent to which the stakeholders can influence, as well as the extent to which they have interest in the different Pestel characteristics related to urban water management on sports fields is analysed. Per stakeholder group these relations are presented underneath. If a stakeholder group scores high on a Pestel characteristic, this means that the stakeholders in this groups have a high influence or interest in the specific characteristic. If they score low, they have little to no influence or interest.

Policy makers

Within this research, the following stakeholder organisations are part of the policy makers: Government of the Netherlands (Dutch Ministry of Public Health, Welfare and Sport + Dutch Ministry of Infrastructure and Water Management + Rijkswaterstaat), Water boards, Province of South-Holland, Municipality of Rotterdam and Neighbourhood managers.

In the context of urban water management on sports fields, policy makers have more influence than interest. The importance of sufficient water management is related to the importance of the realisation of a wealthy, strong, sustainable city, for and with the inhabitants. A good living environment will ensure satisfied citizens. Depending on the ruling political party there is more focus on e.g. economics or on (environmental) sustainability. When it comes to sports, the ruling party has less influence, it is mostly about the amount of subsidies released.

Figure 12 shows the relation between the sports related associations and the six Pestel characteristics, based on their interest and influence. These relations are described in more detail in Table 19.

Figure 12. Relation between policy makers and Pestel characteristics (source: own image).

Table 19. Relation between policy makers and Pestel characteristics in more detail.

	Interest	Influence
Political	To realise a healthy city, policy makers have an interest in clear and transparent policy.	Policy makers are responsible for the design and implementation of policy, as well as monitoring the compliance.
Economical	Policy makers strive for a healthy, strong city. This includes the opportunity for all residents to play sports, and a sufficient sports infrastructure is essential. Sufficient economical support is necessary to make this possible. Municipalities have to ask for budget by provinces, and the provinces ask for budget by the national government.	Policy makers divide the budget, for e.g. subsidies, and thus are able to influence the transition.
Social	Policy makers are the link between the inhabitants of Rotterdam and the Municipality of Rotterdam. The aim is a to provide a healthy living environment for all inhabitants	Policy makers influence the general case.
Technological	In order to maintain a healthy city, policy makers have an interest in innovation in the technical field.	Policy makers have little influence on technological innovations. They give subsidies to certain technology developers, and therefore have some influence, because these technology developers have a better chance to continue to develop than another developers. Policy makers make policy related to technological elements as well.
Environmenta —	Policy makers are responsible for a good living environment, and therefore have an interest in a healthy environment. Depending on who is making policy there will be more focus on economics or on the environment.	This is in line with technological influence, they regulate it and can influence it, but to a small extent. Policy makers make policy related to environmental elements.
Legal	In order to create and maintain a healthy city, policy makers have an interest in clear laws and regulations.	Policy makers are responsible for the design and implementation of laws, as well as monitoring the compliance.

Sports related associations

Within this research, the following stakeholder organisations are part of the sports related associations: Vereniging Sport en Gemeenten, NOC*NSF, Sports federations, De Groene Club, Sportbedrijf Rotterdam and Rotterdam Sportsupport.

Sports related associations have the aim to realise a save and healthy sports environment for everyone. They make policy related to sports, and have a high interest in innovations related to environmental and technical fields as these innovations can improve the sports environment. However, they have little influence, partly because they lack a budget to do research on their own.

Figure 13 shows the relation between the sports related associations and the six Pestel characteristics, based on their interest and influence. These relations are described in more detail in Table 20.

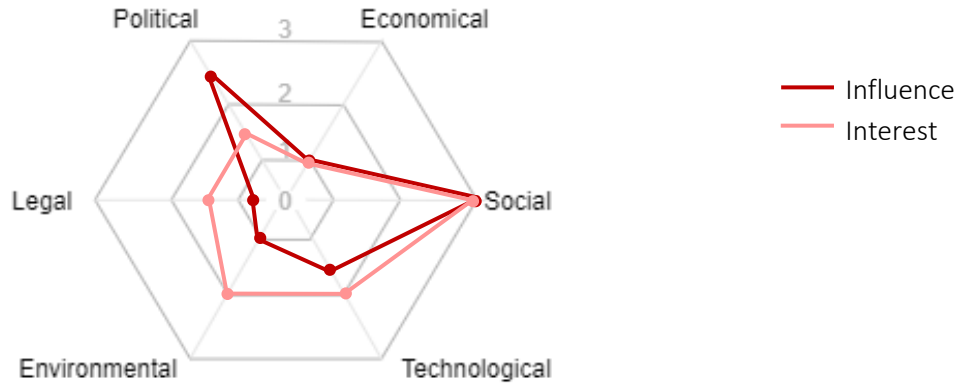

Figure 13. Relation between sports related associations and Pestel characteristics (source: own image).

Table 20. Relation between sports related associations and Pestel characteristics in more detail.

	Interest	Influence
Political	Rules are a precondition, properly observed rules ensure safe and healthy sports environments.	Sports related associations make rules and policy on a smaller scale, with a focus on sports.
Economical	Money is needed to carry out sports activities. However, sports related associations do not have a profit motive.	They do not have a lot of money, they are dependent on sports clubs and subsidies for their income.
Social	Sports related associations are focussed on making sport accessible to everyone. They have an interest in ensuring that everyone can practice sports in a healthy way.	These associations are the link to all members. They have a social responsibility, which includes the realisation of a sufficient sports environment for everyone. The associations are representatives of all member.
Technological	They benefit from technically useful irrigation systems and others. They indirectly have an interest, as this will ensure better playable sports fields which leads to more satisfied members.	Sports related associations work together with technology developers that focus on sports fields, however they do not develop new technologies themselves. They do introduce the need for new technologies.
Environmental	Sports related associations must ensure that sports clubs are prepared for the future. That means that on behalf of the clubs they are responsible for the	They work together with pioneers that focus on innovations in the environmental field. They have

	identification of what is possible on sports fields, what could be new innovations, also in terms of maintenance and the like.	little influence but some associations seem to introduce the need for innovations.
Legal	They have an interest in clear and transparent regulations that are applicable and that they can properly explain to their members. They have an interest in 'sustainable' policy as well, meaning that regulations do not change too often, because they are intermediaries / connections between regulations and sports clubs. They have to translate regulations into policy, and to give an example, sports clubs cannot just install solar panels at once. Regulations and policy should take into account the potential of sports clubs to change.	They have to comply with existing laws and regulations.

Pioneers

Within this research, the following stakeholder organisations are part of the pioneers:
Pioneers (e.g. Field Factors, Newae), Rotterdams WeerWoord and Rotterdam Ingenieursbureau.

Figure 14 shows the relation between the pioneers and the six Pestel characteristics, based on their interest and influence. These relations are described in more detail in Table 21.

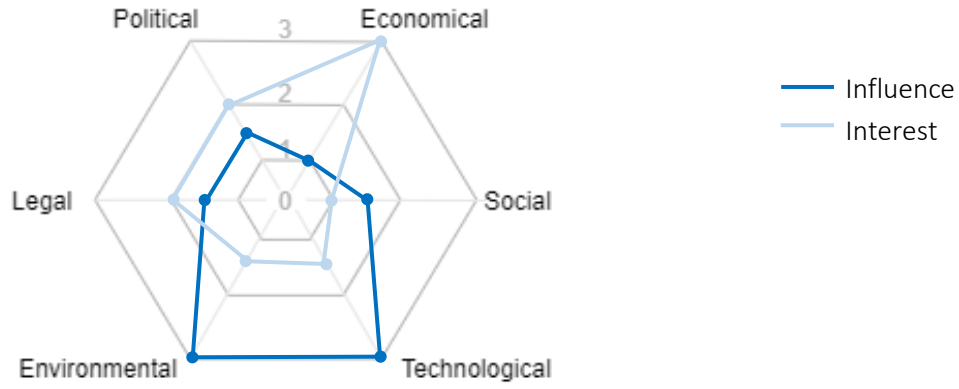

Figure 14. Relation between pioneers and Pestel characteristics (source: own image).

Table 21. Relation between pioneers and Pestel characteristics in more detail.

	Interest	Influence
Political	Good policy provides room for innovation. As policy often follows innovations, and not the other way around, pioneers are dependent on existing policies for their innovations.	Pioneers are depending on policy. They aim to establish guidelines for changes in policy to implement innovations on a larger scale
Economical	Pioneers have a lot of interest in sufficient investors, which could e.g. come from subsidies from research institutes or governmental bodies.	They are depending on the investments for innovating. In a later phase, if innovations are implemented on a larger scale, they will become private companies with profit.

Social	Innovations have to fit in the social structure, the innovations have to be supported by society. Maybe not in the first phase, e.g. in pilot projects, but when you want to implement your innovation it should fit in social structures and commitment from in this case sports clubs is needed.	In the first phase of pioneering a small group of stakeholders will be involved. Because the first idea of the innovation has to be tested, which is done at a small scale.
Technological	Pioneers have an interest in successful innovations, and the financial and social added value creation of their innovations.	They have a high influence on technological elements, as they are front-runners in developing new technologies.
Environmental	They have an interest in successful innovations regarding environmental elements as well, as this will further develop their business case.	Pioneers are front-runners when it comes to innovations in the field of climate adaptation and the environment.
Legal	Pioneers have a big interest in well-defined rules and regulations, as it is clear where there is room for innovations.	Pioneers are constantly looking at what is possible within the law, pushing up against the limits of what they can do, and they try to influence legislation to make innovation easier.

Research and knowledge providers

Within this research, the following stakeholder organisations are part of the research and knowledge providers: Research and knowledge institutes (e.g. KWR, H2Óke, IHE, Tauw, Deltares, TU Delft and RIVM), STOWA and RIONED.

Figure 15 shows the relation between the pioneers and the six Pestel characteristics, based on their interest and influence. These relations are described in more detail in Table 22.

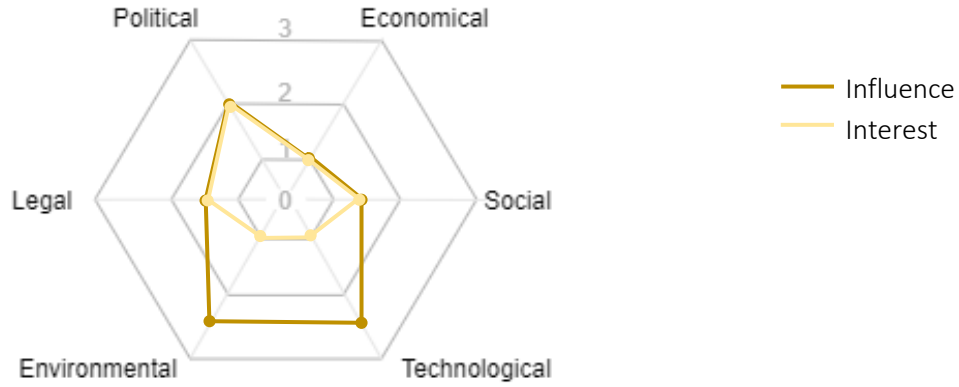

Figure 15. Relation between research and knowledge providers and Pestel characteristics (source: own image).

Table 22. Relation between research and knowledge providers and Pestel characteristics in more detail.

	Interest	Influence
Political	Research and knowledge providers have an interest in that research results have an effect in society. There is aimed for applied knowledge, meaning that they want that society and policy makers are going to use the knowledge they obtained by doing research.	They are depending on policy but do contribute knowledge etc. on which policy is formed / based.

Economical	They do not have a profit motive, as they are public organisations, performing subsidized research.	They are financed by governmental subsidies, so they do not have a lot of influence.
Social	In the end it is important that the knowledge that is gained by these research and knowledge providers can be reflected on a specific function in society, in this case sports fields.	These research and knowledge providers are doing research and the knowledge gained from this is eventually used and will thus mean something for society. However, this is a very indirect influence.
Technological	Little interest: it's not their interest, it's their job.	They do technological research and provide other stakeholders with knowledge in the field of technology. They therefore has a very high influence.
Environmental	Little interest: it's not their interest, it's their job.	They do research in the context of the environment, which is broadly connected to almost everything that is researched. They as well provide other stakeholders with knowledge. They therefore has a very high influence.
Legal	It is important that research results have an effect in society.	They are depending on legislation but do contribute knowledge on which legislation is based.

Sports clubs

Within this research, the following stakeholder organisations are part of the sports clubs:
Sports clubs, including their board members, playing members, volunteers, etc.

Figure 16 shows the relation between the pioneers and the six Pestel characteristics, based on their interest and influence. These relations are described in more detail in Table 23.

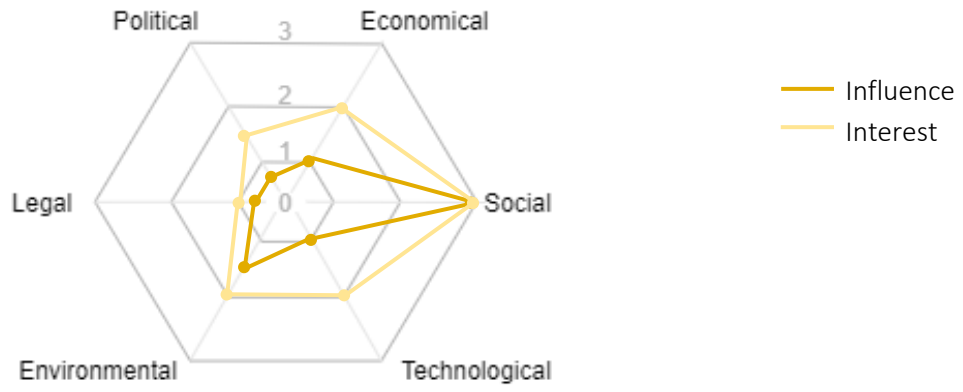

Figure 16. Relation between sports clubs and Pestel characteristics (source: own image).

Table 23. Relation between sports clubs and Pestel characteristics in more detail.

	Interest	Influence
Political	Indirect, well-defined policy ensures a healthy and sustainable sports environment.	Sports clubs are fully depended on existing policy. They can discuss their needs and wants with for example sports federations, that make policy on the scale of sports fields. This means that they do have a little bit of influence through this communication.

Economical	Sports clubs have in interest in a financial stable club. They are dependent on contributions and subsidies, and do not have a profit motive.	They are dependent on contributions and subsidies, and seem to have little money left for e.g. innovations.
Social	Sports clubs have a social interest. The Municipality for example wants to facilitate sports, however the sports clubs represent the full body of this societal matter. Their interest is a healthy, well-running sports club	Sports clubs represent the societal element of water management on sports fields. As a sports club is a community based organisation, the social element scores very high.
Technological	Sports clubs benefit from good technical systems, this lies at the basis of aiming for a healthy club, because for them year-round playability of sports fields is crucial.	When it comes to technological innovations, sports clubs are dependent on available knowledge and resources, they do not have the resources themselves to play a role in technical innovations, and are as well not able to initiate such innovations.
Environmental	Sports clubs benefit from a healthy environment and innovations that support the environment, as for them year-round playability of sports fields is crucial.	When it comes to environmentally friendly innovations, sports clubs are dependent on available knowledge and resources, they do not have the resources themselves to play a role in these innovations, and are as well not able to initiate such innovations. Their influence is dependent on the type of volunteers and the sports clubs' vision as well. They have the capacity to choose to install solar panels or not, so the focus of the sports clubs, whether this focus is more or less on more or less on environmental issues is guiding.
Legal	Indirect, well-defined legislation ensures a healthy and sustainable sports environment.	Sports clubs are fully depended on existing legislation.

Private companies

Within this research, the following stakeholder organisations are part of the private companies: Evides drinking water company, Landscape architects, Irrigation system suppliers / builders and Contractors sports fields.

Figure 17 shows the relation between the pioneers and the six Pestel characteristics, based on their interest and influence. These relations are described in more detail in Table 24.

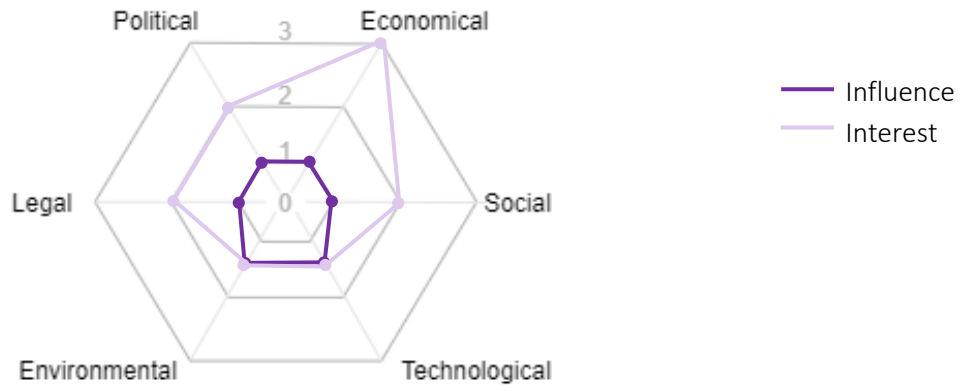

Figure 17. Relation between private companies and Pestel characteristics (source: own image).

Table 24. Relation between private companies and Pestel characteristics in more detail.

	Interest	Influence
Political	Private companies have an interest in well-defined and transparent policy, so that it is clear what can and cannot be done.	They are fully dependent on policy, and have little to no influence.
Economical	They have a big profit motive, the aim of these companies is to make as much money as possible.	They however have little influence, their role is to sell their products/services, and they often respond to demand from society.
Social	A lot is done for the benefit of the customer. Private companies have to sell their products/services. They have an interest in society as these are the buyers.	They provide services for stakeholders, and therefore have little influence.
Technological	Depending on the type of company, technological plays an important role.	Their influence is not that great because they often are one of many, mainstream.
Environmental	Depending on the type of company, environmental plays an important role. There will be few drivers for this environmental pillar, unless the heart of the company lies in sustainable environments, or when they have to compete with other companies, that this could be a business strategy.	Their influence is not that great because they often are one of many, mainstream.
Legal	They have an interest in clear regulations that don't change too often, you do not want too many obstacles to what you want to sell.	They have to operate within the limits of legislation.

This stakeholder analysis shows that all stakeholders are needed in the transition as they all are able to influence different aspects of this transition and have their interests are scattered. It can as well be identified that all stakeholders discussed do actually have a stake in this context, none of the stakeholders scored a zero on the scale from zero to three.

6.3.2 | Mapping formal relations

The relations between the stakeholder groups can be identified by looking at the roles, responsibilities and ambitions of the stakeholders, as well as by looking at their interests and influences on the topics related to the Pestel characteristics. Table 25 presents an overview of the relations between all stakeholder groups, based on whether it is a direct or indirect relation, and whether it is a hierarchical or formal relation.

A direct relation means that a stakeholder communicates directly with another stakeholder, as well as that decisions of one stakeholder have a direct influence on another stakeholders. If policy on technological innovation changes, pioneers in the field of technology will feel the direct impact of this. However, if sports policy changes, first sports related associations will use this policy to develop more detailed policy focussed on sports, that will be implemented on sports clubs. The sports clubs have a direct relation with sports related associations, but an indirect relation with policy makers.

A hierarchical relation means that one stakeholder has more influence on another stakeholder than the other way around. A formal relation is a relations between stakeholders where there is little to no hierarchy. For example, research and knowledge providers have a formal relationship with policy makers, as they provide knowledge that policy makers base their policies on. In case of a hierarchical

relation, the arrow in the table shows from which stakeholder to which stakeholder the hierarchy goes.

Table 25. Relations between stakeholder groups.

Relation between stakeholder group x and y		Type of relation	
Policy makers	Sports related associations	Direct	Hierarchical →
Policy makers	Pioneers	Direct	Hierarchical →
Policy maker	Research and knowledge pr.	Direct	Formal
Policy makers	Sports clubs	Indirect	-
Policy makers	Private companies	Direct	Hierarchical →
Sports related associations	Pioneers	Indirect	-
Sports related associations	Research and knowledge pr.	Indirect	-
Sports related associations	Sports clubs	Direct	Formal
Sports related associations	Private companies	Indirect	-
Pioneers	Research and knowledge pr.	Direct	Hierarchical ←
Pioneers	Sports clubs	Indirect	-
Pioneers	Private companies	Direct	Formal
Research and knowledge pr.	Sports clubs	Indirect	-
Research and knowledge pr.	Private companies	Indirect	-
Sports clubs	Private companies	Indirect	-

The formal relations between the relevant stakeholders and stakeholder groups are presented in a formal chart in
Figure 18.

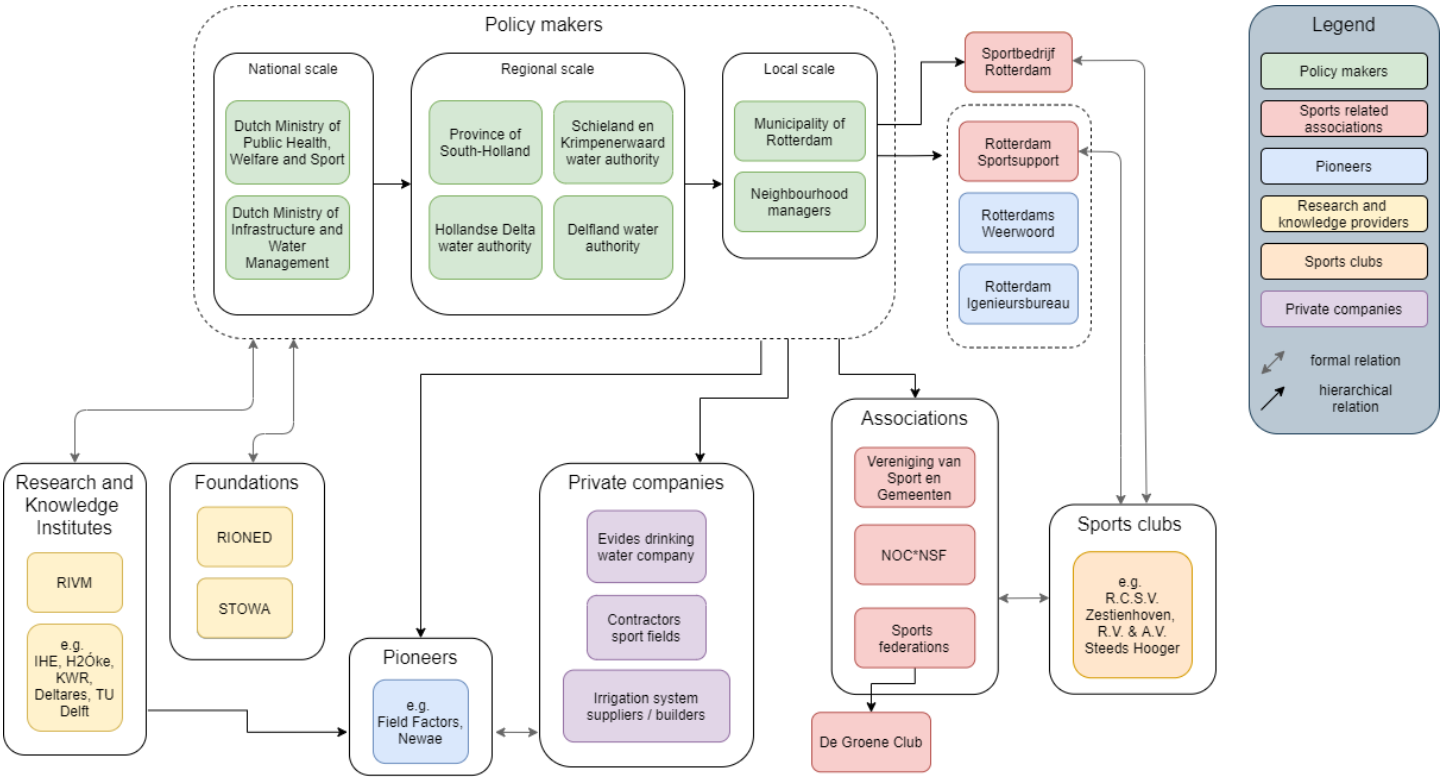

Figure 18. Formal relations between stakeholders (source: own image).

6.4 | Boundary spanning

The case in Rotterdam has been conducted to study, understand and analyse governance challenges and opportunities towards boundary spanning. At this point, the goal of a future-proof solution to ensure year-round playability of the sports fields has not been reached yet. The main reason seems to be the multiple stakeholders involved, with different perspectives, and therefore different approaches on how to reach the goal aimed for.

6.4.1 | Knowledge sharing and new knowledge creation

In the interviews and the focus group it was found that stakeholders involved have different, sometimes incorrect knowledge within the context of urban water management on sports fields. For example, multiple stakeholders reasoned from the idea that sports fields are irrigated with tap water, however most of the times surface water or ground water is used. This resulted in a focus on somewhat 'out of context' issues. For example, one of the boundaries mentioned by these stakeholders was that drinking water is too cheap, and therefore an incentive to make a transition towards more circular water use remains excluded.
It as well became clear that different stakeholders have fragmented knowledge and strong opinions on different topics. For example, regarding the criteria used in tenders for sports fields and whether these criteria generally offer scope for sustainability, contractors and technology providers seemed to know most on what the criteria are and how they could be interpreted. This is considered reasonable, as these are the stakeholders who have a lot to do with these tenders. Most other stakeholders mentioned that they did not have much knowledge on this topic. Hence, when it came to the quality of the irrigation water and whether or not rules are needed to ensure sufficient quality, policy makers, research and knowledge institutes and users of the sports fields could provide more detailed knowledge on current policies and the effects of the water quality on the sports fields and the health of the athletes. The opinions on these matters also seemed to be more outspoken when coming from stakeholders that related more to the specific topic discussed.

In the focus group, where these different knowledge and viewpoints of the stakeholders were discussed, it was found that by sharing the knowledge, a more pragmatic and useful discussion could take place. The fragmented knowledge on the current situation was shared, and where perspectives still differed, all stakeholders were this way provided with a certain basis for the discussion. As multiple stakeholders are involved that act on different spatial scales, for example the current situation of water management on sports fields was discussed (small spatial scale), as well as water management on a larger spatial scale of the municipality, with a focus on the integration of sports fields in a larger context.
By sharing knowledge and viewpoints, a platform was build where new knowledge could be created. An example of combining fragmented knowledge which allowed for new knowledge creation is the following: Stakeholders related to regular sports fields management, as Sportbedrijf Rotterdam, sports federations and Rotterdam Sportsupport, clarified the situation of water management on sports fields in Rotterdam. It was mentioned that sports clubs do not have the financial capacity to realise a transition in water management on their own. A stakeholder related to the Municipality of Rotterdam mentioned that in Rotterdam joint investment ensured the realisation of multiple projects in other functions where there was not enough money available by the stakeholders related to the function itself. Hereafter, a discussion followed on whether it was possible to realise joint investment

on sports fields. Such 'new knowledge' was only created because the different stakeholders involved were sharing their knowledge and viewpoints.

Fragmented knowledge related to urban water management for sports fields is the main reason for an integrated approach where relevant stakeholders have the opportunity to understand each other's viewpoints and perspectives in order to realise change. This research, and especially the results of the focus group, is a first step towards boundary spanning in relation to sustainable urban water management. Knowledge sharing and creating new knowledge, involving all relevant stakeholders is essential in this process.

6.4.2 | Opportunities for boundary spanning

The opportunities for boundary spanning that are regarded promising by relevant stakeholders related to a transition towards a long term circular water availability for sports fields are identified throughout this research, and specified in the focus group. The stakeholder analysis provides more information on which stakeholders could be able to take up what responsibilities related to these boundary spanning activities.

A remarkable aspect that came up in this research is that all stakeholders involved in this case are positive according to a transition towards sustainable urban water management. Similar perspectives came out:

- More attention for quality of the water used to irrigate the sports fields is necessary.
- Pilots are important if we want to improve water management and water use on sports fields.
- All involved parties need to move towards sustainable water management.

However, this transition has not been realised yet. Therefore, three pathways are identified to contribute to a first step towards sustainable urban water management.

Three boundary spanning activities are regarded promising by stakeholders related to a transition towards a long term circular water availability for sports fields:

a. Realise a consortium
b. Perspectives towards the future
c. Explore joint investment

a. & b. The realisation of a consortium enables the creation of a platform for knowledge sharing and new knowledge creation. All stakeholders could and should be involved. This is important as it creates an opportunity to learn each other's jargon, and get to know each other's strengths and weaknesses, to learn how collaboration could take place in order to realise a transition. All stakeholders have fragmented knowledge, on the current situation, but also on how future scenarios would look like. In order to provide a perspective towards the future, it is important that knowledge is shared and all stakeholders hear each other's visions and perspectives, in order to ensure that all these different pieces of knowledge come together, to create a complete and clear overview.

c. The first step in exploring joint investment could be the realisation of pilots. These do not cost as much as direct implementation of an innovation on a larger scale, it creates a possibility to learn a lot, and it creates a platform for knowledge sharing. By involving relevant stakeholders in pilot projects, it can become clear what the innovations yield for whom, which will make it more feasible to free up

budgets for joint investment on a larger scale. Pilots will provide the opportunity for more research on the effects of the quality of irrigation water on sports fields as well.

The process of the transition should take into account all stakeholders, and all these stakeholder should have a say in this. It is important that decisions are supported by all stakeholders, and that no situation arises where a stakeholder says 'this is how it should be done'. The next steps in the process should be identified together, as all stakeholders bring their fragmented knowledge and distinguishing visions, and in order to realise a transition all these different pieces of knowledge should come together.

To ensure the realisation of a transition towards more sustainable urban water management on sports fields, good communication and sufficient knowledge sharing and new knowledge creation is key.

6.4.3 | Boundary spanning activities

In Table 3 and Table 4 in Paragraph 4.3 the premise and boundaries found in literature are defined for the specific situation researched: a small-scale public function with interests in a larger field/context. Also, a first overview of the boundary spanning processes, objects, activities and boundary spanners is drafted and presented as well. Table 26 and Table 27 provide an overview of how boundary spanning and the Pestel framework relate to the results in this study, made concrete for the Rotterdam case. It indicates in a structured manner what has been included from the theory and what can be supplemented from this research.
The tables give an overview of the results from this research, showing whether the premise and boundaries can indeed be defined as was found in literature. The boundary spanning activities, and the corresponding processes and objects are presented in this table as well. Furthermore, the role that stakeholders could take in these boundary spanning activities is based on the stakeholder analysis (Paragraph 6.3), and is elaborated on in the tables.

Additions and adjustments have been made where necessary. The parts in italics (*xxx*) have been validated, the parts crossed out (~~xxx~~) are parts that are not in line with the results from this research.

Table 26. Boundary spanning and Pestel aligned, case study sports fields Rotterdam, PART I.

	Political	Economical	Social
Premise	*Policy focusses separately on each of the small-scale functions in bigger contexts. Communication and joint actions are therefore hampered.* The municipality of Rotterdam is a front runner when it comes to climate adaptation and sustainable policy development. The Municipality has some water and sports related institutions, namely Sportbedrijf Rotterdam, Rotterdam Sportsupport, and Rotterdams WeerWoord. These parties are still working on a not yet sufficiently realised future-proof sports environment.	*The focus is on a small-scale, public function with interests in a larger field, dependent on public investments. Money has to be divided over all the functions within the bigger context of a municipality or province.*	*All different stakeholders for different organisations that are involved have different opinions and visions and ambitions related to a transition towards more sustainable urban water management.*
Boundaries	*There are boundaries on an organisational and spatial scale level. There is a gap between policy makers and what happens in the field, how policy is aimed to be implemented and how this is experienced by people who should act upon this policy.* Policy focusses separately on each of the small-scale functions in bigger contexts.	*This specific public function is an organization run by volunteers, which has not a lot of money and is already struggling with keeping the organisation running.* *Also, all individual stakeholders involved do not have the capacity, enough money to realize innovations on their own.*	*The boundaries lay between different stakeholders and organizations. It is difficult to work together, and maybe even to find each other, when stakeholders use different jargon, have their own cultures and ways of communicating. Organizational.* *There is as well a cultural boundary, as there is no consultation structure, and therefore a communication boundary between these stakeholders and others. With all those volunteers it is difficult to get into a formal platform for example.*
Boundary spanning processes	All involved parties need to move towards sustainable water management. In the focus group there is proved that stakeholders have fragmented knowledge and are not fully aware of each other's viewpoints on a transition. As a first step, more focus groups should be performed, in order to realise a platform for good communication and sufficient knowledge sharing and new knowledge creation. Stress tests, risk dialogues and expert interviews are processes that can be additionally performed. By realising pilot projects, it can become clear what the innovations yield for whom, which will make it more feasible to free up budgets for joint investment on a larger scale. Pilots will also provide the opportunity for more research on the effects of the quality of irrigation water on sports fields, as well the possibility to try out new technical and environmental innovations. Pilot projects bring all involved stakeholders together and create platforms where new knowledge can be created.		
Boundary spanning objects	*Visions and ambitions* As an overarching note, it should be mentioned that action plans are needed. These action plans will make sure a transition is actually realised instead of only envisioned. These action plans will support the realisation of a transition, and should involve the boundary spanning processes and boundary spanners.	*Budget*	*Action plans*

	Political	Economical	Social
Boundary spanning	*The alignment with the Pestel framework shows that interests and influences between stakeholders diverge, and that depending on the transition that is aimed to be realised, but for all transitions related to small-scale public functions in a bigger field the Pestel elements are intertwined and should be all be involved, in an integrated approach, in order to realise the transition* (Dewulf, 2019; Reed et al., 2008). An integrated approach, where stakeholders have the opportunities to understand each other's viewpoints and perspectives in order to enable knowledge sharing and new knowledge creation should be implemented. Creating a consortium, exploring joint investment, and giving more insight in a perspective towards the future are the three main boundary spanning activities that should be realised in order to span the communication and knowledge boundaries between stakeholders that hamper a transition towards more sustainable water management on sports fields.		

	Political	Economical	Social
Boundary spanners	*Policy makers* Policy makers should take the lead in the realisation of the consortium, as they are strong and structured organisations, with the power to use policy, legislation and money. They are responsible for the involved of all other stakeholders, through for example focus groups. Policy makers do not have the ability to create new knowledge themselves, so it is their responsibility to involve knowledge and research providers in order to gain more insight in e.g. the effects of the quality of irrigation water on sports fields, or to perform a feasibility study of innovations or new policy structures. Realising pilot projects is a first step in realising a transition. Within policy there should be enough room for innovation to guarantee a development towards a transition. <u>Government of the Netherlands</u> The need for rules regarding water quality of surface water that is used for irrigation of sports fields has to be researched. The Ministry of Infrastructure and Water Management and the Ministry of Ministry of Public Health, Welfare and Sport should collaborate and together outsource research on the effect of the quality of irrigation water on the sports fields and the health of the athletes. This means that they should collaborate with research and knowledge providers in order to make research supported policy. H2ÓKe is one of these organisations that should be involved, as of their expertise in the field of water and health. <u>Water boards</u> are responsible for the surface water that sports clubs use to irrigate their sports fields. The quality of this water does not always seems to be sufficient for the use of irrigation. If policy regarding this quality were to be implemented, water boards should take the lead in providing a more practical approach on how measuring quality and monitoring whether policy is adhered to could be realised on a broader scale. As water boards already have a lot of experience in monitoring water quality, it is reasonable to assume that they know what the best ways are to do this. <u>Province of South-Holland</u>	*Financial experts* Policy makers and knowledge and research providers are not responsible for the development and implementation of innovations, to enable actual innovation, and therefore private companies and pioneers are crucial for the realisation of a transition on sports fields. Public Private Partnerships (PPP) are important, as these involves governmental organisations and private businesses that work together to realise projects and provide services to the population. These PPP can connect financial resources with knowledge and policy. <u>Sports clubs</u> Sports clubs will be the users of more innovative water systems on sports fields, but do not have the financial capacity to realise such systems. Joint investment should be explored, which involves all stakeholders, and should be based on what circular water management on sports fields yields for whom. <u>De Groene Club</u> The focus of De Groene Club is currently on reducing energy use, as this has a direct influence on the energy costs of a sports club. If it becomes clear what a different way of using water can mean for a sports club, how they can financially and socially benefit from it in the longer term, it is the task of the green club to pitch this properly to the sports clubs. They have a very direct link with sports clubs. De Groene Club could fulfil a role in collaboratively with other parties taking the step towards the larger scale application of innovations and other governance regarding sustainable water management on sports fields. They can show sports clubs where the added value lies for the club, the same way as they are advising sports clubs now regarding energy efficiency. This also means that De Groene Club should engage with research institutions	*Community based stakeholders (anyone that moves on and around the small-scale public function: e.g. people that are playing sports or doing recreational activities, and volunteers.)* Policies and knowledge should be communicated with the field. Within a consortium, knowledge sharing and communication should be transparent and clear. Sports related associations should translate the policies into usable policy for sports clubs. They should work together with private companies, pioneers, knowledge and research providers and sports clubs in order to realise the implementation of innovations on sports fields. The companies and knowledge providers should take a lead in this collaboration. <u>The Vereniging Sport en Gemeenten, NOC*NSF and sports federations</u> have a responsibility to clearly communicate policy made on a national scale towards implementable policy for sports clubs. When for example new regulations regarding the quality of water are implemented, and this water should be of a sufficient quality in order to be used as irrigation water, these associations should inform sports clubs on these regulations and give advice on how sports clubs could e.g. monitor water quality. In projects concerning innovative water systems on sports fields, these organizations play a major role in the step from pilot projects to the larger-scale implementation of these innovations. Also, these associations can contribute to a transition by monitoring the problems that occur on sports fields and by sharing the knowledge learned from adapting to these issues with other sports clubs, creating more opportunities for climate resilient sports infrastructures. <u>Neighbourhood managers</u> are responsible for obtaining and keeping an overview of the maintenance needs of all

	The Province of South-Holland plays a role in the broader implementation of innovations on sports fields. Their vision should include realising a more sustainable and safe sports environment through circular water management on sports fields, and this vision should come back as well in the ambitions of the Municipality of Rotterdam.	and national policy makers about what they think is necessary in terms of knowledge and policy to actually gain the information needed that could convince sports clubs to innovate. Municipality of Rotterdam The Municipality of Rotterdam is already taking first steps towards a different approach to water, by subsidizing pilot projects in Rotterdam. As a frontrunner regarding climate adaptation in The Netherlands, the municipality should ensure that these projects are widely known, and should share its strategies towards the implementation of these projects. They should share knowledge with other municipalities, and a first step could be taken by the Province of South-Holland, realising a platform for this knowledge sharing, for example with the use of focus groups, bringing together the municipalities on a broader scale.	parties active in the management of the outdoor space (private and public). The neighbourhood managers could play a big role in identifying water related problems in the surroundings of sports fields. These managers can see from up close how water is managed in different neighbourhoods, and will be the first to know if there are issues regarding this water management. In collaboration with Rotterdams WeerWoord, they could get more information on how an urban water system works, and how to identify is there are issues regarding water management, which can then be communicated with the Rotterdams WeerWoord in an early stage. Sportbedrijf Rotterdam and Rotterdam Sportsupport are together responsible for the implementation of the sports policy drawn up by the municipality of Rotterdam. As a partner of the Municipality of Rotterdam, they provide the link between the municipality and the athletes and sports clubs. Their role in the transition is to inform and communicate with sports clubs and athletes on for example how they can join consortia.

Table 27. Boundary spanning and Pestel aligned, case study sports fields Rotterdam, PART II.

	Technological	Environmental	Legal
Premise	*New technologies are not yet implemented on a larger scale. Scaling up innovative technologies is difficult.*	*There is not enough knowledge on environmental innovations related to urban water management. Also, there is a lack of knowledge of the impact of the environment on a small-scale public function and how and with what impact such a functions could be integrated in a bigger context in order to make such a context more future proof.*	~~*It is difficult to change laws and regulations. This means that if the aim is to realise a transition, and definitely on a smaller scale, it is not easy to adapt legal instruments towards this transition.*~~ Within current regulations and procedures, a transition towards sustainable water use on Rotterdam sports fields is possible. It indeed seems to be difficult to change laws and regulations, however there is an overall agreement that a first step in the transition should not be motivated by the use of rules and regulations, and therefore the legal element does not cause a direct boundary for this context.
Boundaries	*New technologies mean that a transition has to be realised, on all areas of the Pestel elements, as these have to be implemented in society.* *These innovations often are risky investments, and it is always the questions who wants to take that risk, who wants to support the innovation.* Also, there is fragmented knowledge on what are possibilities for technical innovations, which innovations should have the best effect on a better water management and what technical innovations could yield in terms of money or societal meaning.	*Urban water management on a smaller scale is still not yet very high on the agenda* (De Groene Club, 2020a; Rijksoverheid, n.d.-e). There is fragmented knowledge on the impact of environmental changes and innovations on sports fields. There is among others more attention for quality of the water used to irrigate the sports fields needed in order to make supported decisions.	~~*When it comes to water, many laws are made on a European scale and do not always apply to The Netherlands specifically (Kaderrichtlijn water EU 2000). It is extra complicated since this study concerns small-scale public spaces and laws often deal with bigger contexts.*~~
Boundary spanning processes			
Boundary spanning objects	*Implementable technological innovation*	*Strategies* Research agenda's, that will give a more structured overview of the themes that should be further researched. These should be focussed on the effects of water quality and quantity on sports fields.	*Regulations*
Boundary spanning			

Boundary spanners	Technological	Environmental	Legal
	~~*Technological companies*~~ Pioneers are frontrunners in the field of technological and environmental innovations. There are innovations available that can ensure circular water use on sports fields. An example is the Urban Water Buffer designed by Field Factors. In the Municipality of Rotterdam there are already numerous pilot projects realised, and pioneers could therefore play a major role in sharing their experience with pilots, and how pilots can best be carried out, as well as how knowledge that is obtained from a pilot project can be shared. They therefore also bear a responsibility to not only focus on the innovation itself when testing new innovations, but also to monitor and evaluate the pilot, in order to share knowledge on a broader scale. STOWA could take up the responsibility for evaluation pilots, but should be working collaboratively with pioneers to ensure that a pilot project is set up in such a way that it can be monitored and evaluated. In order to implement circular water systems on sports fields, irrigation system suppliers and contractors should work together with pioneers. For example, pioneers develop new technological innovations for water storage and filtering, irrigation system suppliers provide the systems that connect these innovations with sprinkler systems, and contractors have knowledge and experiences on how to bring these two systems together to realise the implementation of circular water systems. Rotterdams WeerWoord is founded by the Municipality of Rotterdam and has the function to realise the implementation of (small-scale) technical innovations in Rotterdam. In Rotterdam it seems logical to initiate climate adaptation of sports fields via the Rotterdams WeerWoord. They are already exploring the opportunities for an improved water management on sports fields, but this should come much higher on their agenda.	*Environmental research institutes* Evides drinking water company The drinking water company Evides is responsible for sufficient quality of drinking (tap) water. Sports fields mainly use surface water and ground water to irrigate the sports fields. Circular water systems, where the aim is to store water in wet periods of overcome water shortages in periods of drought, and to reuse water that is used to for example irrigate water fields, is desired in the transition towards sustainable urban water management on sports fields. There should be a focus on remaining a good quality of the water, to ensure safe reuse. Hence, Evides could share their knowledge on how to provide sufficient quality of the water. STOWA and RIONED should be responsible for knowledge sharing on a broad scale. In collaboration with research and knowledge institutes research agendas can be created. STOWA and RIONED should as well take a role in evaluating the effect of a transition on a broader scale. Transitions towards sustainable urban water management for green urban infrastructures are addressing environmental problems. As these issues are not yet always as clear, for example the effects of drought on the playability of sports fields, not only the effect of a transition should be evaluated, but also the problem itself should be research in more detail.	*Policy makers*

CHAPTER 7 | DISCUSSION

This chapter reflects on the methodology and theory applied in this research, furthermore it discusses the limitations, and proposes directions for further research.

7.1 | Discussion of methodological processes and theories applied

This research contributes to achieving circular urban water management on sports fields. This paragraph reflects on the methodology and theory applied in this study.

Q methodology successful in combining qualitative and quantitative approach

The Q methodology follows a mixed methods approach and has proven to be useful in combining the qualitative and quantitative approach of this study. According to Doyle et al. (2009), mixed methods approaches are better equipped to understand complex problems such as sustainable water management because these kind of problems need to be studied from different angles. In addition, mixed methods research offers greater possibilities than a single method approach to identify the interests and needs of diverse stakeholders and for responding to decision makers agenda's, as well as to the interests of other legitimate stakeholders. In this study opinions, knowledge, experiences and values of various stakeholder groups, including policy makers were crucial in order to create future pathways towards sustainable water management. If only a quantitative approach has been used, for example a survey, data were collected, giving percentages about opinions, then the background of these data, the 'why' respondents would choose for a certain answer could not be answered. On the other hand, by using 'only' a qualitative way of data generation, it would be difficult to compare the stories of the stakeholders and come up with strategies most stakeholders would back up.

Careful involvement of stakeholders

The relevant stakeholders identified in Paragraph 6.1.1 have been given the opportunity to share knowledge and develop new knowledge by participating in and contributing to this research. These expert stakeholders were guided through the process of identifying opportunities for sustainable urban water management by participation at various moments throughout the process. They participated both in the Q methodology and in the focus group. This approach is assumed to assure a more reliable outcome of this study. A mixed methods approach, by combining qualitative and quantitative data collection in a Q methodology format has therefore been successful.

The combination of Q methodology with the Pestel framework has been valuable since it provided a suitable data collection and analyses structure that is fundamental to the scope of the Q methodology, and ensured the integration of relevant aspects and definition of the identification of boundaries. Q methodology also provided the opportunity to not only reach out to stakeholders once, which is an often-used approach, but to discuss their viewpoints twice. Based on the operationalized topic list, the stakeholders participated in a first set of interviews, where the experts shared their viewpoints on the current situation. In a second set of interviews, the stakeholders ranked the characteristics related to urban water management on sports fields on to what extend they consider these characteristics important. The result of this approach has led to promising pathways.

Mutual influence

The focus group provided a platform where stakeholders came together to share knowledge and start the discussion on finding opportunities for sustainable urban water management. A side-effect of this approach is that stakeholders influence each other. Even if this could be a risk regarding the outcome of the discussions, it is uncertain whether this is a sustainable influence. The focus group is a snapshot of the viewpoints of the stakeholders and there is no opportunity to monitor the development of opinions in time. It can therefore be assumed that the effect of the mutual influence within the focus group on the results can be ignored.

However, it has proven to be very important that stakeholders are exposed to the viewpoints of other stakeholders and cultivate understanding for each other's viewpoints. This approach has ensured a meaningful discussion on possible opportunities and it enhances a collaborative support of the outcomes of the focus group. The focus group approach has in my opinion contributed largely to sustainable results.

Pestel framework supports the research

The Pestel framework provided an optimal approach to identify relevant stakeholders and supported the link to the political, economic, social, technological, environmental and legal viewpoints of those stakeholders. By operationalizing the different elements of the Pestel framework and connecting various stakeholder groups to all these elements, it became clear that for example policy makers have a lot of knowledge about policy and law elements but less knowledge about technological elements. It turned out that all identified stakeholders were relevant and needed to make a shift towards sustainable urban water management and at the same time that none of the identified stakeholder groups had a complete overview of all knowledge needed to initiate a transition towards sustainable urban water management. Even within some of the organisations, for example, the Municipality of Rotterdam, it became clear in the interviews and in the focus group that policy makers with various functions and roles pointed out different viewpoints and interests. By operationalizing the different Pestel elements and integrating them in the focus group, it became clear where there were boundaries, where boundary spanning was feasible, who could act as boundary spanners and which activities were promising. Hence, it sounds reasonable to state that the Pestel framework has proven to successfully support this research.

Regulations and Procedures

According to regulations and procedures, a transition towards sustainable water use on Rotterdam sports fields is possible. Hence, all stakeholders agreed that a first step in the transition should not be motivated by the use of rules and regulations, and therefore the legal element does not cause a direct boundary for this context.

Better connection between Pestel and boundary spanning is needed

What is lacking in the Pestel framework is that it does neither give a direction on how to overcome fragmented knowledge, how to span boundaries, nor on what kind of level, like organizational or spatial scale level, boundary spanning could be feasible, desirable or promising. On the other hand an integrated framework such as Pestel could contribute to shape boundary spanning as it gives the opportunity to look at the separate elements of the Pestel framework and examine the feasibility of boundary spanning. For example when new technologies are available but policy makers have no clue

about the implementation and how to raise public support, it would be helpful to introduce the boundary spanning theory in combination with Pestel; boundary spanning to find out the boundaries and Pestel to identify the relevant stakeholders and their viewpoints, values, knowledge and opinions. A better connection between the Pestel framework and boundary spanning should be designed in further research.

7.2 | Limitations of research

This paragraph describes possible limitations to this research.

An important stakeholder group - the sports clubs – has not been actively involved

Due to COVID19, an important stakeholder group has not been actively involved in this research: the sports clubs. No playing members of the sports clubs took part in the research and neither did volunteers of the sports clubs or for example parents of young people who play sports on the fields. This is due to the COVID 19 situation at the time the interviews and the focus group took place, when athletes were not allowed to practise their sport on the sports fields, and it was therefore not possible to reach out to this stakeholder group. Nevertheless, it has been possible to include two board members of two different sports clubs in the interview sessions in the Q methodology, whose viewpoints provided relevant insights in water management from a sports club point of view. Besides this, some of the experts in the stakeholder groups were sporters themselves, which provided an indirect representation of this group. It is difficult to analyse or predict what the effect of this limitations could be on the results of this study. Possibly the involvement of sports club representatives could have led to a new perspective design. For example, sports clubs will be the main users of innovative technology systems on sports fields. There could be yet unidentified perspectives on who should be responsible for monitoring water quality used for irrigation of sports fields when circular water systems are implemented.

Stakeholders appear to agree on the need for transition

The stakeholders involved seem to be all positive about the transition towards circular urban water management. This has been substantiated by the expert interviews and in the discussion in the focus group, as well as identified by the factor analysis, where the correlation matrix shows that there are no negative correlations between the stakeholders included. No stakeholders were found that are openly stating to be against such a transition. Could the outcome be different if stakeholders would be involved that do not support such a transition, if these stakeholders exist at all? Has there been a bias following the introduction to the Q sort interviews, where the stakeholders were asked to watch a 2-minute video on the Urban Water Buffer, in which the importance of more sustainable water management was pointed out? It also raises the question why this transition has not yet been executed or achieved, when all stakeholders seem to feel the urgency for this transition and seem to be willing to cooperate. Potentially this observation successfully exposes the need for collaboration and alignment, which is indeed a result and conclusion from this research (Reed, 2008).

Definition of the first perspective

From the three perspectives developed in the Q methodology, the participants of the focus group all mentioned they identified most with either the second (Water Wise) or the third (Urban Ultra) perspective. However, it became clear in the discussion that multiple participants did follow a line of reasoning based on the first perspective (Field Focus), which is explained in more detail in Paragraph

6.2.1. One of the reasons that stakeholders mentioned that they do not identify with the first perspective might be connected to the way it has been defined. The first perspective might be perceived as less ambitious while perspectives two and three are defined more integrated and innovative. Stakeholders could be tempted to choose a larger scope alternative. It is difficult to analyse or predict what the effect of this limitations could be on the results of this study.

Personal opinion versus organizational role and responsibility
The stakeholders that participated in this research are asked to reason from their role in the organisation. However, it is uncertain how their personal opinions and the expert knowledge of the stakeholders are connected and how these different stakeholder roles could have disturbed the research. As this is a subject that many people are also personally involved in, it may be that during interviews the personal opinions and expert knowledge are mixed up/are intertwined. During the interviews it has however been mentioned more than once that the research concerns expert knowledge, and that stakeholders should reason from their expert point of view. During the discussion in the focus group, several participants referred to their personal sports life. However, although there is no prove, it is assumed that the interviews are approached from expert point of view, that experts were able to distinguish their expert knowledge and their personal opinions (Beck, 2007; Edelenbos et al., 2011).

Generalisation of the results to other small-scale green urban infrastructure functions outside sport and recreation seems difficult as sport fields in combination with sustainable urban water management are characterized by a unique set of variables, and most of the sport fields are run by volunteers. Other small scale functions, run by volunteers in urban areas are community centers or other types of community based organizations. These organizations cannot be compared with sport and recreation when it comes to water management. Furthermore sport fields are a-typical in their use of water. Irrigation of sport fields is of a different order than using water in any other small scale green urban infrastructure function outside sport and recreation. However, generalization is possible within green urban infrastructures for sports and recreation in other (urban) regions.

7.3 | Recommendations for further research

Taking the limitations of this study into account, further research is recommended on strengthening the theory of boundary spanning and the Pestel framework. Following this thesis results and Reed (2008), further research is needed to the effect of stakeholder processes in environmental decision making.

CHAPTER 8 | CONCLUSION

As more and more people are living in cities, the pressure that the green infrastructure functions sport and recreation puts on resources such as water availability increases tremendously. The negative effects of urban development and more extreme weather events result in major challenges in the management of green urban infrastructures. There is a need for governance transitions towards more sustainable urban water management. This study aims to explore the challenges and opportunities to achieve a transition in water governance that ensures long term circular water availability for the green urban infrastructure functions sport and recreation. Generalizing from the underlying case study, general conclusions can be drawn and the question that guided this research can be answered: *What governance transitions according to relevant stakeholders contribute to ensure long term circular water availability for the green urban infrastructure functions sport and recreation?*

Governance transitions are about transitions in the tasks, roles and responsibilities that all involved stakeholders fulfil to ensure sufficient water quantity and quality for the green urban infrastructure functions sport and recreation. Governance is defined as the decisions and actions of the relevant stakeholders involved. Long term circular water availability is about ensuring climate resilient infrastructures. Long term is hereby defined as future-proof solutions for that have an impact on the long term. Circular water availability means that water surpluses in wet periods will be used to overcome water shortages in periods of drought. The green infrastructure functions sport and recreation are defined as green facilities used by public parties to practice sports on both professional and recreative levels, exercise activities and recreational activities.

8.1 | Enhancing transition through identifying communication and knowledge boundaries

Multiple stakeholders are involved within the ambition of a governance transition in urban water management for the green urban infrastructure functions sport and recreation. These are stakeholders from different organizations, that often have their own visions and perspectives on how a transition should be realized. In this research it was identified that the relevant stakeholders involved in water management on sports clubs in the Municipality of Rotterdam are positive towards a transition towards sustainable urban water management. Boundaries have been identified that hamper such a transition, caused by the fragmented knowledge on the current situation of each of the stakeholders and their different perspectives, and therefore different approaches on how to reach the intended goal. This research shows that stakeholders have fragmented knowledge and as a result none of the stakeholders oversee the total picture. Examples of missing knowledge are the effects of different water qualities on sports fields and the health of the athletes, the amount of water used for the irrigation of sports fields, and exactly what technical innovations could yield for which stakeholders, from an economic, social and environmental perspective. Knowledge sharing in the focus group has proven to be successful in closing knowledge gaps and aligning these pieces of knowledge to identify the bigger context. However, even after all fragmented knowledge has been brought together, some of the knowledge is still missing to oversee the full problem context. These communication and knowledge boundaries complicate joint action to realise such a transition. By identifying and examining where there is room to span these boundaries and determining which roles the different stakeholders could and should play in this, a transition is enhanced.

8.2 | Generalizing results of sports fields Rotterdam case

This research addresses the case of sports fields in the Municipality of Rotterdam. The bigger context of this research studies a single small-scale public function with interests in a larger field. From the results of the case study towards the bigger context of sports club cases in other urban areas, as well as the generalisation towards other public/private green urban infrastructures for sport and recreation, such as an arboretum or a playground, the following can be concluded:

1. Creating a consortium to realize a platform for stakeholders for knowledge exchange and new knowledge creation is relevant on both a small and a broader spatial scale. This creates an opportunity to learn each other's jargon, to get to know each other's strengths and weaknesses, and to learn how collaboration could be shaped to realise a transition. A more supported perspective towards the future can be identified in this consortium, as the fragmented knowledge of the stakeholders is shared and aligned, and the broader context can be described.

2. In situations where none of the stakeholders have the financial capacity to support innovations on their own, exploring joint investment could create an opportunity to take an initial step towards the transition. Operating as joint parties towards challenges related to e.g. water use, consumption and supply, and by defining water more as a value, enables an understanding what this means for the quality of the green infrastructures and its immediate surroundings. It gives an opportunity to focus more specifically on what innovations potentially could deliver. When effects are viewed and approached on a larger scale, joint investments can be made. By involving relevant stakeholders in pilot projects, a very specific situation can be created showing who benefits to what extend from which innovations. This will make it more feasible to free up budgets for joint investment on a larger scale. Pilot projects will additionally provide the opportunity for more research, for example on the effects of the quality of irrigation water on sports fields.

3. To get insight in the stakeholders involved in sports clubs outside of Rotterdam and in other green urban infrastructures, it is necessary to perform additional stakeholder analyses. For example, in the Municipality of Rotterdam the municipality owns the sports fields, however, Sportbedrijf Rotterdam is responsible for managing the sports fields. Different governance structures may occur in other urban areas. For the green infrastructure functions sport and recreation, which is broader than just sports fields, it is also important to reconsider who is involved in this. Taking an arboretum as example: green keepers will be involved, who do not play a role on sports fields. The Pestel framework has proven to provide a useful basis for identifying stakeholders and bringing together their fragmented knowledge and perspectives. This integrated framework should therefore be addressed when new stakeholder analyses are performed.

4. Although the governance structures, the stakeholders involved and the roles, responsibilities and ambitions of these stakeholders may differ in other contexts, policy makers seem to be the most equipped to initiate a transition. The Municipality of Rotterdam is a front runner when it comes to sustainable innovation and climate adaptation. They have a governance structure where these topics are addressed by organisations such as Rotterdams WeerWoord, which is a collaboration between the Municipality of Rotterdam, the water authorities that play a role in Rotterdam and Evides drinking water company; and Rotterdam has its own organisation for maintenance and

renewal, Ingenieursbureau Rotterdam. For other municipalities that aim to realise a transition in urban water management the advice is to introduce such organisations as well, as these are easily approachable. An example in another municipality is Amsterdam Rainproof (Amsterdam Rainproof, n.d.). Specifically in bigger urban areas, such 'intermediary' organisations are desired. Instead of communicating with 'the municipality', these intermediary organisations are on one hand accessible for organisations in the field, and on the other hand they have connections, formal and informal, with the municipality and water authorities. As policy makers are identified to be the most equipped to initiate a transition, and all relevant stakeholders should be involved, such organisations provide the opportunity to realise knowledge sharing and new knowledge creation between policy makers and other involved organisations.

8.3 | Generalizing results towards similar urban volunteer organisations

A sports club has a unique organizational structure and a specific culture. It is an organisation that works with many volunteers, for example parents of children who are playing sports, or residents who want to be socially involved. The changing of volunteers is very frequent, which means that a sports club is always dependent on new, changing perspectives on the everyday management. Although volunteers are extremely valuable to keep a sports club running and have a lot of input on what happens on a sports club, they mostly do not have professional training in this type of management. In addition, volunteers are often not selected, but they apply for being a volunteer themselves, often with no specific knowledge or training. This means that there is little control over who does what. Due to this limited professional and relatively short-term engagement, when it comes to innovations, their implementations are uncertain. One year a sports club board can consist of volunteers with a very environmentally focused perspective, while another year the sports clubs' vision can be more economically focussed. Running such a public function by volunteers is a very specific situation. The question is if the results from this research could be generalized towards similar urban organisations that are powered by volunteers. Regarding general transitions it can be concluded that using the Pestel framework and enhancing transition through identifying communication and knowledge boundaries can be very useful in enhancing transitions in other areas. However, the approach related to urban water management cannot be generalized.

8.4 | Successful integrated approach with Pestel framework as fundament

Academic research is often focussed on one or two elements regarding a certain issue, for example either a technical research, or a social-economic research, or a policy research. This underlying research is constructed as an integrated approach to balance all elements, using the Pestel framework as a basis. This ensures the inclusion of all stakeholders involved and gives the opportunity to gain their perspectives on the larger context. As the knowledge and communication boundaries between stakeholders are not exclusively present in these separate elements, but are 'crossing boundaries' between these different elements, this integrated approach enables that all existing boundaries can be identified. This underlying research reveals that the challenge lies in the details and in the mutual knowledge insights and alignment on a broad spectrum of subjects, as the Pestel framework approach represents. The combined approach of Pestel, Q methodology, boundary spanning and focus groups has proven to successfully address wicked problems that involve a complex challenge and a large and diverse group of stakeholders.

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APPENDIX A | Literature review

Table 28. Overview literature review.

Keywords	Nr. of hits	Summary of results
Urban water management	44.445	Urban water management seems to be u buzz-word. Combinations with other concepts are required.
Circular water availability for urban green infrastructure	6	Mainly the focus is on a lack of water infrastructures, solid waste management and climate adaptation. Long term framing of challenges is required.
Nature-Based Solutions in combination with urban water management in Rotterdam	57	Mostly there is a connection between Nature Based Solutions and urban water management related to flooding and integrated planning. Nature Based Solutions are seen as a possible solution for wicked problems.
Pestel characteristics	105	The Pestel characteristics are mainly connected to environmental wicked problems, like waste management and health. No connections are found between Pestel and sustainable urban water management.
Pestel framework and Q methodology	1	This research combines a PESTLE analysis with Q methodology to investigate and describe the variables that influence the situation. In doing so, it lists the institutional factors that are presently deemed by various stakeholders to be either opportunities or barriers to implementing a system to maintain grid balance in the Dutch electrical infrastructure (Woliner, 2020).
Boundary spanning	8114	
Boundary spanning in combination with stakeholder participation.	148	
Boundary spanning in combination with stakeholder participation and sustainable urban water management in green infrastructure	4	The most relevant paper seems: Stakeholder participation in long term planning of water infrastructure (Roovers & van Buuren, 2016). It describes the severe problems that are encountered in long-term planning involvement of stakeholders. They mention that problems are encountered because of the misfit in planning horizons between asset managers and stakeholders.
Implementation sustainable water management strategies	4781	
Implementation sustainable water management strategies in combination with urban green infrastructures	123	
Implementation sustainable water management strategies in combination with urban green infrastructures and stakeholder participation	25	Most papers deepened my insight in the topic of sustainable water management for green urban infrastructures and the combination with stakeholder participation. The implementation of urban resilience and management of urban hydrologic processes using green infrastructure, as well as water quality and quantity and sustainable water management are discussed.

APPENDIX B | Topic list

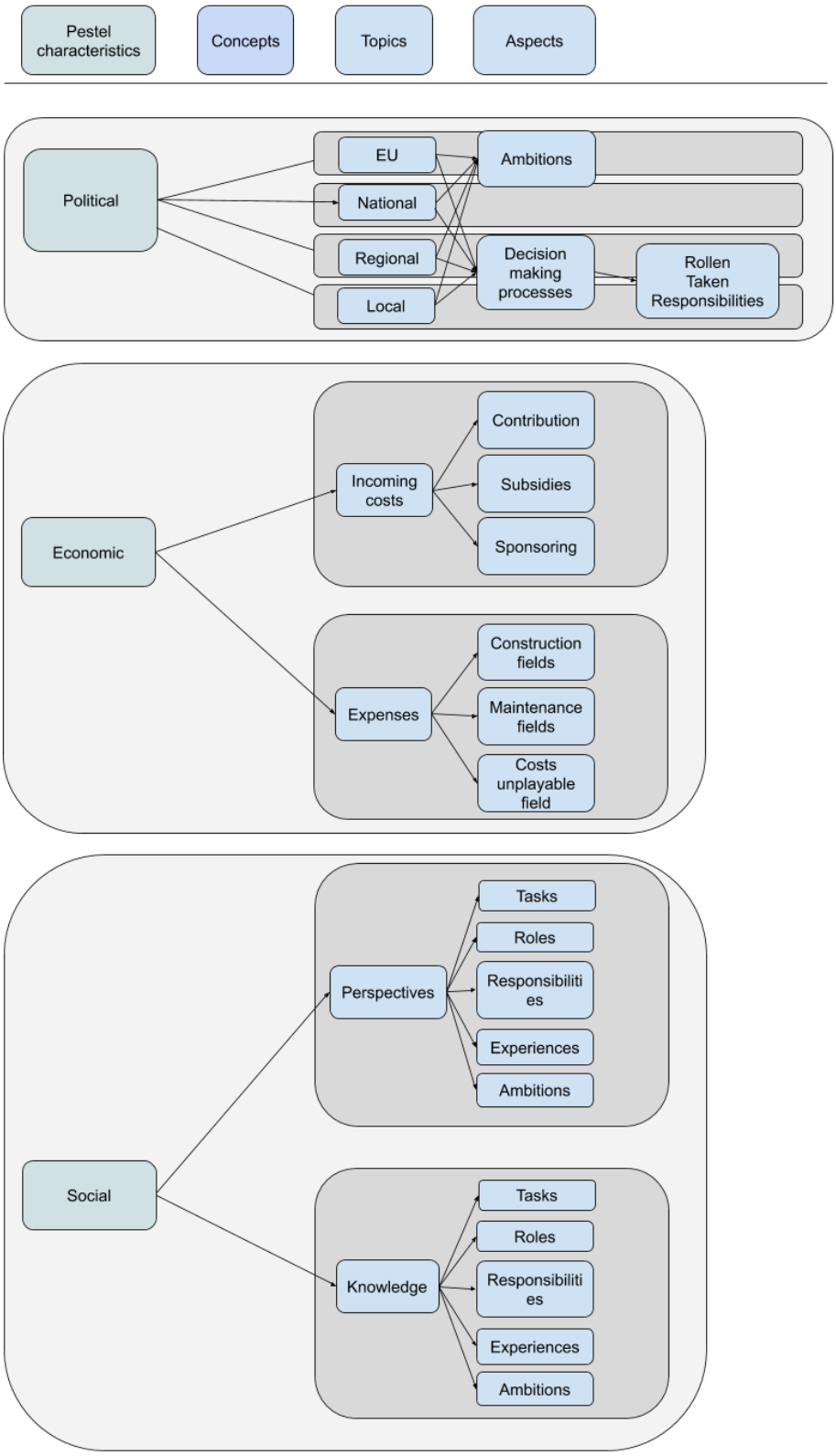

Figure 19. Topic list part I (source: own image).

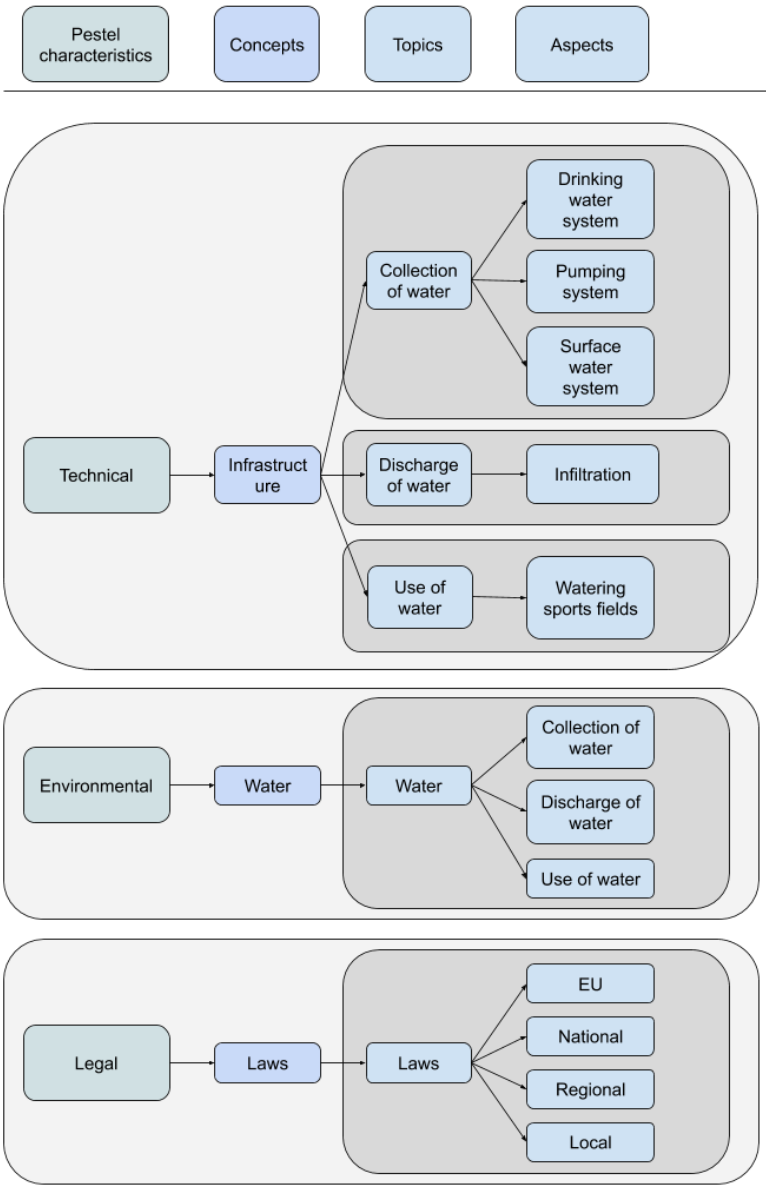

Figure 20. Topic list part II (source: own image).

APPENDIX C | Interview design discourse analysis

The interview design for the discourse analysis is presented in this appendix. The interview sometimes is adjusted, depending on the stakeholder. This interview design presented the basis of the interview.

1. Kunt u mij allereerst iets vertellen over uw werkzaamheden uw organisatie?

Wat houdt uw functie in?
Kunt u iets vertellen over uw werkzaamheden?
Wat zijn uw:

- Taken
- Rollen (in de organisatie)
- Verantwoordelijkheden

Hoe lang werkt u hier al/hoe lang doet u dit werk al?
En wat is uw achtergrond?

2. Wat zijn de rollen, taken en verantwoordelijkheden van uw organisatie als het gaat om stedelijk waterbeheer op sportvelden?

Wat beheren jullie precies?
Wat zijn jullie ambities op dit gebied? Zijn er specifieke ambities waar ik aan kan denken, met nummers of iets?

3. Hoe worden deze uitgevoerd in de praktijk?

4. Als het gaat om besluitvormingsprocessen, hoe werkt dat dan binnen uw organisatie?
Wie besluit over wat en wanneer en hoe gaat dat dan?

- Overleg met gemeenten en andere waterschappen en provincie bijv.?
- Misschien een voorbeeld geven van een van de ambities en hoe jullie die realiseren, hoe zo'n proces te werk gaat

5. Met wie werken jullie samen?
Met wie wel/ en met wie niet?
En hoe verloopt die samenwerking

(gemeenten, provincie, met andere waterschappen, uni van waterschappen, rijkswaterstaat, rijksoverheid, etc)

6. Hoe worden jullie gefinancieerd?
>en wie bepaalt waar dat geld dan naartoe gaat?

7. Hoe ervaar je de wil van partijen met wie jullie samenwerken om duurzamer te worden > specifiek die van de stakeholders die in deze context relevant zijn. Om zelf duurzamer te worden of hierin mee te gaan?

- Bottum up/top down?

8. Zijn er bepaalde wetten waar jullie je ambities op baseren?

9. Doen jullie projecten op gebied van hergebruik van water of circulair omgaan met water. En kijken jullie dan ook naar de kwaliteit van het water dat daarvoor gebruikt wordt?
>in tijden van wateroverschot water opvangen en hergebruiken in tijden van droogte

10. Ligt er een focus op water binnen de stad houden/in de regio/.. water vasthouden?

Zijn er nog onderwerpen waar ik niets over gevraagd heb maar waarvan u denkt dat het wel belangrijk is?
Zijn er nog mensen binnen uw netwerk waarvan u denkt; daar moet ik mee praten?

Ik anonimiseer de uitwerkingen van dit interview. Dat betekent dat de resultaten niet zijn terug te herleiden naar u. Als ik u wil citeren, dus alles wat terug te herleiden is naar uw naam of functie, stuur ik u deze citaten eerst op via de mail, en als u akkoord gaat kunt u schriftelijk toestemming geven dat ik deze citaten mag gebruiken in mijn onderzoek.

APPENDIX D | Set of statements in Dutch

Table 29. Set of statements in Dutch.

Theme		Statement
Political (beleid)	1	Het huidige beleid vormt geen belemmering voor het implementeren van innovaties.
	2	Het is duidelijk wie welke verantwoordelijkheid draagt voor problemen rondom droogte en wateroverlast op sportvelden.
	3	Criteria die binnen aanbestedingen voor sportvelden gehanteerd worden bieden in het algemeen ruimte voor duurzaamheid.
	4	Een sportclub wordt betrokken bij beleidsvormingsprocessen rondom een sportveld.
Economic (Economisch)	5	Er is voldoende externe financiële ondersteuning om als sportclub duurzaamheidsmaatregelen te treffen.
	6	De gemeente Rotterdam maakt voldoende budget vrij voor water gerelateerde duurzaamheidsinitiatieven.
	7	Op de totale begroting van een sportclub is het beregenen van sportvelden met oppervlakte- of grondwater relevant.
	8	Droogte op sportvelden leidt tot economische schade op de lange termijn.
	9	De gevolgen van droogte op een sportveld zijn in geld uit te drukken.
Social (Sociaal)	10	Sportclubs vergelijken zich met andere sportclubs als het gaat om duurzaam waterbeheer.
	11	In Nederland wordt preventief gehandeld als het gaat om klimaatverandering.
	12	Alle betrokken partijen zijn nodig om een transitie naar een circulaire manier van omgaan met water op sportvelden te realiseren.
	13	Om een sportclub te verduurzamen spelen de leden een belangrijke rol.
	14	Sportclubs hebben een voortrekkersrol in de transitie naar het circulair omgaan met water op een sportveld.
Technological (Technologisch)	15	Het vervangen van natuurgras en hybride sportvelden door kunstgras of watervelden lost alle problemen rondom water op sportvelden op.
	16	Pilots zijn erg belangrijk in de transitie naar duurzaam omgaan met water op sportvelden.
	17	Het opvangen en hergebruiken van water voor het beregenen van sportvelden is een goede oplossing om sportvelden voor te bereiden op droogte.
	18	Waterbeheer in de gemeente Rotterdam is inzichtelijk.
	19	Droogte vormt een uitdaging voor een goede bespeelbaarheid van een sportveld het hele jaar rond
Environmental (Milieu)	20	Het wordt steeds droger in Rotterdam.
	21	De kwaliteit van het sproeiwater op sportvelden heeft geen invloed op de gezondheid van sporters.
	22	De kwaliteit van het sproeiwater op sportvelden heeft geen invloed op de kwaliteit van het sportveld.
	23	Groene sportvelden in de stad zijn een kans om effecten van klimaatverandering tegen te gaan.
	24	De effecten van droogte op een sportveld zijn voor mij helemaal duidelijk.
Legal (Wetgeving)	25	Publieke organisaties zorgen door het financieren van klimaat adaptieve maatregelen op privaat grondgebied voor een betere waterhuishouding in Nederland.
	26	Er zijn regels nodig rondom de kwaliteit van het oppervlakte water en grondwater voor het beregenen van sportvelden.
	27	Regelgeving zorgt voor circulair omgaan met water op sportvelden.

APPENDIX E | Online tool

An online tool is set up in which the respondents can sort the statements during an online, face to face interview. Interaction between the interviewer and the participant is very important. All participants agreed to share their screen during the Q sort.

The basis for the online tool is given in a step-by-step guide to set up an online Q methodology study (Banasick, n.d.-a). Table 30 presents the steps taken to design the online tool. The final tool can be found via the following link: https://aarts-scriptie.netlify.app.

Table 30. Overview steps taken to design online tool Q sort.

	Explanation	Website
Repository Shawn Banasick	Download and save basis for website	https://github.com/shawnbanasick
Brackets	Text editor: to modify the Easy-HtmlQ settings file to personalise the website	http://brackets.io/
GitHub	Input files: the repository is stored here, website settings/input is changed	https://github.com/evaaarts/ThesisProject
Netlify	Website: the GitHub repository is uploaded	https://app.netlify.com/sites/aarts-scriptie/overview
Firebase	Database: a new project is created, where data from the website comes in and is stored	https://console.firebase.google.com/u/0/project/thesis-project-eva-aarts/database/thesis-project-eva-aarts/data?pli=1
Ken-Q	Data analysis tool: the data from Firebase is downloaded as JSON file and uploaded in the Ken-Q tool, whereafter the factor analysis can be performed	https://shawnbanasick.github.io/ken-q-analysis/#section1

APPENDIX F | Interview design Q sort

The interview design for the Q sort interviews is presented in this appendix.

PRE-INTRO:

- Zoals in de mail omschreven wil ik inzicht krijgen in mogelijkheden voor een transitie naar een duurzame watervoorziening op sportvelden in de Gemeente Rotterdam. Met een duurzame watervoorziening doel ik op het opvangen en filteren van regenwater, dat kan worden opgeslagen om het water met een degelijke kwaliteit te kunnen hergebruiken.
- Ik heb een filmpje meegestuurd, heeft u tijd gehad om deze te bekijken? Anders kijken we hem nu even met z'n tweeën: https://www.youtube.com/watch?v=aVGJJ0Ab9gw.
- Ten aanzien van dit soort innovaties leg ik straks stellingen aan u voor en ik hoor dan graag uw mening over deze stellingen. Het is daarbij de bedoeling dat u aan dit soort innovaties blijft denken tijdens het interview.
    - Het gaat dus niet om een regenton waarin je water opvangt en hergebruikt, maar een degelijk systeem die mogelijkheden biedt om water te filteren en op te slaan voor hergebruik, in dit geval voor het beregenen van sportvelden.
- Stellingen komen vanuit een eerste set interviews en literatuur onderzoek.

- Vraag:
    - In hoeverre ben je bekent met circulaire systemen > wat zijn je ervaringen hiermee?
    - Wat is je rol binnen de organisatie

Als gezegd wil ik je graag een aantal stellingen voorleggen, om erachter te komen hoe je tegen deze stellingen aankijkt. Daarvoor gebruiken we de volgende website: https://aarts-scriptie.netlify.app.

- *Link in chat*
- Wilt u uw scherm delen, dan kan ik meekijken met wat u doet
    - *Unlock scherm delen voor alle participants*
        - *Open website*
        - *Kom terug naar zoom*
        - *Druk op de groene knop 'share screen'*
        - *Klik nu op het scherm van de website*
        - *Dit betekent dat ik de website ook te zien krijg, en als jij dus dingen gaat invullen daar, ik kan meekijken!*

- Mag ik dit interview opnemen? Ik vernietig alles als ik het interview heb uitgewerkt
    - *Opnemen*

STAP 1:

Van te voren aangeven:

- Vanuit uw rol binnen *organisatie* de statements ordenen.
- Hardop nadenken & blijf denken aan innovaties etc. die te maken hebben met die circulaire systemen van water opvangen, filteren en hergebruiken.
- Niet kijken naar statement nummers, dat is voor mij zodat ik gemakkelijker kan meeschrijven
- *Uitleg begrippen*

STEP 1 RANKING STATEMENTS

STAP 2:

Van te voren aangeven:

- Muis op stelling houden als je hem hebt verplaatst: dan kun je hem helemaal zien
- Ranken als in hoe belangrijk zijn de volgende statements voor u
- Lees ze eerst allemaal écht goed door nog een keer voordat je gaan ranken
- Instructie volgen > eerst eens van meest eens naar minst eens invullen, dan oneens, dan neutraal

STEP 2 RANKING STATEMENTS

Vragen tijdens interview stap 2:

- *Vragen stellen over buitenste 2 rijen*
- *Huidig situatie, waarheen, hoe komen we daar en wie moet er verantwoordelijk zijn?*
    - *Als het gaat om bijvoorbeeld verantwoordelijkheid > het statement 'het is duidelijk wie verantwoordelijk is' > in interview doorvragen naar wie dat dan is, en wie dat moet zijn, ..*
- *Als iets opvalt: vragen over stellen*

VRAGEN ACHTERAF:

- Zijn er nog andere stellingen die je graag wilt toelichten?
- Is er nog iets wat ik niet heb gevraagd waarvan u denkt dat het belangrijk is dat ik het moet weten?
    - Maak hier een stelling van en rangschik deze erbij

- Wider understanding:
  Dus samenvattend; hoe kijk je aan tegen mogelijkheden voor een transitie naar een duurzame watervoorziening op sportvelden in de Gemeente Rotterdam? Waar zie je kansen, mogelijkheden, en waar zie je belemmeringen?

- Ken je nog iemand anders die relevant zou kunnen zijn voor mijn onderzoek? Met bijvoorbeeld een hele andere mening of achtergrond.
- Ik heb ontzettend veel geleerd van dit interview. Ik hoop nog met een aantal mensen een focus groep te houden om de resultaten te bespreken, mag ik u hier een laatste keer voor benaderen?
    - Eventueel email adres achterlaten

PRIVACY

Ik anonimiseer de uitwerkingen van dit interview. Dat betekent dat de resultaten niet zijn terug te herleiden naar u. Als ik u wil citeren, dus alles wat terug te herleiden is naar uw naam of functie, stuur ik u deze citaten eerst op via de mail, en als u akkoord gaat kunt u schriftelijk toestemming geven dat ik deze citaten mag gebruiken in mijn onderzoek.

APPENDIX G | Factor analysis

Correlation matrix

A correlation matrix is formed, showing to what extend each Q sort corresponds to another Q sort. The total number of correlations, how many pairs can be made, is calculated by: (*m*) * (*m*-1) / 2, where *m* is the number of measured variables/columns in the matrix (Watts & Stenner, 2012, p. 8). This matrix includes 27 variables, namely the 27 statements, meaning that the total number of correlations is 351.

The correlation matrix, showing to what extend the different stakeholders are correlated with each other when it comes to how they ranked the statements, and is shown in Table 31.

Table 31. Correlation matrix.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	X	0.51	0.49	0.17	0.23	0.39	0.62	0.20	0.21	0.35	0.43	0.39	0.52	0.27	0.52	0.21	0.52	0.39	0.30
2		X	0.45	0.40	0.39	0.42	0.63	0.23	0.35	0.48	0.48	0.53	0.30	0.44	0.45	0.60	0.45	0.60	0.45
3			X	0.42	0.21	0.52	0.32	0.19	0.42	0.52	0.60	0.41	0.40	0.50	0.52	0.45	0.57	0.42	0.31
4				X	0.52	0.40	0.12	0.47	0.27	0.28	0.37	0.64	0.14	0.37	0.30	0.52	0.49	0.67	0.14
5					X	0.26	0.23	0.47	0.26	0.41	0.20	0.37	0.21	0.13	0.32	0.27	0.48	0.45	0.30
6						X	0.45	0.11	0.55	0.49	0.42	0.52	0.62	0.71	0.47	0.49	0.73	0.45	0.37
7							X	0.13	0.33	0.62	0.31	0.25	0.48	0.25	0.54	0.44	0.48	0.52	0.52
8								X	0.07	0.21	0.33	0.45	0.15	0.17	0.40	0.42	0.32	0.41	0.09
9									X	0.39	0.15	0.28	0.31	0.23	0.36	0.23	0.51	0.35	0.29
10										X	0.36	0.44	0.58	0.48	0.50	0.63	0.61	0.49	0.62
11											X	0.45	0.38	0.40	0.37	0.57	0.58	0.52	0.16
12												X	0.24	0.63	0.43	0.67	0.58	0.55	0.30
13													X	0.47	0.33	0.45	0.73	0.46	0.37
14														X	0.42	0.67	0.61	0.53	0.34
15															X	0.40	0.57	0.52	0.52
16																X	0.65	0.62	0.52
17																	X	0.68	0.44
18																		X	0.33
19																			x

Which organisation represents each Q sort is shown in Table 32.

Table 32. Which organisation represents which Q sort.

Q SORT NR	ORGANISATION
1	Evides Waterbedrijf
2	STOWA
3	Hoogheemraadschap Delfland
4	Municipality of Rotterdam – Advisor Climate Adaptation
5	Field Factors bv
6	Municipality of Rotterdam – Process Manager Rotterdams Weerwoord
7	Stichting RIONED
8	R.C.S.V Zestienhoven
9	Rotterdam Sportsupport
10	H2Óke Water en Gezondheid advies
11	Tu Delft - Urbanism
12	Van Kessel Sport en Cultuurtechniek bv
13	Municipality of Rotterdam – Program Manager Rotterdams Weerwoord
14	Van Oosten beregeningssystemen
15	Municipality of Rotterdam - Neighbourhood Manager \ Outdoor Space Manager
16	KNHB
17	KWR
18	Sportbedrijf Rotterdam
19	Municipality of Rotterdam - Advisor Climate Adaptation & Urban Water

To find the correlation coefficients presented in the correlation matrix, Pearson's Correlation Coefficient *r* is used. The formula is given underneath:

$$r_{xy} = \frac{\sum x_i y_i - n\bar{x}\bar{y}}{\sqrt{(\sum x_i^2 - n\bar{x}^2)}\sqrt{(\sum y_i^2 - n\bar{y}^2)}}.$$

Where:

- n = sample size
- x_i and y_i = individual sample points indexed with i
- $\bar{x}$ and $\bar{y}$ can be found by the following formula:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

In words, this means that to find the correlation coefficients, it starts with taking the sum of all rankings of Q sort *x* (xbar) and the sum of all rankings of Q sort *y* (ybar). Then, for each Q sort, for all rankings, the difference between the sum and the ranking is calculated (xi-xbar & yi-ybar) and then squared ((xi – xbar)^2 & ((xi – xbar)^2), resulting in a list of 27 numbers for both Q sorts. This gives the basis for the equation for *r*xy.

This formula is checked by hand in excel, showing the same numbers as the Ken Q analysis presents, so there can be concluded that the formula is indeed the formula used by the Ken Q analysis.
This results in an r for each correlation between two different Q sorts, where:

- r=1 ; perfect positive correlation
- r=0 ; no linear correlation
- r=-1 ; perfect negative correlation

Applied to sample *r*xy (Sample Pearson Correlation Coefficient)

Factor extraction

The unrotated factor matrix is shown in Table 33.

Table 33. Unrotated factor matrix.

Q SORT NUMBER	ORGANISATION	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7
1	Evides Waterbedrijf	0.576	-0.2407	0.1129	0.0613	0.0725	-0.2363	0.0782
2	STOWA	0.708	0.0599	0.2047	0.0382	0.2264	-0.1855	0.1071
3	Water board Delfland	0.6675	-0.0744	-0.1856	0.0188	0.1437	-0.2756	0.1224
4	Municipality of Rotterdam – Advisor Climate Adaptation	0.5739	0.5344	-0.0338	0.1833	-0.2782	-0.1014	0.0758
5	Field Factors bv	0.4852	0.1263	0.2346	0.0545	-0.4484	0.1142	0.1865
6	Municipality of Rotterdam – Process Manager Rotterdams Weerwoord	0.7269	-0.1858	-0.4696	0.1613	-0.0455	-0.0565	0.0067
7	Stichting RIONED	0.6212	-0.3387	0.4405	0.28	0.1384	-0.1447	0.054
8	R.C.S.V Zestienhoven	0.4084	0.4106	0.1653	0.1293	-0.1078	0.0838	0.0053
9	Rotterdam Sportsupport	0.4711	-0.248	-0.0832	0.0493	-0.2083	-0.1416	0.0589
10	H2Óke Water en Gezondheid advies	0.7367	-0.2029	0.0531	0.0387	0.0595	0.2903	0.0606
11	Tu Delft - Urbanism	0.6185	0.1293	-0.1293	0.0102	0.1552	-0.0972	0.0444
12	Van Kessel Sport en Cultuurtechniek bv	0.7045	0.3892	-0.0769	0.0876	0.0755	0.0414	0.0068
13	Municipality of Rotterdam – Program Manager Rotterdams Weerwoord	0.6143	-0.3631	-0.1199	0.1066	-0.0985	0.1445	0.0118
14	Van Oosten beregeningssystemen	0.6682	0.0304	-0.421	0.0967	0.2554	0.1044	0.074
15	Municipality of Rotterdam - Neighbourhood Manager \ Outdoor Space Manager	0.6863	-0.1492	0.2351	0.0695	0.0085	-0.0209	0.0023
16	KNHB	0.7692	0.264	-0.0543	0.0352	0.2156	0.3275	0.1339
17	KWR	0.8807	-0.0887	-0.2246	0.0298	-0.2465	0.0734	0.0426
18	Sportbedrijf Rotterdam	0.7819	0.24	0.0624	0.0349	-0.1226	-0.0859	0.0206
19	Municipality of Rotterdam - Advisor Climate Adaptation & Urban Water	0.5446	-0.2381	0.2095	0.0877	0.1545	0.2497	0.067
	Eigenvalues	8.1382	1.3041	0.9676	0.2116	0.6863	0.5508	0.1155
	% Explained Variance	43	7	5	1	4	3	1
	Comulative % Expl Variance	43	50	55	56	60	63	64

The eigenvalue (EV) for a factor is calculated by taking the squared factor loadings of all Q sorts on that factor and summing all these loadings.

Factor rotation

A visualisation of a factor rotation is shown in Figure 21.

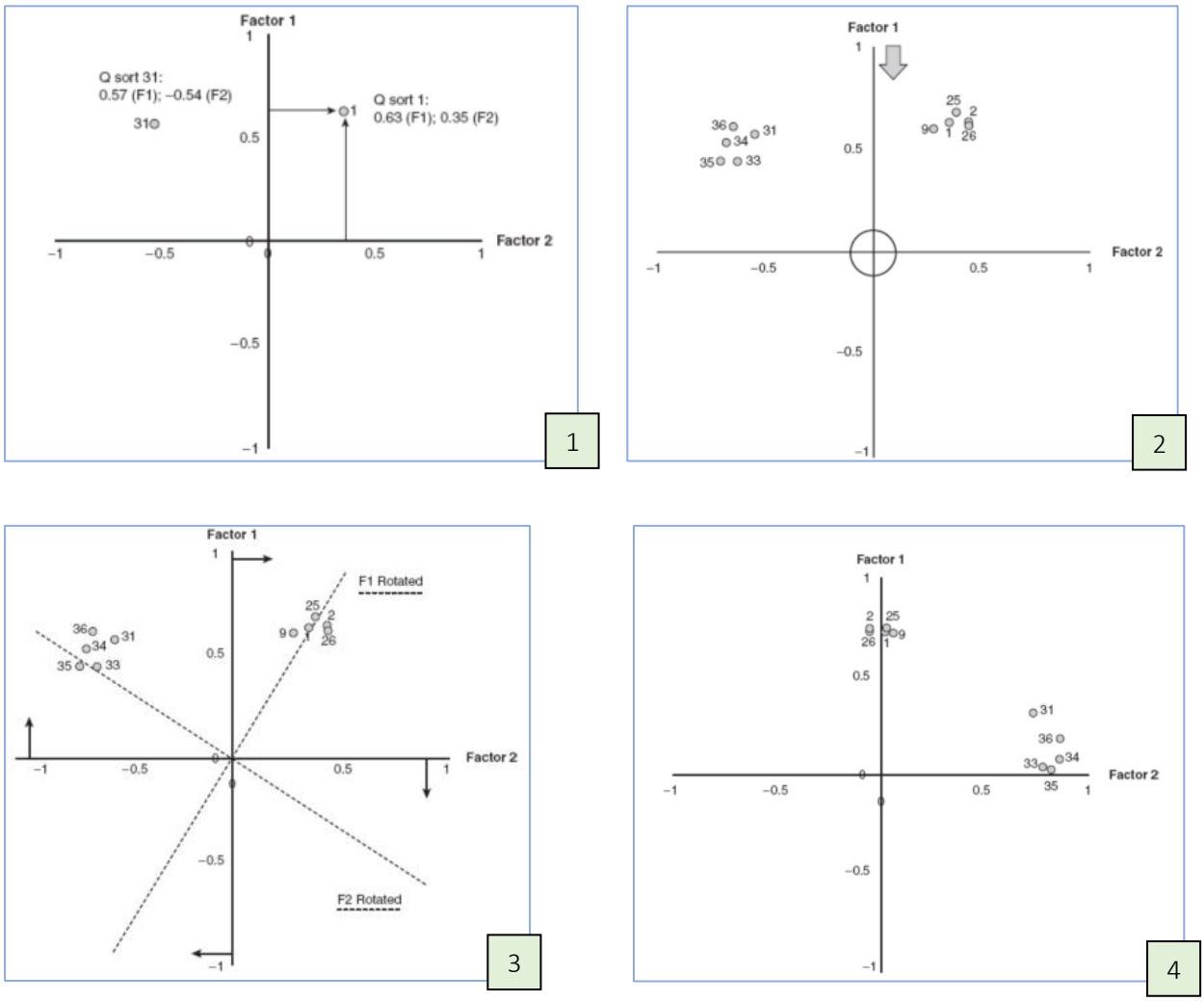

Figure 21. Visualisation factor rotation (Watts & Stenner, 2012).

Significant factor loadings

In Table 34 the final factor loadings of each Q sort on each of the three factors after rotation are shown. Highlighted are the significant factor loadings per organisation, showing with which factor the stakeholder identifies most.

Table 34. Final factor loadings of each Q sort on each factor after rotation.

Q SORT NUMBER	ORGANISATION	FACTOR 1	FACTOR 2	FACTOR 3
1	Evides Waterbedrijf	0.1487	0.5317	0.3123
2	STOWA	0.4806	0.5089	0.2383
3	Water board Delfland	0.2912	0.3125	0.5506
4	Municipality of Rotterdam – Advisor Climate Adaptation	0.7535	0.0345	0.2169
5	Field Factors bv	0.4123	0.3629	0.0681
6	Municipality of Rotterdam – Process Manager Rotterdams Weerwoord	0.1926	0.2285	0.8332
7	Stichting RIONED	0.1434	0.8132	0.113
8	R.C.S.V Zestienhoven	0.5888	0.1265	0.0007
9	Rotterdam Sportsupport	0.0543	0.3524	0.404
10	H2Óke Water en Gezondheid advies	0.2617	0.5685	0.4417
11	Tu Delft - Urbanism	0.4367	0.2125	0.4244
12	Van Kessel Sport en Cultuurtechniek bv	0.7037	0.1596	0.3647
13	Municipality of Rotterdam – Program Manager Rotterdams Weerwoord	0.0369	0.4731	0.5463
14	Van Oosten beregeningssystemen	0.3416	0.1117	0.704
15	Municipality of Rotterdam - Neighbourhood Manager \ Outdoor Space Manager	0.3035	0.6244	0.2582
16	KNHB	0.6423	0.2768	0.4184
17	KWR	0.3948	0.42	0.7083
18	Sportbedrijf Rotterdam	0.6475	0.3694	0.3425
19	Municipality of Rotterdam - Advisor Climate Adaptation & Urban Water	0.1473	0.5722	0.2192
	Eigenvalues	3.46	3.36	3.59
	% Explained Variance	18	18	19
	Comulative % Expl Variance			

APPENDIX H | Final factor arrays

Factor array Factor 1

EV: 3.46

Explains 18% of study variance

Q sorts: 6

Composite Q sort for Factor 1

-4	-3	-2	-1	0	1	2	3	4
✳✳◀ 11. In Nederland wordt preventief gehandeld als het gaat om klimaatverandering.	18. Waterbeheer in de gemeente Rotterdam is inzichtelijk.	1. Het huidige beleid vormt geen belemmering voor het implementeren van innovaties.	✳✳◀ 6. De gemeente Rotterdam maakt voldoende budget vrij voor water gerelateerde duurzaamheidsinitiatieven.	7. Op de totale begroting van een sportclub is het beregenen van sportvelden met oppervlakte- of grondwater relevant.	23. Groene sportvelden in de stad zijn een kans om effecten van klimaatverandering tegen te gaan.	26. Er zijn regels nodig rondom de kwaliteit van het oppervlakte water en grondwater voor het beregenen van sportvelden.	✳▶ 27. Regelgeving zorgt voor circulair omgaan met water op sportvelden.	✳▶ 17. Het opvangen en hergebruiken van water voor het beregenen van sportvelden is een goede oplossing om sportvelden voor te bereiden op droogte.
15. Het vervangen van natuurgras en hybride sportvelden door kunstgras of watervelden lost alle problemen rondom water op sportvelden op.	5. Er is voldoende externe financiÃ«le ondersteuning om als sportclub duurzaamheidsmaatregelen te treffen.	2. Het is duidelijk wie welke verantwoordelijkheid draagt voor problemen rondom droogte en wateroverlast op sportvelden.	3. Criteria die binnen aanbestedingen voor sportvelden gehanteerd worden bieden in het algemeen ruimte voor duurzaamheid.	8. Droogte op sportvelden leidt tot economische schade op de lange termijn.	✳✳▶ 24. De effecten van droogte op een sportveld zijn voor mij helemaal duidelijk.	9. De gevolgen van droogte op een sportveld zijn in geld uit te drukken.	✳◀ 16. Pilots zijn erg belangrijk in de transitie naar duurzaam omgaan met water op sportvelden.	✳✳▶ 19. Droogte vormt een uitdaging voor een goede bespeelbaarheid van een sportveld het hele jaar rond.
		22. De kwaliteit van het sproeiwater op sportvelden heeft geen invloed op de kwaliteit van het sportveld.	21. De kwaliteit van het sproeiwater op sportvelden heeft geen invloed op de gezondheid van sporters.	4. Een sportclub wordt betrokken bij beleidsvormingsprocessen rondom een sportveld.	✳✳◀ 12. Alle betrokken partijen zijn nodig om een transitie naar een circulaire manier van omgaan met water op sportvelden te realiseren.	20. Het wordt steeds droger in Rotterdam.		
			✳◀ 14. Sportclubs hebben een voortrekkersrol in de transitie naar het circulair omgaan met water op een sportveld.	✳◀ 25. Publieke organisaties zorgen door het financieren van klimaat adaptieve maatregelen op privaat grondgebied voor een betere waterhuishouding in NL.	13. Om een sportclub te verduurzamen spelen de leden een belangrijke rol.			
				10. Sportclubs vergelijken zich met andere sportclubs als het gaat om duurzaam waterbeheer.				

Legend

✳ Distinguishing statement at P< 0.05

✳✳ Distinguishing statement at P< 0.01

▶ z-Score for the statement is higher than in all other factors

◀ z-Score for the statement is lower than in all other factors

	Relative Ranking of Statements in factor 1				
			Consensus		
	Highest Ranked Statements	factor 1	Distinguishing	factor 2	factor 3
17	Het opvangen en hergebruiken van water voor het beregenen van sportvelden is een goede oplossing om sportvelden voor te bereiden op droogte.	4	D	2	3
19	Droogte vormt een uitdaging voor een goede bespeelbaarheid van een sportveld het hele jaar rond.	4	D*	1	1
	Positive Statements Ranked Higher in factor 1 Array than in Other Factor Arrays				
27	Regelgeving zorgt voor circulair omgaan met water op sportvelden.	3	D	-1	2
26	Er zijn regels nodig rondom de kwaliteit van het oppervlakte water en grondwater voor het beregenen van sportvelden.	2	C	1	1
20	Het wordt steeds droger in Rotterdam.	2		-1	1
24	De effecten van droogte op een sportveld zijn voor mij helemaal duidelijk.	1	D*	-2	0
13	Om een sportclub te verduurzamen spelen de leden een belangrijke rol.	1	C*	0	1
8	Droogte op sportvelden leidt tot economische schade op de lange termijn.	0		-2	0
4	Een sportclub wordt betrokken bij beleidsvormingsprocessen rondom een sportveld.	0	C	0	-1
10	Sportclubs vergelijken zich met andere sportclubs als het gaat om duurzaam waterbeheer.	0		-2	0
	Negative Statements Ranked Lower in factor 1 Array than in Other Factor Arrays				
25	Publieke organisaties zorgen door het financieren van klimaat adaptieve maatregelen op privaat grondgebied voor een betere waterhuishouding in NL.	0	D	2	2
6	De gemeente Rotterdam maakt voldoende budget vrij voor water gerelateerde duurzaamheidsinitiatieven.	-1	D*	3	0
14	Sportclubs hebben een voortrekkersrol in de transitie naar het circulair omgaan met water op een sportveld.	-1	D	0	0
18	Waterbeheer in de gemeente Rotterdam is inzichtelijk.	-3		-1	-2
5	Er is voldoende externe financiÃ«le ondersteuning om als sportclub duurzaamheidsmaatregelen te treffen.	-3	C	-1	-3
	Lowest Ranked Statements				
11	In Nederland wordt preventief gehandeld als het gaat om klimaatverandering.	-4	D*	0	2
15	Het vervangen van natuurgras en hybride sportvelden door kunstgras of watervelden lost alle problemen rondom water op sportvelden op.	-4	C*	-4	-4

Figure 22. Final factor array Factor 1 + Distinguishing statements (source: own image).

Factor array Factor 2

EV: 3.36

Explains 18% of study variance

Q sorts: 5

Composite Q sort for Factor 2

-4	-3	-2	-1	0	1	2	3	4
15. Het vervangen van natuurgras en hybride sportvelden door kunstgras of watervelden lost alle problemen rondom water op sportvelden op.	2. Het is duidelijk wie welke verantwoordelijkheid draagt voor problemen rondom droogte en wateroverlast op sportvelden.	✳◀ 24. De effecten van droogte op een sportveld zijn voor mij helemaal duidelijk.	✳▶ 18. Waterbeheer in de gemeente Rotterdam is inzichtelijk.	4. Een sportclub wordt betrokken bij beleidsvormingsprocessen rondom een sportveld.	26. Er zijn regels nodig rondom de kwaliteit van het oppervlakte water en grondwater voor het beregenen van sportvelden.	23. Groene sportvelden in de stad zijn een kans om effecten van klimaatverandering tegen te gaan.	✳✳▶ 6. De gemeente Rotterdam maakt voldoende budget vrij voor water gerelateerde duurzaamheidsinitiatieven.	✳▶ 12. Alle betrokken partijen zijn nodig om een transitie naar een circulaire manier van omgaan met water op sportvelden te realiseren.
✳✳◀ 21. De kwaliteit van het sproeiwater op sportvelden heeft geen invloed op de gezondheid van sporters.	22. De kwaliteit van het sproeiwater op sportvelden heeft geen invloed op de kwaliteit van het sportveld.	✳◀ 10. Sportclubs vergelijken zich met andere sportclubs als het gaat om duurzaam waterbeheer.	✳✳◀ 27. Regelgeving zorgt voor circulair omgaan met water op sportvelden.	13. Om een sportclub te verduurzamen spelen de leden een belangrijke rol.	✳✳▶ 1. Het huidige beleid vormt geen belemmering voor het implementeren van innovaties.	✳◀ 17. Het opvangen en hergebruiken van water voor het beregenen van sportvelden is een goede oplossing om sportvelden voor te bereiden op droogte.	9. De gevolgen van droogte op een sportveld zijn in geld uit te drukken.	16. Pilots zijn erg belangrijk in de transitie naar duurzaam omgaan met water op sportvelden.
		✳✳◀ 8. Droogte op sportvelden leidt tot economische schade op de lange termijn.	✳✳◀ 20. Het wordt steeds droger in Rotterdam.	✳ 11. In Nederland wordt preventief gehandeld als het gaat om klimaatverandering.	7. Op de totale begroting van een sportclub is het beregenen van sportvelden met oppervlakte- of grondwater relevant.	25. Publieke organisaties zorgen door het financieren van klimaat adaptieve maatregelen op privaat grondgebied voor een betere waterhuishouding in NL.		
			5. Er is voldoende externe financiÃ«le ondersteuning om als sportclub duurzaamheidsmaatregelen te treffen.	14. Sportclubs hebben een voortrekkersrol in de transitie naar het circulair omgaan met water op een sportveld.	19. Droogte vormt een uitdaging voor een goede bespeelbaarheid van een sportveld het hele jaar rond.			
				3. Criteria die binnen aanbestedingen voor sportvelden gehanteerd worden bieden in het algemeen ruimte voor duurzaamheid.				

Legend

✳ Distinguishing statement at P< 0.05

✳✳ Distinguishing statement at P< 0.01

► z-Score for the statement is higher than in all other factors

◄ z-Score for the statement is lower than in all other factors

	Relative Ranking of Statements in factor 2				
			Consensus		
	Highest Ranked Statements	factor 2	Distinguishing	factor 1	factor 3
12	Alle betrokken partijen zijn nodig om een transitie naar een circulaire manier van omgaan met water op sportvelden te realiseren.	4	D	1	3
16	Pilots zijn erg belangrijk in de transitie naar duurzaam omgaan met water op sportvelden.	4	C	3	4
	Positive Statements Ranked Higher in factor 2 Array than in Other Factor Arrays				
6	De gemeente Rotterdam maakt voldoende budget vrij voor water gerelateerde duurzaamheidsinitiatieven.	3	D*	-1	0
9	De gevolgen van droogte op een sportveld zijn in geld uit te drukken.	3		2	-1
25	Publieke organisaties zorgen door het financieren van klimaat adaptieve maatregelen op privaat grondgebied voor een betere waterhuishouding in NL.	2	C	0	2
1	Het huidige beleid vormt geen belemmering voor het implementeren van innovaties.	1	D*	-2	-3
7	Op de totale begroting van een sportclub is het beregenen van sportvelden met oppervlakte- of grondwater relevant.	1		0	-1
4	Een sportclub wordt betrokken bij beleidsvormingsprocessen rondom een sportveld.	0	C	0	-1
14	Sportclubs hebben een voortrekkersrol in de transitie naar het circulair omgaan met water op een sportveld.	0		-1	0
3	Criteria die binnen aanbestedingen voor sportvelden gehanteerd worden bieden in het algemeen ruimte voor duurzaamheid.	0		-1	-2
	Negative Statements Ranked Lower in factor 2 Array than in Other Factor Arrays				
13	Om een sportclub te verduurzamen spelen de leden een belangrijke rol.	0	C*	1	1
27	Regelgeving zorgt voor circulair omgaan met water op sportvelden.	-1	D*	3	2
20	Het wordt steeds droger in Rotterdam.	-1	D*	2	1
24	De effecten van droogte op een sportveld zijn voor mij helemaal duidelijk.	-2	D	1	0
10	Sportclubs vergelijken zich met andere sportclubs als het gaat om duurzaam waterbeheer.	-2	D	0	0
8	Droogte op sportvelden leidt tot economische schade op de lange termijn.	-2	D*	0	0
22	De kwaliteit van het sproeiwater op sportvelden heeft geen invloed op de kwaliteit van het sportveld.	-3	C*	-2	-2
	Lowest Ranked Statements				
15	Het vervangen van natuurgras en hybride sportvelden door kunstgras of watervelden lost alle problemen rondom water op sportvelden op.	-4	C*	-4	-4
21	De kwaliteit van het sproeiwater op sportvelden heeft geen invloed op de gezondheid van sporters.	-4	D*	-1	-1

Figure 23. Final factor array Factor 2 + Distinguishing statements (source: own image).

Factor array Factor 3

EV: 3.59

Explains 19% of study variance

Q sorts: 6

Composite Q sort for Factor 3

-4	-3	-2	-1	0	1	2	3	4
15. Het vervangen van natuurgras en hybride sportvelden door kunstgras of watervelden lost alle problemen rondom water op sportvelden op.	5. Er is voldoende externe financiÃ«le ondersteuning om als sportclub duurzaamheidsmaatregelen te treffen.	22. De kwaliteit van het sproeiwater op sportvelden heeft geen invloed op de kwaliteit van het sportveld.	✳◄ 4. Een sportclub wordt betrokken bij beleidsvormingsprocessen rondom een sportveld.	14. Sportclubs hebben een voortrekkersrol in de transitie naar het circulair omgaan met water op een sportveld.	13. Om een sportclub te verduurzamen spelen de leden een belangrijke rol.	✳► 11. In Nederland wordt preventief gehandeld als het gaat om klimaatverandering.	✳ 17. Het opvangen en hergebruiken van water voor het beregenen van sportvelden is een goede oplossing om sportvelden voor te bereiden op droogte.	✳✳► 23. Groene sportvelden in de stad zijn een kans om effecten van klimaatverandering tegen te gaan.
✳◄ 2. Het is duidelijk wie welke verantwoordelijkheid draagt voor problemen rondom droogte en wateroverlast op sportvelden.	1. Het huidige beleid vormt geen belemmering voor het implementeren van innovaties.	18. Waterbeheer in de gemeente Rotterdam is inzichtelijk.	✳✳◄ 7. Op de totale begroting van een sportclub is het beregenen van sportvelden met oppervlakte- of grondwater relevant.	✳✳ 6. De gemeente Rotterdam maakt voldoende budget vrij voor water gerelateerde duurzaamheidsinitiatieven.	20. Het wordt steeds droger in Rotterdam.	25. Publieke organisaties zorgen door het financieren van klimaat adaptieve maatregelen op privaat grondgebied voor een betere waterhuishouding in NL.	✳ 12. Alle betrokken partijen zijn nodig om een transitie naar een circulaire manier van omgaan met water op sportvelden te realiseren.	16. Pilots zijn erg belangrijk in de transitie naar duurzaam omgaan met water op sportvelden.
		3. Criteria die binnen aanbestedingen voor sportvelden gehanteerd worden bieden in het algemeen ruimte voor duurzaamheid.	✳✳◄ 9. De gevolgen van droogte op een sportveld zijn in geld uit te drukken.	8. Droogte op sportvelden leidt tot economische schade op de lange termijn.	26. Er zijn regels nodig rondom de kwaliteit van het oppervlakte water en grondwater voor het beregenen van sportvelden.	► 27. Regelgeving zorgt voor circulair omgaan met water op sportvelden.		
			21. De kwaliteit van het sproeiwater op sportvelden heeft geen invloed op de gezondheid van sporters.	10. Sportclubs vergelijken zich met andere sportclubs als het gaat om duurzaam waterbeheer.	19. Droogte vormt een uitdaging voor een goede bespeelbaarheid van een sportveld het hele jaar rond.			
				✳ 24. De effecten van droogte op een sportveld zijn voor mij helemaal duidelijk.				

Legend

✳ Distinguishing statement at P< 0.05

✳✳ Distinguishing statement at P< 0.01

► z-Score for the statement is higher than in all other factors

◄ z-Score for the statement is lower than in all other factors

	Relative Ranking of Statements in factor 3				
			Consensus		
	Highest Ranked Statements	factor 3	Distinguishing	factor 1	factor 2
23	Groene sportvelden in de stad zijn een kans om effecten van klimaatverandering tegen te gaan.	4	D*	1	2
16	Pilots zijn erg belangrijk in de transitie naar duurzaam omgaan met water op sportvelden.	4	C	3	4
	Positive Statements Ranked Higher in factor 3 Array than in Other Factor Arrays				
11	In Nederland wordt preventief gehandeld als het gaat om klimaatverandering.	2	D	-4	0
25	Publieke organisaties zorgen door het financieren van klimaat adaptieve maatregelen op privaat grondgebied voor een betere waterhuishouding in NL.	2	C	0	2
13	Om een sportclub te verduurzamen spelen de leden een belangrijke rol.	1	C*	1	0
14	Sportclubs hebben een voortrekkersrol in de transitie naar het circulair omgaan met water op een sportveld.	0		-1	0
8	Droogte op sportvelden leidt tot economische schade op de lange termijn.	0		0	-2
10	Sportclubs vergelijken zich met andere sportclubs als het gaat om duurzaam waterbeheer.	0		0	-2
	Negative Statements Ranked Lower in factor 3 Array than in Other Factor Arrays				
4	Een sportclub wordt betrokken bij beleidsvormingsprocessen rondom een sportveld.	-1	D	0	0
7	Op de totale begroting van een sportclub is het beregenen van sportvelden met oppervlakte- of grondwater relevant.	-1	D*	0	1
9	De gevolgen van droogte op een sportveld zijn in geld uit te drukken.	-1	D*	2	3
3	Criteria die binnen aanbestedingen voor sportvelden gehanteerd worden bieden in het algemeen ruimte voor duurzaamheid.	-2		-1	0
5	Er is voldoende externe financiÃ«le ondersteuning om als sportclub duurzaamheidsmaatregelen te treffen.	-3	C	-3	-1
1	Het huidige beleid vormt geen belemmering voor het implementeren van innovaties.	-3		-2	1
	Lowest Ranked Statements				
15	Het vervangen van natuurgras en hybride sportvelden door kunstgras of watervelden lost alle problemen rondom water op sportvelden op.	-4	C*	-4	-4
2	Het is duidelijk wie welke verantwoordelijkheid draagt voor problemen rondom droogte en wateroverlast op sportvelden.	-4	D	-2	-3

Figure 24. Final factor array Factor 3 + Distinguishing statements (source: own image).

APPENDIX I | Email to participants focus group

First email to invite participants

Beste ..,

Deze zomer hebben wij elkaar gesproken in een interview omtrent mogelijkheden voor een transitie naar een duurzame watervoorziening op sportvelden in de Gemeente Rotterdam. Hierbij heeft u meegeholpen aan mijn onderzoek door verschillende uitspraken rondom waterbeheer en gebruik op sportvelden te rangschikken. Ik wil u hierbij nogmaals bedanken voor dit interessante gesprek, het interview heeft veel relevante informatie opgeleverd.

Als aangegeven tijdens ons vorige gesprek wil ik in deze laatste fase van mijn onderzoek verschillende betrokken partijen bij elkaar brengen in een focusgroep om mijn resultaten terug te leggen en inzicht te krijgen in wat vervolg stappen rondom anders omgaan met water op sportvelden kunnen zijn.

Ik heb voor mijn onderzoek met de volgende partijen gesproken: *Gemeente Rotterdam, Sportbedrijf Rotterdam, Evides Waterbedrijf, Stichting RIONED, H2Óke Water en Gezondheid Advies, Van Kessel Sport en Cultuurtechniek bv, KNHB, R.C.S.V. Zestienhoven, Field Factors BV, Van Oosten Beregeningssystemen, KWR, Rotterdam Sportsupport, Hoogheemraadschap Delfland, STOWA en TU Delft.* De interviews hebben mij een beeld gegeven van hoe er tegen deze transitie wordt aangekeken, waar verschillen liggen tussen perspectieven van deze stakeholders en waar juist groepen ontstaan van stakeholders met dezelfde ideeën. Deze bevindingen leg ik graag tijdens het eerste deel van de focusgroep aan u terug. In het tweede deel zal onder begeleiding van een onafhankelijke gespreksleider een discussie worden gevoerd, waarin alle stakeholders hun percepties hierover kunnen delen, en we opzoek gaan naar eerste stappen richting een transitie naar een duurzaam waterbeheer op sportvelden.

De focusgroep zal vrijdag 27 november 2020 of maandag 30 november 2020 plaatsvinden. In de focusgroep krijgt u de kans om met betrokken partijen in gesprek te gaan, inzicht te krijgen in hoe andere partijen denken over waterbeheer en gebruik op sportvelden en uw percepties omtrent vervolgstappen te bespreken met partijen die hier ook mee bezig zijn.
Ik streef naar een deelname van 9 mensen in de focusgroep. Met stakeholders die niet aanwezig kunnen zijn hoop ik de opnamen van de focusgroep te kunnen delen. Omdat ik uw mening erg belangrijk acht hoop ik dat u deel kunt nemen aan de focusgroep.

De praktische informatie van de focusgroep op een rijtje:
Datum: 27 november 2020 of 30 november 2020
Tijd: 09:00 – 11:00
Locatie: online (de link voor de meeting volgt)
Gespreksleider: Martine Rutten
Participanten: 9

Ik hoor graag uiterlijk vrijdag 13 november of en op welke data u aanwezig kunt zijn bij de focusgroep.
Voor vragen kunt u mij altijd mailen of bellen op 0623550534. Alvast bedankt.
Met vriendelijke groet, Eva Aarts

Second email to send link to and inform participants on preparations for focus group

Goedemiddag,

Bedankt dat u wilt deelnemen aan mijn focusgroep morgen ochtend 27 november van 9:00 uur tot 11:00 uur!

Voorbereiden op focusgroep

Zoals u weet doe ik onderzoek naar mogelijkheden rondom een transitie naar een duurzame watervoorziening op sportvelden in de gemeente Rotterdam. Voor dit onderzoek heeft u allemaal in een eerder stadium deelgenomen aan een interview. Om de verschillende uitgangspunten in deze interviews met elkaar te kunnen vergelijken, heb ik het aantal perspectieven aan de hand van een statistische analyse gereduceerd naar 3 overkoepelende perspectieven.

Het doel van de focusgroep is het valideren van de resultaten uit de interviews en erachter komen waar ruimte ligt voor het verbeteren van waterbeheer en gebruik op sportvelden.

Kunt u zich voorbereiden op de focusgroep door onderstaande perspectieven te lezen en te kijken of u zich op basis van wat u heeft ingevuld kunt herkennen in een van deze drie perspectieven, want dat wordt het startpunt van de discussie vrijdag. In de voorstelronde zal ik u vragen aan te geven met welk van deze drie perspectieven u zich het meest identificeert.

Perspectieven

Perspectief 'Het sportveld centraal'

Binnen dit perspectief ligt de focus op het sportveld, waarbij vanuit een eigen situatie naar buiten toe wordt beredeneerd. Er wordt geïdentificeerd wat kansen en uitdagingen op het sportveld zijn, en van daaruit gekeken naar waar mogelijkheden liggen om hierop in te spelen.

De karakteristieken van die perspectief zijn als volgt:

- Alle betrokken partijen nodig
- Pilots zijn belangrijk, hoe meer hoe beter
- Motivatie voor transitie vanuit eigen ambities
- Effecten droogte op sportveld en de impact van anders omgaan met water moeten helder worden
- Droogte vormt een grote uitdaging voor de bespeelbaarheid van een sportveld
- Preventief handelen belangrijk

Perspectief 'Wijs met water'

Binnen dit perspectief wordt er gekeken naar waar mogelijke oplossingen liggen omtrent een duurzame watervoorziening op sportvelden en er wordt dan gekeken hoe en waar deze kunnen worden toegepast. Combinaties met waterproblemen in de omgeving van een sportveld worden meegenomen.

De karakteristieken van die perspectief zijn als volgt:

- Eerste stap transitie door gemeente en sportclub
- Gemeente moet meer budget vrijmaken

- Aandacht kwaliteit sproeiwater
- Combinatie met waterproblemen omgeving
- Focus op opvangen en hergebruiken van regenwater op sportvelden
- Regelgeving rondom kwaliteit en kwantiteit water nodig

Perspectief 'Stadsgerichte aanpak'
Vanuit dit perspectief wordt gekeken naar een sportveld als onderdeel van de stad, waarbij niet alleen watermanagement functies maar ook bijvoorbeeld sociale cohesie- en warmtemanagement- functies van een sportveld worden meegenomen. Een geïntegreerde stadsaanpak staat centraal.

De karakteristieken van die perspectief zijn als volgt:

- Sportclubs betrekken bij beleidsvormingsprocessen
- Iedereen moet worden betrokken en op 1 lijn zitten
- Verantwoordelijkheden heel erg onduidelijk
- Groene sportvelden in de stad geven een kans om klimaatverandering tegen te gaan
- Regelgeving eerste stap naar transitie

Praktische zaken

Bij deze de link om deel te nemen aan de meeting (kopieer deze link en plak deze in de zoekbalk van je internet browser): meet.google.com/wxs-qnmw-bsh

Daarnaast, de meeting wordt opgenomen zodat ik de resultaten van deze focusgroep kan verwerken in mijn onderzoek. De opname wordt verwijderd na de afronding van dit onderzoek. Indien u hier niet akkoord mee bent, laat het mij dan vooral weten voor 16:00 uur, dan bedenken we samen een oplossing.

Meer informatie onderzoek

Het doel van mijn onderzoek is om te kijken waar kansen liggen voor een duurzame watervoorziening op sportvelden in de gemeente Rotterdam. Dit onderzoek doe ik in kader van mijn thesis, een individueel onderzoek waarmee ik mijn master Industrial Ecology aan de TU Delft en Leiden Universiteit afsluit. In deze master leren we vanuit verschillende perspectieven naar duurzaamheidsproblemen te kijken, waarbij we proberen sociale en technische aspecten te verbinden, om zo tot geïntegreerde en geaccepteerde oplossingen te komen. Ik doe mijn afstudeeronderzoek in samenwerking met het bedrijf Field Factors.

Ik open de meeting morgen 5 minuten van te voren, u bent dan van harte welkom!
Mocht u over iets van bovenstaande vragen hebben, laat het mij dan alstublieft weten.

Met vriendelijke groet en nogmaals bedankt,
Eva Aarts

APPENDIX J | Stakeholder identification

Global scale

United Nations

The United Nations (UN) are responsible for maintaining international peace and security, delivering humanitarian aid, protecting human rights, upholding international law, and promoting sustainable development. The latter is defined by among others the '2030 agenda for sustainable development', in which the Sustainable Development Goals are presented, and the 'Paris climate change agreement 2015', which was supported by the UNFCCC and provides a pathway to make sure the global temperature rise is limited to 2, preferably 1.5, degrees (United Nations, n.d.-a).

The Sustainable Development Goals (SDG's) consist of 17 goals as a call for action by all countries to promote prosperity while protecting the planet (United Nations, n.d.-b, 2015). Promoting and making policy for enabling sufficient water in a circular way to keep urban sports fields playable can contribute to achieving many of these SDG's; it will have a direct impact on good health and well-being, contributing to SDG 3, as well as on SDG 6: promoting access to clean water, SDG 12: promoting a sustainable infrastructure and responsible use of water, SDG 13: promoting climate resilient environments, and SDG 17: promoting worldwide partnerships and collaboration to be able to realise all other SDG's. Other SDG's that are touched upon are: quality education (SDG 4), gender equality (SDG 5), industry, innovation and infrastructure (SDG 9) and reduced inequalities (SDG 10).

The IPCC was created to determine the state of climate change and to identify areas that need to be further researched, in order to identify potential future risks as well as to analyse adaptation and mitigation options (IPCC, n.d.). The research itself is not done by the IPCC.

On a water level, the United Nations European Program (UNEP) helps countries to "protect and restore freshwater and marine ecosystems to sustain their surfaces for generations to come" (United Nations - environment programme, n.d.). The missions of the UNEP is to arrange leadership and stimulate partnerships in order to inspire, inform and enable nations and peoples to enhance their quality of life without compromising the lives of future generations.

World Health Organisation

The World Health Organisation (WHO) is promoting health, working towards a safe world and serving the vulnerable (World Health Organisation, n.d.). Their goal is to "ensure that a billion more people have universal health coverage, to protect a billion more people from health emergencies, and provide a further billion people with better health and well-being". When it comes to sports, which is a subcategory within physical activity, the WHO mentions that "sport and active recreation can help promote physical activity for people of all ages and abilities", and aims to create access to "safe and enabling environments and to diverse opportunities to be physically active in their daily lives, as a means of improving individual and community health and contributing to the social, cultural and economic development of all nations". Their target is "a 15% relative reduction in the global prevalence of physical inactivity in adults and in adolescents by 2030" (World Health Organisation, 2018).

The WHO is responsible for directing and coordinating of authority on international health work. Its mission is to enhance the quality of life, to reduce encumber of diseases and poverty, and to provide access to health care for all.

European scale

European Union

The European Commission is the executive branch of the European Union (EU) and is responsible for the formulation of proposals for new European laws, as well as implementing decisions made by the European Parliament and Council of the European Union (European Union, n.d.). This case-study falls within the legislation of the EU, and though the EU will not be seen as a main stakeholder in this research, there must be act within the boundaries of this legislation.

On a European scale, legislation for water seems to be based on (European Commission, n.d.-b)():

- The Water Framework Directive (WFD), adopted in 2000 by the European Commission, which "takes a pioneering approach to protecting water based on natural geographical formations: river basins".
- The Environmental Quality Standards Directive (EQSD), adopted in 2008, which follows up on the WDFs strategy 'strategies against pollution of water'. The EQSD sets environmental surface water quality standards, in order to ensure minimal risks from hazardous substances in the water.
- The Groundwater Directive (GWD), again a complementation of the WDF. The GWD was adopted in 2006, in order to achieve sufficient quantities and qualities of groundwater, by establishing quality standards and introducing measures to prevent or limit inputs of pollutants into groundwater.
- The Floods Directive (FD), adopted in 2007, which is designed to make sure flood risks are assessed and when needed reduced.

When it comes to climate adaptation strategies, the European Commission mentions that adaptation strategies are needed at different special scales, from local to EU and international levels, and will often focus on urban areas, as cities have a major role in their implementation. The Covenant of Mayors for Climate and Energy is "the main conduit for EU support to cities for climate-change adaptation" (European Commission, n.d.-a).

The European Water Association is one of the major professional organisations in Europe that is dealing with the management and improvement of the water environment, working closely with the European Commission.

The Directorate General for Youth, Sport, Education and Culture (DG EAC) is the division of the European Commission responsible for the development and implementation of European policy when it comes to sport. The DG EAC focusses on the development of sport and society and supports dialogue between policy makers and sport organisers to promote healthy living and social cohesion (European Commission, n.d.-c).

Global and European rules, regulations and ambitions are translated towards national and regional policy, roles and responsibilities. It is therefore chosen to only indirectly include stakeholders on a European and Global scale.

National scale

The Dutch national government

The Dutch national government is responsible for the coordination of government policy and communications. The national government makes policy, enacts laws and ensures compliance (Rijksoverheid, n.d.-c). There are 12 different ministries, that prepare policies and legislation. The two highly relevant ministries for this research are the Dutch ministry of Public Health, Wellbeing and Sports and the Dutch ministry of Infrastructure and Water.

Dutch Ministry of Public Health, Welfare and Sport

The Ministry of Health, Welfare and Sport (in Dutch: VWS) is the Dutch Ministry responsible for public health, health care, quality of life, social work and sport. It encourages people to adopt healthy lifestyles e.g. by exercising more and eating healthily, and has the ambition to keep all residents healthy as long as possible and to restore the sick to health as quickly as possible. The 'sports mission' of the Ministry is to make it possible for everyone to play sports and to exercise, as this promotes health, provides social contacts and contributes to self-development (Government of the Netherlands, 2020).

The National Institute for Public Health and the Environment (In Dutch: RIVM) is an independent branch of the Ministry of Health, Welfare and Sport, conducting scientific research on behalf of government policy in the area of public health, the environment and nature.

Dutch Ministry of Infrastructure and Water Management

The Ministry of Infrastructure and Water Management (in Dutch: I&W) is a committed to make the Netherlands safe, accessible and liveable. Hence, it aims for strong connections over the road, water and in the air. The ministry is responsible for the protection against flooding and to ensure a sufficient quality of air, water and soil, and is working towards the realization of a circular economy (Rijksoverheid, n.d.-a).

Three Directorates-General are relevant within the topic of water on sports fields, namely the Directorate-General for the Environment and International Affairs, the Directorate-General for Water and Soil Affairs and Rijkswaterstaat.

Directorate-General for the Environment and International Affairs

The Directorate-General for the Environment and International Affairs is responsible for policy development in the fields of:

- a clean, safe, healthy and sustainable human environment;
- air quality;
- circular economy;
- sustainability;
- environmental security and environmental risks

Directorate-General for Water and Soil Affairs
The Directorate-General for Water and Soil Affairs is responsible for policy development in the fields of:

- water policy and flood risk management;
- climate adaptation;
- water projects in specific areas;
- water and soil issues.

Rijkswaterstaat
Rijkswaterstaat is the executive agency of the Ministry of Infrastructure and Water Management. Rijkswaterstaat is responsible for the main road and waterway networks and the main water systems in the Netherlands, as well as the environment in which they are embedded.

When it comes to water systems, Rijkswaterstaat ensures a safe and user-friendly national water system, and protects the Netherlands against flooding. Sufficient water quality and quantity are key. They work in close cooperation with water boards, other public authorities, NGOs and private parties.

Research and knowledge institutes

Research and knowledge institutes such as Deltares, IHE, KWR, TAUW, TU Delft and H2Óke are doing research to provide knowledge for and give advises to industries, governments and water authorities. Some institutes are specifically focussed on water, others have a broader context, but are doing a lot of projects on e.g. sustainable use of fresh water resources (KWR, n.d.), water management and flood protection (TAUW, n.d.). Circular economy, sustainable urban development and climate adaptation are examples of overarching themes that are taken into account.

These research and knowledge institutes have the responsibility to realise knowledge development and knowledge sharing, as well as strengthen learning capacities. Research is conducted on topics such as extreme weather events and flooding, water scarcity and desiccation and adaptive planning. The institutes have different goals and visions, but all aim to work towards future-proof solutions (Deltares, n.d.; IHE Delft, n.d.).

Associations related to sports

Associations related to sports that should be taken into account when looking at water governance on sports fields are the Vereniging Sport en Gemeenten, the NOC*NSF, and the Sports federations.

The Vereniging Sport en Gemeenten (VSG) is the representative of the Dutch municipalities in the field of sports. The VSG acts on a national level as a discussion partner on behalf of municipalities in contacts with ministries, sports umbrella organizations and research and educational institutions. Municipalities play an important role when it comes to sports and exercise in the Netherlands. About 70% of the Dutch municipalities is affiliated with the VSG. Ensuring that sports and exercise activities are accessible, nearby and safe for all citizens, together with the promotion of a healthy lifestyle, is the key mission of the VSG (Vereniging Sport en Gemeenten, n.d.).

The NOC*NSF is an umbrella organisation for all the sports in the Netherlands. NOC*NSF supports, coordinates, and represents the interests of the associated sport federations. The mission of the

NOC*NSF is to create optimal sports conditions for everyone. NOC*NSF is a partner of the Nationaal Sportakkoord, aiming for among others a sustainable sports infrastructure and a healthy sports environment (NOC*NSF, 2018).

There are 77 sport federations affiliated with the NOC*NSF (NOC*NSF, n.d.). They represent about 24.000 sport clubs with about 5.2 million athletes.

De Groene Club is a sport-wide initiative of the KNVB, KNHB and KNLTB and in collaboration with the provinces of Gelderland, Overijssel and South Holland to make sports facilities more sustainable. The KNVB, KNHB and KNLTB have the ambition to realise sustainable sports accommodations. The focus seems to be on taking sustainable measures that lead to lowering the energy bill contributes to this, as energy is one of the largest costs for a club (KNVB, n.d.).

Foundations

Two foundations related to the context of urban water management and sports fields are Stichting Rioned and STOWA.

Stichting RIONED is the umbrella organisation for urban water management in the Netherlands. Responding to new challenges and opportunities, Stichting RIONED focusses on the importance of urban water management: taking proper care of waste water, rainwater and groundwater in cities and villages.
Sufficient urban water management ensures no flooding, health and environmental protection. Climate change requires more space above and in the ground to collect water, as well as active cooperation from residents and land owners. Stichting RIONED connects city, water and people.

The need to involve plot owners and residents to ensure sustainable urban water management is getting more and more awareness. Stichting RIONED focuses primarily on professionals by providing direction and offering concrete products. However, plot owners and residents are also target groups because of their own capabilities and responsibilities (Stichting RIONED, n.d.)

STOWA is the centre of expertise of the Dutch water authorities. Its mission is to develop, collect, distribute and implement applied knowledge, to ensure effective, efficient and future-proof water management (STOWA, n.d.). STOWA sets up research agendas with the water authorities, and makes sure the knowledge requirements are placed with the correct knowledge providers. Examples of organisations STOWA collaborates with are given under Research Institutes. STOWA is a link between the users of knowledge, knowledge providers and regional water managers.

Private businesses

Four private businesses that are related to urban water management on sports fields are drinking water companies, sprinkler systems suppliers, contractors and landscape architects.

The drinking water company that supplies fresh water to South-West of the province of South-Holland, including the Municipality of Rotterdam, is Evides Waterbedrijf. Evides Waterbedrijf is responsible for providing good quality drinking water up to the main tap (Evides Waterbedrijf, n.d.)

Landscapes form our living environment. Landscape architects are responsible for studying and designing sustainable solutions for important landscape challenges such as climate change, health and urbanisation.

Contractors that operate in the context of sports clubs are responsible for the construction of sports facilities and sports fields. Through proper installation, the aim is to realise future-proof accommodations. Sprinkler systems suppliers are responsible for the supply and construction of sprinkler systems on sports fields, and often work together with contractors.

Pioneers

Pioneers in the field of sustainable urban water management on sports fields can be for example technology providers, consultants and engineers, such as Field Factors, Draintalent and Newae. These pioneers take a leading role in the realisation of change, for example by developing innovative technologies that provide opportunities for more sustainable water use, but also by for example conducting research on water quality and quantity, which can play a role in a change of awareness or regulations. These pioneers often work together with governmental organisations such as municipalities, provinces, and water authorities, but as well with research and knowledge institutes. Depending on the type of pioneer, other stakeholder relations could be identified as well. These pioneers

Regional scale

Province of South-Holland

The Netherlands consists of twelve provinces, responsible for policy making on a regional scale. The provinces translate national policy into regional measures. The provinces are as well responsible for compliance with environmental laws for air, soil and water and the supervision of the water boards and the municipalities (Interprovinciaal Overleg, n.d.; Rijksoverheid, n.d.-b). The Municipality of Rotterdam is located within the Province of South-Holland. Together with municipalities, water authorities and social organisations they ensure the implementation of policies. In the coalition agreement 2019-2023, the Province of South-Holland states that they are committed to realise a climate-proof environment by stimulating sufficient greenery and water in and around residential areas (Provincie Zuid-Holland, n.d.-a). The aim is to investigate how the regions can cope with weather extremes, to ensure that measures related to themes such as heat and drought are taken. Commitment to climate adaptation offers international opportunities. The Province of South-Holland is a frontrunner in the field of climate adaptation and aims to remain so, by innovating and ensuring the implementation of climate adaptation in all their projects.

In the context of sports, the Province of South-Holland mentions that sport and exercise are important for health, and that they contribute to this by investing in the quality of green infrastructures. Together with municipalities they discuss the opportunities for sports in public spaces and the realisation of more sustainable sports accommodations. Their aim is to realise a sufficient sports infrastructure to ensure all residents have the opportunity to play sports (Provincie Zuid-Holland, n.d.-b).

Water authorities

Together with Rijkswaterstaat, regional water authorities are charged with water management in the Netherlands. They are responsible for ensuring a sufficient supply of water as well as protecting the Netherlands against flooding (Rijksoverheid, n.d.-e). Regional water authorities are responsible for regional waters, such as canals and polder waterways. They work on sufficient water quantity, water safety and are as well responsible for waste water purification (Dutch Water Authorities, n.d.). The Municipality of Rotterdam falls under the responsibiliy of the Delfland water authority, Schieland en Krimenerwaard water authority, and Hollandse Delta water authority.

Local scale

Municipality of Rotterdam

The Municipality of Rotterdam is one of the four biggest municipalities in The Netherlands. It is one of the metropoles in the Netherlands that has faced multiple water problems in the previous years and is chosen as the single case study for this research. The Municipality of Rotterdam plays an important role in the implementation of sustainable governance. A municipality performs tasks that are of direct importance to its residents. In addition, the municipality also implements many national laws (Rijksoverheid, n.d.-d).

The ambitions of the Municipality of Rotterdam on securing sufficient water quality, water quantity and water safety are set by the Rotterdams WeerWoord. In the context of sports, the Municipality of Rotterdam has the ambition for 2030 to further increase sustainable participation in sports, to optimize the (social) effect of sports and exercise and to move along with an environment with rapidly changing needs, technologies and possibilities (Gemeente Rotterdam, 2017b).

The Municipality of Rotterdam (Sports and Culture) is responsible for formulating municipal sports policy, advising the municipal council on sports policy and fulfilling the commissioning (direction) for the implementation of sports policy. For the implementation of the sports policy, the municipality works together with three parties in particular; Rotterdam Sportsupport, Rotterdam Topsport and Sportbedrijf Rotterdam.
Rotterdam Topsport is committed to a strong top sports climate, among others by guiding top sports events and supporting top sports associations, talents and top athletes (Rotterdam Sportsupport, n.d.).

Sportbedrijf Rotterdam

The vast majority of the sports fields in the Municipality of Rotterdam is owned by the municipality. These sports clubs however are managed by Sportbedrijf Rotterdam, a privatized organization that operates, maintains and supports sports venues throughout the Municipality of Rotterdam (Sportbedrijf Rotterdam, 2020). Sportbedrijf Rotterdam manages 84 sports locations with sports accommodations for outdoor sports activities.

Rotterdam Sportsupport

Rotterdam Sportsupport develops and connects programs to get the residents of Rotterdam active in sports and society. Rotterdam Sportsupport works together with 346 sports clubs in Rotterdam, aiming for vital, safe and future-proof sports clubs (Rotterdam Sportsupport, n.d.).

Rotterdams WeerWoord

The Rotterdams WeerWoord is a collaboration between the Municipality of Rotterdam, the Schieland and Krimpenerwaard water authority, the Hollandse Delta water authority, Delfland water authority and Evides Waterbedrijf. The aim of the Rotterdams WeerWoord is to prepare Rotterdam for a more extreme climate together, making the city weather resistant in collaboration with the residents of Rotterdam. The goal of the Rotterdams WeerWoord is a climate-proof Rotterdam by 2025 (Rotterdams WeerWoord, n.d.). The six themes on which the Rotterdams WeerWoord focusses are land subsidence, drought, floodings, ground water, heat stress and precipitation.

Ingenieursbureau Rotterdam

Rotterdam has its own engineering office for maintenance and renewal (Gemeente Rotterdam, n.d.-b). The engineers of the Municipality of Rotterdam combine knowledge and implementation and can therefore cope with any infrastructural challenge, making the realisation of ambitions feasible.
The engineering office also shares its knowledge and expertise outside the Rotterdam city boundaries. For example, there is a partnership with Rijkswaterstaat and the Municipality of Amsterdam, and knowledge is as well shared with international networks.

Neighbourhood managers

A neighbourhood manager obtains and keeps an overview of the maintenance needs of all parties active in the management of the outdoor space (private and public). This maintenance requirements are translated into a multi-year area plan, where the implementation is realized in the most favourable way possible for all parties involved, both for the municipality as well as for the residents and companies in the area. In consultation with project managers, the actual implementation of measures is ensured.

Sport clubs

The sports clubs represent the board members of a sports club and the playing members, as well as family members or friends that support the players when a game is played, volunteers to assist with tasks, everyday management and so on. The sports clubs are responsible for the irrigation of the sports fields. Sports clubs have few resources to realise major sustainability transitions on a sports field. That responsibility is now often taken up together with Sportbedrijf Rotterdam and the Municipality of Rotterdam.

APPENDIX K | Validation perspectives

Table 35. Overview validation consensus statements.

Name	More attention for quality of the water used to irrigate the sports fields is necessary	Pilots are important if we want to improve water management and water use on sports fields	Eventually we need all involved parties to join
(18) Sportbedrijf Rotterdam	Agree	Agree	Agree
(16) KNHB	Agree	Agree	Agree
(14) Van Oosten beregeningssystemen	Agree	Agree	Disagree
(9) Rotterdam Sportsupport	Agree	Agree	Agree
(2) STOWA	Agree	Agree	Agree
(19) Municipality of Rotterdam - Advisor Climate Adaptation & Urban Water	Agree	Agree	Disagree
(11) TU Delft	Agree	Agree	Agree
(6) Municipality of Rotterdam – Process Manager Rotterdams Weerwoord	Agree	Agree	Agree
(4) Municipality of Rotterdam – Advisor Climate Adaptation	Agree	Agree	Disagree
(5) Field Factors bv	Agree	Agree	Disagree
(10) H2Óke Water en Gezondheid advies	Agree	Agree	Agree
(3) Hoogheemraadschap Delfland	Agree	Agree	Disagree
(15) Municipality of Rotterdam - Neighbourhood Manager \ Outdoor Space Manager	Agree	Agree	Agree

Table 36. Overview of with which perspective the stakeholders identify themselves the most.

Organisation	Beginning focugroup	After presentation	Statistical analyse
(18) Sportbedrijf Rotterdam	UU	UU	WW
(16) KNHB	WW	WW	WW
(14) Van Oosten beregeningssystemen		WW	UU
(9) Rotterdam Sportsupport	WW	WW	UU
(2) STOWA	UU	UU	
(19) Municipality of Rotterdam - Advisor Climate Adaptation & Urban Water	WW	WW	FF
(11) TU Delft	WW	WW	
(6) Municipality of Rotterdam – Process Manager Rotterdams Weerwoord	UU	UU	UU
(4) Municipality of Rotterdam – Advisor Climate Adaptation	WW	WW	WW
(5) Field Factors bv	UU	WW	WW
(10) H2Óke Water en Gezondheid advies	WW	WW	FF
(3) Hoogheemraadschap Delfland	UU	UU	UU
(15) Municipality of Rotterdam - Neighbourhood Manager \ Outdoor Space Manager		WW	FF

Urban Ultra
Water Wise
Field Focus

Table 37. How often are the characteristics of the perspectives mentioned in the focus group.

Field Focus		Water Wise		Urban Ultra	
All stakeholders needed	I	First step transition by municipality and sports club		Clarify responsibilities for drought and flooding of sports fields	III
Pilots are important, the more the better	II	Municipality must free up more budget		Everyone must be involved and aligned	~~IIII~~
Effects of drought on sports fields and the impact of using water differently must become clear	I	Combination with water problems in the surroundings of sports fields	III	Integrate sports fields in the city to combat climate change	II
Preventive action is important		Focus on collecting and reusing rainwater on sports fields to guarantee playability of fields		Tackle drought on sports fields to prevent economic damage and additional social problems.	II
Motivation for transition based on own ambitions	I	Regulations concerning the quality and quantity of water required		Regulations are the first step towards a transition	I

Table 38. Overview of the validation of the perspectives.

Bold text: Within what perspective the stakeholder falls according to the statistical analysis, as well as with what perspective the stakeholder identifies most.
Italic text: From what perspective does the stakeholder seems to reason
Underlined text: The characteristic that the quotes support.
Normal text: Quotes from stakeholders which support the characteristic from the perspective

Organisation	Field Focus	Water Wise	Urban Ultra
(18) Sportbedrijf Rotterdam		**Statistical analysis**	**Stakeholder identifies most with this perspective** Everyone must be involved and aligned Realising partnerships, involving all parties, in the development of initiatives that are difficult for us should be possible with a city-oriented approach. Volunteers are busy keeping the sports club running.
(16) KNHB	*This stakeholder seems to focus on challenges and opportunities related to sports fields and finding opportunities outside a sports field to relate to.* Pilots are important, the more the better The more pilots the better. All stakeholders needed Rarely is a sports association that says let's think about whether we can do something else with that water. 9 out of 10 times the Municipality of Rotterdam, Leiden, Utrecht or Amsterdam that comes up with these initiatives. It is a call from the outside It must be all parties, because if we want to do something with this, then we must ensure that that responsibility here is at least felt by much more parties, and everyone is needed. Motivation for transition based on own ambitions I'm not saying it should be top-down or bottom-up, it's a shared story. Effects of drought on sports fields and the impact of using water differently must become clear We must also focus much more on water when raising awareness for	**Stakeholder identifies most with this perspective** **&** **Statistical analysis** Combination with water problems in the surroundings of sports fields We must also focus much more on water when raising awareness for sustainability on sports fields, as well as on sustainable solutions in the surroundings of a sports field.	

	sustainability on sports fields, as well as on sustainable solutions in the surroundings of a sports field.		
(14) Van Oosten beregeningssystemen		***Stakeholder identifies most with this perspective***	***Statistical analysis*** *This stakeholder seems to focus on finding solutions characterised by an inside-out reasoning, but in an integrated approach.* Clarify responsibilities for drought and flooding of sports fields & Regulations are the first step towards a transition Who is responsible for what seems to be a piece of regulation, or a piece of putting things in order. Integrate sports fields in the city to combat climate change Ultimately, the association itself has to ensure that a transition can be realized. Sportbedrijf Rotterdam will not be able to jump in every year at every sports clubs when water related problems occur. Especially because we will get more and more problems. You can slowly work towards a certain standard, but that also takes time.
(9) Rotterdam Sportsupport		***Stakeholder identifies most with this perspective*** Combination with water problems in the surroundings of sports fields Opportunities for that urgency to contribute to ideas for sustainable ways of water collection.	***Statistical analysis*** Tackle drought on sports fields to prevent economic damage and additional social problems. It is indeed the volunteers who maintain the sports fields. What you notice is that the amount of volunteers in the maintenance determines the quality of the grass and therefore also the irrigation is very important. A more automated system will already help a lot to ensure a good quality of the fields. In the past two years, mainly the drought seemed to be a problem, as some sports clubs, especially football clubs, are located where drought causes a lot of problems with collecting water for the fields. Everyone must be involved and aligned If the government, in combination with all kinds of parties, takes action on a project-based level sports clubs are absolutely prepared to take steps in this and think

			along in this matter. At this moment it is the incentive they simply do not feel. And they may have to invest a lot and that will be very difficult with their budgets.
(2) STOWA		Combination with water problems in the surroundings of sports fields When improving water management on sports fields, it is definitely a good idea to include water management in the surroundings of a sports field a well.	***Stakeholder identifies most with this perspective*** Everyone must be involved and aligned Everyone should be on one line. On this line a consortium can be created where there should be enough shared interest. This consortium should be combined with sharing 'sector' knowledge.
(19) Municipality of Rotterdam - Advisor Climate Adaptation & Urban Water	***Statistical analysis***	***Stakeholder identifies most with this perspective*** *I reason purely from a focus on water*	
(11) TU Delft		***Stakeholder identifies most with this perspective***	
(6) Municipality of Rotterdam – Process Manager Rotterdams Weerwoord			***Stakeholder identifies most with this perspective*** **&** ***Statistical analysis*** *Within the Rotterdams WeerWoord we strive for a collaborated working method.*
(4) Municipality of Rotterdam – Advisor Climate Adaptation		***Stakeholder identifies most with this perspective*** ***&*** ***Statistical analysis*** *This stakeholder follows a solution based approach, with a focus on water.* Focus on water What does the water use, consumption or supply means for the quality of the sports complex and its immediate surroundings. When looking at it from this perspective, you define it more as a value, the value of water. What does it yield then? Exploring joint investment, such as in social real estate, so that you can look as joint parties at what that means for water in and around the sports complex. Towards sustainable water systems.	Clarify responsibilities for drought and flooding of sports fields Besides responsibility for drought, who is responsible for water quality on sports fields is unclear. Tackle drought on sports fields to prevent economic damage and additional social problems. To take the pressure off my volunteers it might be good if we get smarter systems Everyone must be involved and aligned Where municipalities or governments and sports clubs can find each other, where they are on the same page.

(5) Field Factors bv		***Stakeholder identifies most with this perspective*** **&** ***Statistical analysis*** *The Water Wise perspective is a nice stepping stone to a transition towards integrated sustainable water management on sports fields.*	
(10) H2Óke Water en Gezondheid advies	***Statistical analysis***	***Stakeholder identifies most with this perspective*** *Where water and people come together, find each other.*	
(3) Hoogheemraadschap Delfland			***Stakeholder identifies most with this perspective*** **&** ***Statistical analysis*** <u>Clarify responsibilities for drought and flooding of sports fields</u> Knowledge about roles and responsibilities is now required <u>Everyone must be involved and aligned</u> When a first consortia and good examples have been successful, regulations may be needed in the long term to get the last sports clubs on board.
(15) Municipality of Rotterdam - Neighbourhood Manager \ Outdoor Space Manager	***Statistical analysis*** <u>Pilots are important, the more the better</u> We started with these kinds of conversations and started exploring enthusiasm and opportunities, doing pilots, and from pilots to rules and regulation and then doing new pilots, and so iteratively take more and more steps together until we work towards another normal.	***Stakeholder identifies most with this perspective***	<u>Clarify responsibilities for drought and flooding of sports fields</u> And who then has that responsibility for each of the preconditions <u>Integrate sports fields in the city to combat climate change</u> Sports fields may have a little less acreage, but they could just as well be such a party. If we can do something for each other, can we than not simply make our city better and more future-proof. So from that perspective, if you have something to offer each other, the one the space and the usability, and the other a big challenge that comes our way, how do you make that combination.