‘Of course we’re not going to reach the Water Framework Directive objectives’

An historical and political-ecological analysis of the water quality of the Langeraarse Plassen and water quality management by the Hoogheemraadschap van Rijnland

MSc Thesis by Jessica van Grootveld

May 2016

Water Resources Management group

WAGENINGEN UNIVERSITY
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Master thesis Water Resources Management submitted in partial fulfilment of the degree of Master of Science in International Land and Water Management at Wageningen University, the Netherlands

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Abstract

All EU member states should meet the Water Framework Directive (WFD) objectives by 2027. The Hoogheemraadschap van Rijnland (HHR), a Dutch Water Board, has decided to invest in the Langeraarse Plassen during WFD's second cycle (2016-2021), in its effort to comply with the WFD and to improve water quality. On-going discussions regarding the implementation of the WFD in general, and the feasibility of cleaning up fen lakes in particular are frequent.

This dissertation investigates the extent to which the historical water quality of the Langeraarse Plassen parallels the nationally formulated WFD reference condition for moderately large, shallow fen lakes (M27 water bodies), and HHR's WFD policy objectives. Additionally, this study sheds light on the WFD II policy process within the HHR and thereby contributes to the discussion about whether the Netherlands will meet the WFD by 2027 or not.

Political ecology, historical ecology, water quality, and policy as a process have framed the analysis. Various historical sources were consulted and sixteen oral-history interviews were conducted, in order to describe the socio-environmental history of the Lakes. A qualitative approach - including thirteen interviews, observations throughout a period of eight-months, and policy document analysis - was employed to unravel HHR's WFD II policy process, with specific reference to the Langeraarse Plassen.

Results show that the Langeraarse Plassen have not matched either the M27 reference condition or HHR's WFD goals since the beginning of the 20th century. Policy analysis has revealed that the traditional, apolitical, linear way in which the HHR envisages policy, does not represent the more chaotic and contested reality, and that the actors of the HHR are operating in a very complex environment. This study further indicates that it is unlikely that the Netherlands will obtain the WFD goals by 2027, especially as ecological water management is still trapped in an underdog position.

Key words: Water Framework Directive; Hoogheemraadschap van Rijnland; Langeraarse Plassen; fen lakes; political ecology; historical ecology; water quality; policy as a process

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Glossary and Abbreviations

Boezem (water)	A continuous system of raised waterways (lakes, rivers, etc.). Pumping stations pump excess water from the lower lying polders to the boezem system (or vice versa). The water in the boezem then flows out to sea or to another boezem system.
EQR	Ecological Quality Ratio
EU	European Union
HHR	Hoogheemraadschap van Rijnland (one of the twenty-three Dutch Regional Water Authorities, or Water Boards)
Hoogheemraad	A Hoogheemraad is someone who is part of the daily board of a regional water authority. The function is comparable to an alderman.
M27	National WFD reference condition for moderately large, shallow peat lakes. A reference condition is a description of the water quality of a water body in its most natural pristine state, with little or no human interference.
Polder	A polder is an area of reclaimed land surrounded by dikes where the water is artificially controlled.
PPD department	Policy and Plan Development Department
RBM	River Basin Management
WFD	Water Framework Directive
WWTP	Waste Water Treatment Plant

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1. Introduction

"Minister Schultz remains convinced that the Netherlands will meet the WFD-objectives." (Waterforum, 2015)

This was the headline of an online article which appeared on Waterforum on 25 November 2015. Schultz, Melanie Schultz van Haegen-Maas Geesteranus, is the Secretary for Infrastructure and the Environment in the Netherlands. The idea that the Netherlands will reach the Water Framework Directive (WFD) goals by 2027 contradicts the results of a recent ex-ante evaluation of Dutch river basin plans for the WFD. The Planbureau voor de Leefomgeving (PBL), a governmental research institute, studied the proposed water quality improvement measures outlined in the Dutch River Basin Management (RBM) plans for 2016-2021 and concluded that the proposed measures were insufficient to reach the intended WFD goals. Achievement of the WFD objectives would require additional commitment by the government, water managers and farmers (van Gaalen et al., 2016).

In 2000, the "*Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy*" or, in short, the EU Water Framework Directive (WFD) came into force (European Parliament & Council of the European Union, 2000). The main goal of the WFD is to create clean and healthy water systems - both surface- and groundwater - throughout Europe by 2015 (STOWA, 2005) (Rijksoverheid, n.d.). Some exceptions to this deadline are possible. In some cases obtaining "good status" ecological- and chemical- waters can be postponed until 2021 or even 2027, as is the case in the Netherlands (CBS, PBL, & Wageningen UR, 2014).

The Netherlands has been labelled as one of the countries within the EU with low WFD ambitions (Behagel & Arts, 2014). In the Netherlands the authorities that deal with the WFD are the Ministry of Infrastructure and the Environment; its executive agency, Rijkswaterstaat, which oversees the national waters; the provinces, which are responsible for groundwater, and the Regional Water Authorities which manage the regional waters (OECD, 2014). The Hoogheemraadschap van Rijnland (HHR) is one of the twenty-three Regional Water Authorities or Water Boards in the Netherlands (DWA, 2015). The second WFD management cycle (2016-2021) has just started. During this period measures will be taken in a few by the HHR prioritised water bodies to improve the water quality, in order to comply with the water quality objectives of the EU WFD. One of the water bodies which has been selected for this second WFD phase is the Langeraarse Plassen[1].

The current water quality of the Langeraarse Plassen has been studied extensively (see (Michielsen, 2012; Torenbeek, 2013b)). At present - in its eutrophic and highly turbid state - it does not meet the terms of the WFD. Implementation of the WFD follows a set of pre-determined steps. One of the requirements is that all WFD member states are obliged to define the terms of good ecological status - in other words the reference condition - for the different water types present in their country. In the Netherlands forty-two natural water types have been identified, and for each water type a detailed description of the pristine ecological status has been given. In other words, an ecology with little or no anthropogenic influences (Siebelink, 2005). Reference conditions have been based on historical data (i), descriptions of undisturbed situations within the Netherlands and abroad (ii), model results (iii) and expert judgement (iv) (Altenburg et al., 2012). It is not the goal of the WFD to change all surface waters

[1] The other prioritised water bodies are Natura 2000 area *de Wilck*, the waters surrounding *Zoetermeer,* and the Westeinderplassen in Aalsmeer (HHR, 2016f).

back to their reference or undisturbed state, but to see the reference as a *stip aan de horizon*[2] which gives direction (Gerrits, 2014). The Langeraarse Plassen can be classified, using the water framework directive typology for Dutch waters (see (Siebelink & van der Wal, 2005)), as moderately large and shallow fen lakes or M27 waters (Torenbeek, 2013b). Based on the reference level for M27 waters the HHR has described its own target situation for this water type as follows: *"We strive to obtain clear water dominated by aquatic plants with a corresponding macro fauna and fish community"* (Torenbeek, 2013b, p. 7). Additionally, water body specific WFD policy goals have been derived using the *Prague Method*[3].

The WFD project team of HHR is currently planning which water quality improvement measures they are going to take in the Langeraarse Plassen. There are a lot of on-going discussions regarding the implementation of the WFD. There are, for instance, those who doubt the feasibility and desirability of cleaning up fen lakes. Attainability of the set WFD policy objectives are also subject to discussion. Theoretically it is possible to restore lakes. In academic literature it is widely recognised that through various restoration measures such as reducing nutrient loads and bio manipulation (of course the choice of measures is case to case specific), lakes can be brought back to their clear water state ((Jaarsma, 2008); (Scheffer, Carpenter, Foley, Folke, & Walker, 2001)). There is no guarantee, however, that restoration measures will lead to the desired outcome. Previous attempts to restore the Langeraarse Plassen, in particular the Geerplas, have only temporarily (1990-1993) been effective. After 1993 the poor water quality returned due to internal eutrophication (Michielsen, 2012).

There are thus strong doubts if it is in fact possible to reach the WFD policy goals in the Langeraarse Plassen. Additionally, it is unknown whether the reference condition (M27), HHR's target image for the Langeraarse Plassen, and the WFD policy goals have ever been present. An historical analysis of the water quality of the Langeraarse Plassen will clarify whether it is realistic from an historical perspective - one of the four aspects upon which the M27 reference condition is based - to return the lakes to a clear state. Furthermore, this study sets out to investigate the bigger picture: that is, to better understand the struggles of implementing the WFD policy process in the Langeraarse Plassen and thereby to shed light on the possibility of reaching the WFD goals by 2027**.** One only has to do a bit of simple arithmetic to see that this goal of meeting the WFD objectives in all HHR's water bodies by 2027 is going to be a challenge. The HHR has forty water bodies in total, of which three have been prioritised in the first period[4] (2009-2015) and four in the second (2016-2021).

The WFD has been studied extensively. Searching for *Water Framework Directive* in the academic search engine Google Scholar results in approximately 2200 (2190) articles or books published in 2016 and a staggering 234.000 hits in total.[5] The complex political process of creating and amending the WFD has also been studied (see: (Kaika & Page, 2003; Page & Kaika, 2003)). The political process, however, continues during the policy implementation phase for which, in the case of the Langeraarse Plassen, the HHR is responsible. In the dominant, linear approach to policy creation and implementation, this is frequently neglected as surmised by Schultz. A study of the WFD policy process inside the HHR has not yet been conducted. This research thesis therefore sets out to fill the knowledge gap.

In short, this research project sets out to investigate the appropriateness of the M27 reference condition and the WFD policy objectives for the Langeraarse Plassen (i), and tries to shed some light

[2] A Dutch saying which, if directly translated, means a dot on the horizon. It refers to an ambitious long term view.
[3] With this pragmatic method the policy objectives are derived from the current water quality, and not directly from the pristine reference condition.
[4] The Nieuwkoopse Plassen, the Reeuwijkse Plassen and the Polder Oukoop/Stein.
[5] Searched on 5-2-2016.

on the policy process (=actor-centred political process) in a particular policy field (=WFD), for a particular case (=WFD II in the Langeraarse Plassen) in a particular organisation (the Hoogheemraadschap van Rijnland).

Chapter contents are as follows: chapter 2 gives background information on the EU WFD, water management in the Netherlands, the Hoogheemraadschap van Rijnland and the Langeraarse Plassen; chapter 3 outlines the conceptual approach which has been used in this research; chapter 4 describes the focus of this research by elaborating on the research objectives and research questions; chapter 5 describes and discusses the methodology which has been employed; chapter 6 presents an historical analysis of the creation of the lakes and the water quality developments; chapter 7 provides an analysis of the WFD policy process inside the HHR; chapter 8 presents the main conclusions, and the final chapter, chapter 9, contains the discussion and recommendations for both further research and for the HHR.

2. Background

This chapter provides background information on the EU WFD, water management in the Netherlands, the Hoogheemraadschap van Rijnland, and the Langeraarse Plassen. The information has been purposefully funnelled from EU to regional level.

2.1 The European Water Framework Directive

2.1.1 General information

The European Water Framework Directive has changed water management within Europe by enabling River Basin management (RBM) and by placing aquatic ecology on the agenda (Hering et al., 2010). Since December 2000 the water quality of European waters has to comply with the guidelines which are stipulated in the EU WFD (Gerrits, 2014). The main goal of the WFD is to create clean and healthy water systems (both surface and groundwater systems) throughout Europe before 2015, and to get citizens involved (STOWA, 2005) (Rijksoverheid, n.d.) (European Commission, 2016). There are some exceptions possible regarding this deadline. In some cases obtaining "good (ecological and chemical) status" waters can be postponed to 2021 or even 2027, as is the case in the Netherlands. When national choices had to be made the Netherlands always opted for a pragmatic approach (Schultz van Haegen, 2016). The WFD encompasses general long term goals which gives the Member States of the EU some freedom. (Liefferink, Wiering, & Uitenboogaart, 2011) However, non-compliance with the WFD does have consequences in the form of economic sanctions (RIVM, n.d.). In the Netherlands the NERPE law (*Wet Naleving Europese Regelgeving Publieke Entiteiten,* which means Law Compliance European Regulatory Public Entities*)* provides a number of instruments for the central government to redirect European sanctions to regional authorities (Kamp & Gerrits, 2013).

Figure 1 gives a schematic overview of what, according to the WFD constitutes to a good status of water bodies. To keep the study achievable in the timeframe, and as it is expected to find more historical data on biological parameter, this study focuses on the biological water quality elements (phytoplankton, vegetation, macro benthos and fish) and the biological supporting parameters, which are further discussed in the conceptual framework chapter.

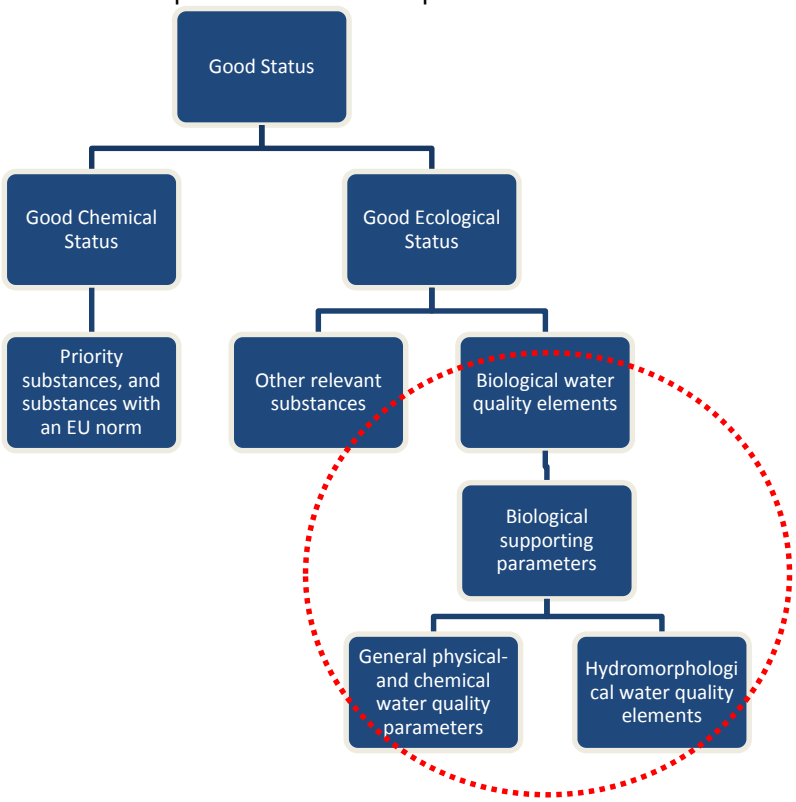


Figure 1: Water Framework Directive scheme (based on (Van Dam, Osté, de Groot, & van Dorst, 2007))

2.1.2 Good Ecological Status and Good Ecological Potential

The European WFD member states have to develop their own classification systems in order to help them judge the biological, hydro morphological and physical-chemical water quality status of their surface water bodies (STOWA, n.d.). The WFD defines which biological elements have to be considered when evaluating ecological status (EuropeanCommission, 2015). These biological water quality elements are: phytoplankton, aquatic vegetation, macro benthos and fish. Further details of the assessment system are developed by the European Member States. The reference condition is used as a benchmark to see how much a water body at present deviates from its pristine natural state (Siebelink, 2005). The condition of a water body is subsequently valued as very good (= reference condition), good, moderate, insufficient or bad. The score on the scale is expressed as an Ecological Quality Ratio (EQR) (CBS, PBL, & WageningenUR, 2014), which ranges from 0 (severe disturbances) to 1 (no or minor disturbances) (WFDUK, 2015).

The ecological goals for natural water types have been developed nationally. Reference conditions (Very Good Ecological Status) have been formulated and the corresponding ecological norms have been developed (Good Ecological Status). The Good Ecological status corresponds with an EQR of 0.6. In the Netherlands a lot of the water bodies are not natural but strongly changed or artificial (Altenburg et al., 2012). For these waters it is allowed to formulate less stringent WFD objectives:

"In cases where a body of water is so affected by human activity or its natural condition is such that it may be unfeasible or unreasonably expensive to achieve good status, less stringent environmental objectives may be set on the basis of appropriate, evident and transparent criteria, and all practicable steps should be taken to prevent any further deterioration of the status of waters." (European Parliament & European Council, 2000, WFD Preamble paragraph 31)

These less stringent WFD goals are derived from the natural water type which resembles the water body the best. For artificial and highly changed surface waters the Maximum Ecological Potential (MEP) - which can be seen as the reference condition - and the Good Ecological Potential (GEP) - the ecological norm - have to be derived (Siebelink, 2005). In the Netherlands there are national guidelines to arrive at a MEP and GEP (see Projectgroep Implementatie Handreiking (2006)).

2.1.3 The EUWFD translation process from EU to national level

From EU level…

In 2000 the Water Framework Directive, which entails legal obligations to safeguard and restore the water quality of all aquatic environments across Europe, was adopted. The environmental lobby was influential in shaping the EU WFD (Kaika & Page, 2003). Multiple actors of state, market and civil society institutions were involved in the making of the EU WFD. Contrasted interests led to arguments over the wording of the Directive (Page & Kaika, 2003). Overall it was a difficult process to create a common water policy for Europe. The end result is a complex set of rules and guidelines that are multi-interpretable (Mostert, Santbergen, Wiering, & Arend, 2010).

To national level…

After the disagreements and negotiations during the wording of the EUWFD ended, the arguments over the interpretation and implementation began. The implementation of the WFD within the Netherlands was a large and complex process and appeared to result in many discussions (Ten Heuvelhof et al., 2010) (Mostert et al., 2010) (van Leussen, 2004).

The Netherlands has transposed the WFD into the Water Act[6] and the Environmental Management Act (Kamp & Gerrits, 2013). According to the EU WFD the translation of European policy to national policy

[6] In Dutch: W*aterwet* which came into force on 22-12-2009.

had to be achieved before 22nd of December 2003. This was also the date by which the basin had to be defined. Already before the enactment of the WFD on the 22-12-2000, the Netherlands was busy with the implementation of the WFD. In 1998 the Implementation Water Framework Directive project group *Implementatie Kaderrichtlijn Water* was founded, which focussed on the determination of watersheds and securing the WFD into national law (Ten Heuvelhof et al., 2010). The period from 2000 until 2003 has been characterised as a *"difficult start of the implementation process"* (Ten Heuvelhof et al., 2010, p. 17) of the WFD within the Netherlands. During that period the WFD received little attention from other parties than the Ministry of Infrastructure & the environment. After the publication of the Aquareinrapport (see: (Bolt et al., 2003)) - in which the impact of the WFD for agriculture, nature, recreation and fishing was assessed - the political discussion regarding the WFD started and the WFD gained more widespread attention (Ten Heuvelhof et al., 2010).

In a watershed approach…

The WFD asks for an international watershed approach. To achieve the WFD mandate, member states divided themselves into watersheds. The Netherlands belongs to four trans- boundary river basins: the Ems, Scheldt, Meuse and Rhine. The Rhine river basin has been split up in a North, East, Middle and West Rhine sub catchment (see Figure 2). In each watershed provinces, municipalities, water boards and the public work agency work together to achieve an improved water quality (Rijksoverheid, 2015b). Through active involvement, informing- and consultation sessions the public and interested parties have been involved in the process at all governance levels (I&M, 2014). "Participation" is a requirement of the WFD.

On a national level, each watershed has to create RBM plans. Additionally international RBM are generated. The RBM plans entail descriptions of the water systems, water quality objectives and water quality improvement measures. The first RBM plans for 2009-2015 were published in 2009. The RBM plans for 2016-2021 were sent to the House of Representatives on 14-12-2015. Details of the plans are worked out in the management plans of the public work agency and the regional water authorities. Furthermore factsheets of all Dutch water bodies are available on the water quality portal[7] (Rijksoverheid, 2015b). The fact sheets give a general description of the water body including a problem description. Moreover they contain information about the WFD status, give a brief overview of proposed measures to improve the water quality and elaborate on the ecological norm (the Good Ecological Potential) for the specific water body.

[7] See: www.waterkwaliteitsportaal.nl

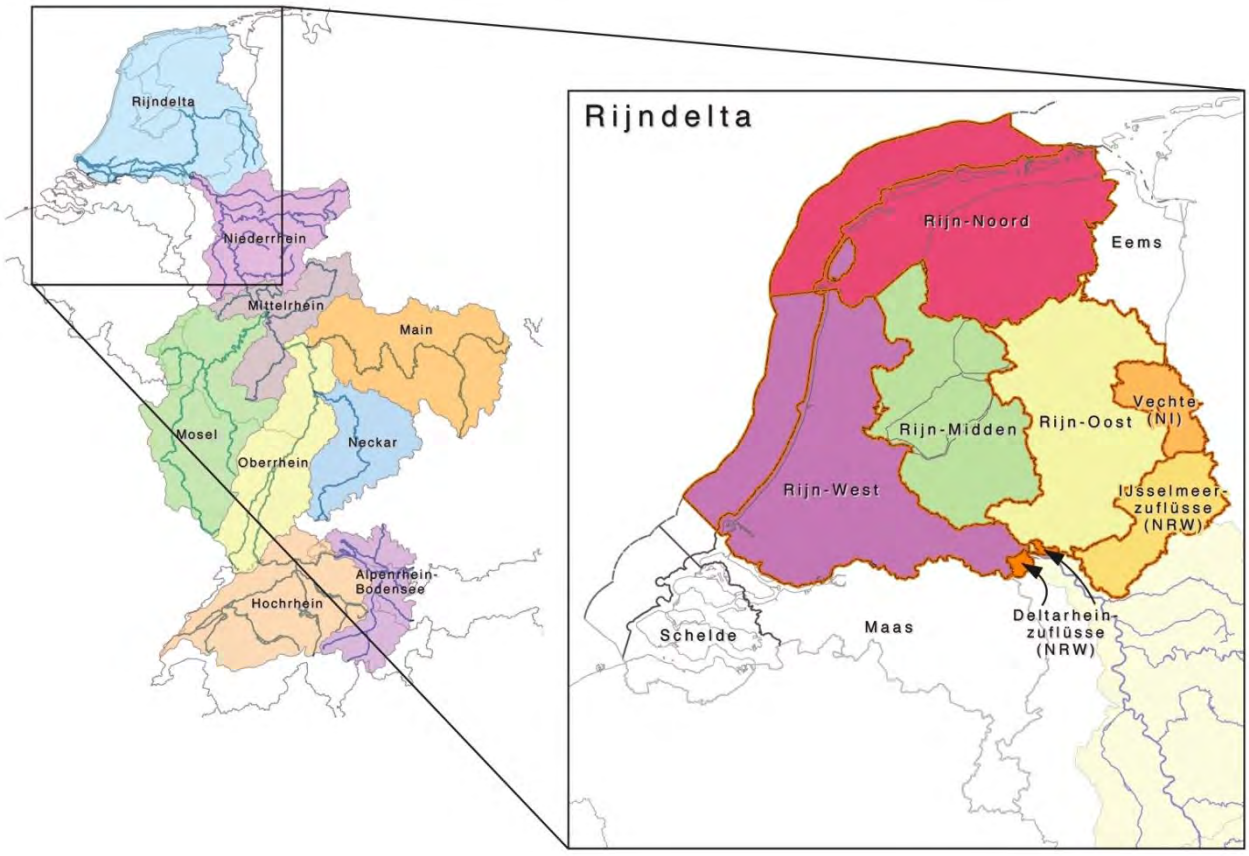


Figure 2: Rhine River Basin and Sub-rhine river basins in the Netherlands (RBO Rijn-West, 2008)

2.2 Water Management in the Netherlands

2.2.1 A historical perspective on water management objectives

Worldwide the Dutch are known for flood protection (Zegwaard & Wester, 2014). Within the Dutch Delta - in which more than 50% of the land lies below sea level - the tradition was to fight the water and try to control it. The heavily modified water system is characterised by canalised waters, polders, river dikes and sea defences (Van der Brugge, Rotmans, & Loorbach, 2005) (Ministry of Transport, n.d.).

Initially flood protection was the main objective in the Dutch Delta, but over time other aspects of water management also became important. Bressers, Huitema, and Kuks (1994) distinguish between four periods that characterise Dutch water management:

1. In the first period the focus lies on flood protection by building dykes. This period started in the beginning of the middle ages.
2. In the second period the emphasis lies on controlling water levels for agriculture and shipping purposes (not specified when the period starts). Flood protection remains an important tasks.
3. In the third period the focus shifts to the protection of water quality (1970). The industrialisation and expansion of agriculture after WOII which leads to prosperity also causes pollution of water bodies. In a response the Pollution of Surface Water Act (WVO) was put into force in 1970.
4. The fourth period is labelled as the integrated water management period, which started in 1985 with the memorandum 'Living with Water' (in contrary to fighting against water). The memorandum promotes ecologically orientated water management (Van der Brugge et al., 2005).

According Van der Brugge et al. (2005) the technocratic regime of Dutch Water Management has been dominant well into the 20th century. In the 20th century water governance in the Netherlands was not only shaped by civil engineering, but also by environmentalism (Zegwaard & Wester, 2014). The incorporation of environmental principles started around the mid-1970s (Disco, 2002). Disco (2002) however questions whether a true shift in ecological water management has actually taken place in Dutch water management. He argues that even though ecologist started working in the originally intrinsically technically focussed water management institutions, the ecologists were locked in in the old structures of technocratic power.
In recent years Dutch water management is returning to placing emphasis on water safety, which is enforced by the current dominant climate change discourse. (Van der Brugge et al., 2005). The Delta Program of 2011 shows that the safety is still dominant in Dutch Water Management (Zegwaard & Wester, 2014). The following quote from a report of the Ministry of Transport, Public Works and Water Management (in 2010 it became part of the Ministry of Infrastructure and the Environment) illustrates the shift to water security in the 21st century:

"…the current system of water management is not capable to deal with future developments. In order to keep the Netherlands safe, liveable and attractive in the coming century (…) a structural change in the water policy and thinking about water is necessary. (…) For a long series of years structurally more money is needed for the protection of the Netherlands against flooding." (Tielrooij, 2000, pp. 5-6)

2.2.2 Present institutional structure

Within the Netherlands water management is carried out by all government levels. The main actors in water quality management in the Netherlands are the Ministry of Infrastructure and the Environment, the National Water Authority (Rijswaterstaat), the Regional water Authorities, the Provinces and the Municipalities (OECD, 2014). Each governmental level has its own concrete tasks and responsibilities related to water management which have been briefly summarised in Figure 3. Also the private sector (mainly the drinking water companies) and other actors play a role in Dutch water management (OECD, 2014).

Figure 3: Responsibilities of the different water management governance levels in the Netherlands (based on information from: (OECD, 2014) (CBS, 2016) and https://www.rijksoverheid.nl)

2.3 The Hoogheemraadschap van Rijnland

2.3.1 Management area

The HHR is one of the twenty-three Dutch Regional water authorities. The location of the main office is in Leiden. The HHR is the water manager in the western part of the Netherlands. HHR's management area (see Figure 4) lies between Ijmuiden, the Western part of Amsterdam, Gouda and Wassenaar and covers an area of approximately 1175 km2 (HHR, 2015d). The water system of HHR lies within the basin of the Rhine.

Figure 4: Management area of the HHR (excluding the coloured areas) (HHR, 2016b)

2.3.2 Responsibilities

The slogan of the HHR is *"dry feat and clean water"* (HHR, 2015i). Summarised the main responsibilities of HHR within its territory are:

- Providing protection against the sea and floods
- Ensuring proper water levels in polders and urban areas
- Providing clean and healthy water in lakes, canals and ditches
- Treatment of wastewater from households and industries

These responsibilities belong to the following themes: water security, sufficient water, clean and healthy water, and the water cycle (HHR, 2015i).

The WFD falls under the 'clean and healthy water' category. HHR's ambition for this responsibility is as follows: *"HHR'S water is clean so people, nature and economy can optimally make use of it"(HHR, 2015d, p. 26).* A lot of political orientated questions arise when reading this statement. Who are the people they are referring to? Is that all of the *ingelanden*[8] or a select group? Whose nature and whose economy are denoted?

In the water management plan - a 6-year plan which sets out the policies and approaches which are needed to perform the tasks well - for the period from 2016 to 2021 the following goals have been formulated:

[8] An *ingeland* is someone who has property (land) in a water managing area.

1. *"We reduce water pollution."*
2. *"We manage and maintain our water system ecological."*
3. *"We realise clean lakes, ponds and natural areas."*
4. *"We make swimming locations clean and safe." (HHR, 2015d, p. 26)*

Taking actions in order to improve the water quality of the Langeraarse Plassen and bring the lakes to a *"good status"* (both ecologically and chemically) belongs to the third goal. The other pointers, especially number one, of course also have effect on the water quality in the Langeraarse Plassen.

2.3.3 Brief historical narrative

The HHR, which was founded in 1255 and is Holland's oldest water board, is considered to be the oldest democratic organisation which is still functioning within the Netherlands (Iterson, Koese, & Manshanden, 2015). Before 1255 the battle against the water was already on going and polder boards took care of the water management. In 1255 the HHR was formed to manage the polders. Until the 1st of January 1997 the polders were under the supervision of the HHR. On the 1st of January 1997 the polders in the jurisdictional area of HHR merged into six new water boards and two polder departments. From that moment onwards the inlying water boards were no longer under the supervision of the HHR. There was a clear task division between the water boards and the overarching HHR. The HHR took care of water quality in the *boezem* waters whereas the water boards were responsible for realizing water quantity objectives within the polders. (Iterson et al., 2015)

Currently the tasks of the HHR are related to water safety, water quantity and water quality objectives. This integral approach is quite new. Up until the first half of the 20th century the tasks of the HHR and the polder boards were only water safety and water quantity related (they managed and maintained dikes for water security and regulated water levels to enable agriculture and shipping). Water quality became a task of the HHR in 1965. In 1970 the water boards were legally assigned the task of wastewater treatment under the Pollution of Surface Water Act (Iterson et al., 2015).

Over time the water quantity managing organisations (inlying water boards) were merged. On the 1st of January 2005 the remaining water boards: de Oude Rijnstromen, Wilck & Wiericke, and Groot-Haarlemmermeer were abolished. The result was one integral water board: the HHR which has the tasks for water quality and water quantity. Overall the reasons for the merge were to realise more efficient and effective water management and to enable integrated water management. (Iterson et al., 2015)

The Langeraarse Plassen belonged under the management of the Noordeindsche polder[9], the Noordeind- en Geerpolder, Waterschap de Aarlanden, Waterschap de oude Rijnstromen, and the Hoogheemraadschap van Rijnland. How the organisational structure developed from polder boards managed by the HHR from 1255 onwards, to multiple water boards, and finally the development to one authority: the HHR, is visualised in Figure 5.

[9] The most Northern part of the Langeraarse Plassen, the Geerplas belonged to the management of the Geerpolder which was part of the overarching water authority Amstelland.

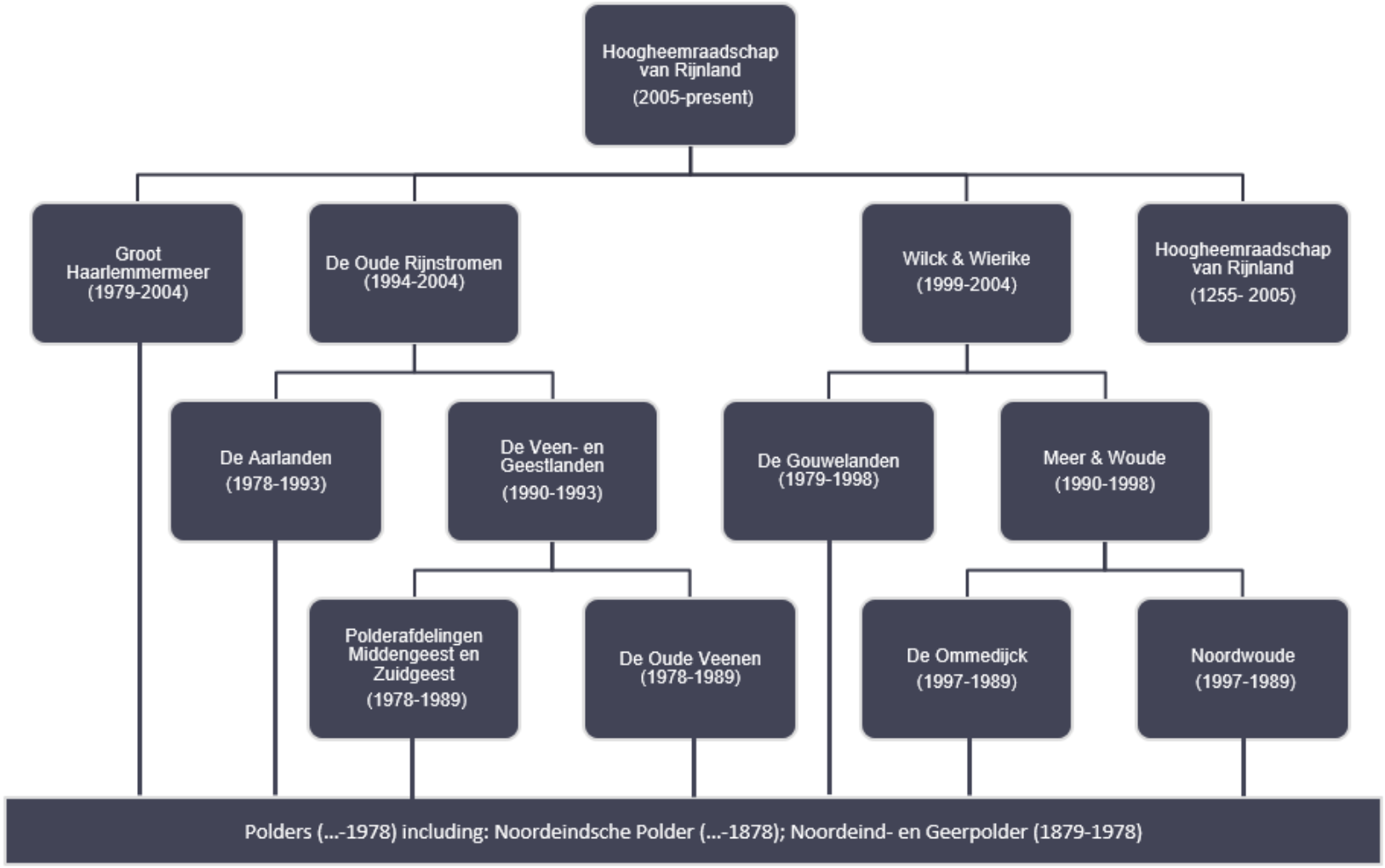


Figure 5: Historical developments in the organisational structure of the HHR

2.4 The Langeraarse Plassen

2.4.1 General description

The Langeraarse Plassen are part of the Western sub catchment of the Rhine river basin. The Lakes are located in the North Eastern Part of the province of South-Holland, in the municipality of Nieuwkoop, between the villages Langeraar and Papenveer (see Figure 6). The Lakes are named after the village of Langeraar which is located on the western side of the lakes. The village Langeraar owes its name to the river Aar (van Berkel & Samplonius, 2006). The Aar divides the (former) municipality of Ter Aar in two parts: the western part called Langeraar and the eastern part which is called Korteraar. Langeraar contains the word *lang,* which means long whereas Korteraar contains the Dutch word *kort* which means short. The western part is called Langeraar as this side is located with a longer length along the river Aar than the eastern side. (Streekarchief Rijnlands Midden, 2015a, 2015b)

From north to south the Langeraarse Plassen consist out of the Geerplas (26,7 ha), the Noordplas (72,7 ha) and the Zuidplas (74,7 ha) which are connected with each other via narrow openings (Michielsen, 2012). The lakes are classified as artificial, or manmade, as they have been created as a consequence of peat mining (Torenbeek, 2013b).
The Geerplas is managed and almost entirely owned by Staatsbosbeheer (Tas, 2012). The objectives for the Geerplas are related to bird conservation. There is currently a cormorant colony which is (the bird faeces) leading to nutrient pollution (and subsequently eutrophication and turbidity) of the water. The bird conservation objective does not go hand in hand with the water quality objective of the HHR and therefore the Geerplas has not been included as part of the WFD water body (Torenbeek, 2013b). In order to minimise the effect of the nutrient rich water, the Geerplas has recently been hydrologically isolated from the Noordplas. So for the second phase of the WFD only the ecological quality of the Noord- and the Zuidplas will be improved.

2.4.2 Hydrology

The Langeraarse Plassen are important for storing water. The lakes and their direct surroundings are located higher than the surrounding polder areas (-1.40 m N.A.P vs -4.5 m N.A.P). A pumping station and an inlet are located on the South side of the Zuidplas. The pumping station transports excess water from the Zuidplas to the Leidsevaart whereas the inlet allows water to enter the Zuidplas. The inlet and pumping station are frequently used as a strict water level within the Lakes (summer level: -1.55 m N.A.P and winter level: -1.60 m N.A.P.) is being maintained. The Zuidplas is connected with the Noordplas through an opening of approximately four meters in the *Kerkpad.* The Geerplas and the Noordplas are also connected with each other via an opening of a few meters. (Michielsen, 2012)

 Figure 6: Location of the Langeraarse Plassen in the Netherlands (Google & Bing maps)

2.4.3 Functions and use of the lakes

The eastern side of the Noord- and Zuidplas is part of an ecological connection zone[10]. There are also greenhouses on the eastern side of the lakes for horticultural purposes (Torenbeek, 2013b). In the near future this greenhouse area will be transformed into a residential area. There are numerous houses/gardens bordering the Noord- and Zuidplas. Additionally both of the lakes are used by surfers, sailors, fishermen and rowers (HHR, 2014). There are also multiple swim locations but these have been abated due to the poor water quality, which does not comply with the EU swimming water quality standards (Michielsen, 2012) (HHR, 2014).

2.4.4 Water quality

Eutrophication has been a problem in HHR's surface waters since the 1960s. Up until today it is still a major problem in the Langeraarse Plassen. The lakes are turbid, nutrient rich and dominated by algae and cyanobacteria. The frequently occurring cyanobacteria blooms in summer time result in swimming bans. The official swimming location was abolished in 2012, people however still swim in the Lakes in in the summer.

There are hardly any submerged aquatic plants growing in the lake and emergent vegetation is scarcely present. The majority of the banks are steep and reed is only present alongside part of the banks. The fish biomass is high and dominated by bream. (Michielsen, 2012) The turbidity is largely being caused by the cyanobacteria, but also by other suspended organic material. The bottom silt layer of the lake is for instance whirled up by bream searching for phytoplankton. Due to the highly turbid state of the lakes (the visibility depth is around 20 cm), light cannot penetrate the water column deep enough which inhibits plants to germinate.

The root cause for all these interlinked problems is an excessive load of phosphorus (both in a particulate and soluble phase) originating from external and internal sources. One of the external sources of phosphorus is the inlet water originating from the Leidsevaart. Internal phosphorus release is caused by soil and water interactions (Michielsen, 2012).

Table 1 gives an overview of the existing- and WFD target water quality situation (for the general physical and chemical water quality parameters). As is evident there is a gap between the two situations.

Table 1: Current and desired physical and chemical water quality in the Langeraarse Plassen (Michielsen, 2012)

Indicator	Unit	Desired WFD water quality	Current water quality
Temperature	°C	>25	25
Oxygen	g/m^3	80-120	100
Chloride	g/m^3	<200	100
Light penetration depth	cm	>90	31
pH	-	5.5-7.5	8.8
Total P	g/m^3	<0.06	0.65
Total N	g/m^3	<1.3	3.7
Chlorophyll	mg/m^3	<25	200

2.5 WFD objectives for the Langeraarse Plassen

The Langeraarse Plassen have been classified as moderately large shallow fen lakes. Or in other words the WFD type M27. The M27 reference condition describes how the lakes would look like in the most natural, undisturbed situation. So without, or with minimal human influences. In the Netherlands a lot of waters are not natural, but artificial or heavily modified. With no human influences most peat lakes,

[10] Ecological connection zones are part of the ecological main structure which enables animals and plants to migrate through various nature areas.

including the Langeraarse Plassen, would not exist. The Langeraarse Plassen are therefore an artificial water body. Only the Duiningermeer is said to be an example of a peat lake which has not been created through peat dredging, and can thus be considered a natural system[11]. In most cases the M27 reference condition describes the situation which would develop if the lake is left to develop as freely and naturally as possible after the excavation of peat[11]. The reference condition is based on historical data, data from undisturbed similar waters, insights from experts, and model results.

Based on the reference level for M27 waters the HHR has described its own target situation for this water type as follows: *"We strive to obtain clear water dominated by aquatic plants with a corresponding macro fauna and fish community" (Torenbeek, 2013b, p. 7).* The target image and M27 reference condition seem similar.

The WFD policy objectives are less stringent. In principle all biological assessments categories (phytoplankton, vegetation, macro benthos and fish) should reach an EQR of 0.6, however for artificial waters one is allowed to adapt the value of EQR for the different categories. The adapted WFD goals for the Langeraarse Plassen, i.e. the ecological WFD policy objectives, and the general chemical-physical water quality goals are depicted in Table 2. For most people the EQRs are very abstract and unclear. What does a fish EQR of 0.45 look like? For the Langeraarse Plassen a fish EQR goal of 0.45 corresponds with a roach-bream fish water type, whereas in the natural situation (EQR of 0.6) a rudd-pike fish water type would be present as is visualised in Figure 7.

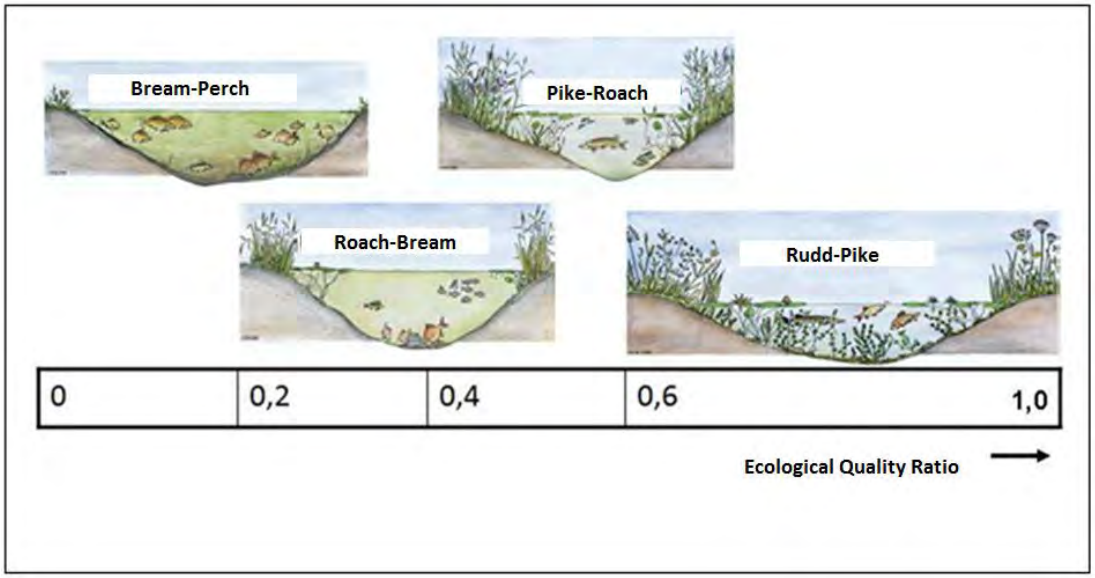


Figure 7: Fish water Types and WFD EQR scale (adapted from: (Vuister, 2015))

The ecologists of HHR have defined that if the goals in Table 2 are met, there will no longer be blue-algae blooms and the light penetration depth will have increased to 90 cm. There will be a small amount of submerged aquatic plants (3%) and some floating plants (0.5%). Furthermore some emergent plants (reed and cattails) will grow on the banks. If the fish parameter reaches an EQR of 0.45 this corresponds with a fish water type of Roach Bream. Due to the low plant cover, a Pike-Roach system is unrealistic. (Vuister, 2015) There is still a lot of uncertainty however whether these goals are attainable.

[11] Personal communication with an ecologist on 16-12-2015

Table 2: GEP values for the Langeraarse Plassen (Torenbeek, 2013b) (Vuister, 2015)

Indicators	**GEP**
Phytoplankton (EQR)	0.6
Aquatic plants(EQR)	0.45
Marco benthos (EQR)	0.45
Fish (EQR)	0.45
Temperature (°C)	25
Oxygen (%)	60-120
Chloride (mg/L)	200
Light penetration depth (m)	0.9
pH (-)	5.5-7.5
Total P (mg P/L)	0.06
Total N (mg N/L)	1.3

If the HHR reaches these GEP goals, the GEP values will be up scaled to 0.6 and the data will be uploaded on the water quality portal, and eventually be sent to Brussels[12]. Concluding: for the Langeraarse Plassen the adjusted GEP for the category fish is 0.45 EQR. If HHR manages to reach this EQR of 0.45 for fish, then the 0.45 will be noted down as a 0.6 (the water board judges its water bodies itself) and sent to Brussels. In fact an adjusted scale is made for Brussels. This will indicate to Brussels that for the Langeraarse Plassen HHR has managed to reach the ecological norm for fish. This evaluation system is a bit strange as two artificial water bodies who both have a 0.6 EQR for fish on the adjusted scale can look completely different in reality as their initial GEP EQR levels can differ.

[12] Personal communication with a government official of HHR in October 2015

3. Conceptual framework

This chapter describes the conceptual framework which has guided me in my research project. Concepts can actually be seen as spectacles. Each concept looks differently at a certain situation, or the 'real world', and therefore they frame the way of looking at issues. Concepts are used to make sense of complex issues and to find some order (Joshi, 2014). By combining several concepts a perspective is formed (Bolding, 2015b). By using various concepts, a wider understanding, from multiple perspectives will be achieved. Yet, one should be aware that perspectives still highlight certain things whereas other aspects are excluded or neglected (Bolding, 2015b). A distinction can be made between abstract (ideas and opinions) and concrete (e.g. frameworks and models) concepts, which I have both used in this research. Political ecology, historical ecology, water quality, multi-level governance and policy as a process are the concepts and theories which have been used and are worked out in the following sub sections.

3.1 Political Ecology

This research is embedded in the framework of Political Ecology. While Historical Ecology (which is explained further on) helps me to understand what has happened, it does not give insights into why things have happened. Political Ecology provides a framework to understand the Why. *"Political Ecology seeks to unravel the political forces at work in environmental access, management and transformation"* (Robbins, 2011, p. 3). The main idea behind political ecology is that politics and environment are very much interrelated as the following quotation points out:
"All economic projects (and arguments) are simultaneously political-economic projects (and arguments) and vice versa. Ecological arguments are never socially neutral any more than socio-political arguments are ecologically neutral" (Harvey, 1993, p. 25).

A lot of political ecologists have studied the past and present and the past-in present. However there are also political ecologists that focus on a shorter temporal scale (Mathevet, Peluso, Couespel, & Robbins, 2015). It is a field of research which is practiced by a wide variety of scholars (e.g. from the fields of anthropology, biology, geography, hydrology, environmental history, remote sensing etc.) all of which share the interest of studying the relationship between nature and the people who work and live in it (HHR, 2016d; Robbins, 2011). Due to its interdisciplinary nature there are numerous definitions of Political Ecology (see (Robbins, 2011, pp. 15-16). Most approaches however do share the following three principles (Bryant & Bailey, 1997, pp. 28-29):

1. Costs and benefits associated with environmental change are distributed unfairly.
2. This unequal distribution reinforces or reduces existing social and economic inequalities
3. This has political implications as the power of actors is altered (in relation to other actors).

One of the main critiques towards the Political Ecology approach is that the emphasis of many political ecologists lies on politics and not on the ecology (Vayda & Walters, 1999).

Political ecology will be used in this study to unravel the political forces at work in environmental management. More specifically historical political ecology will be used to understand the present water quality management of the HHR in the Langeraarse Plassen. An overview of where Political Ecology is situated within this study is depicted in Figure 8.

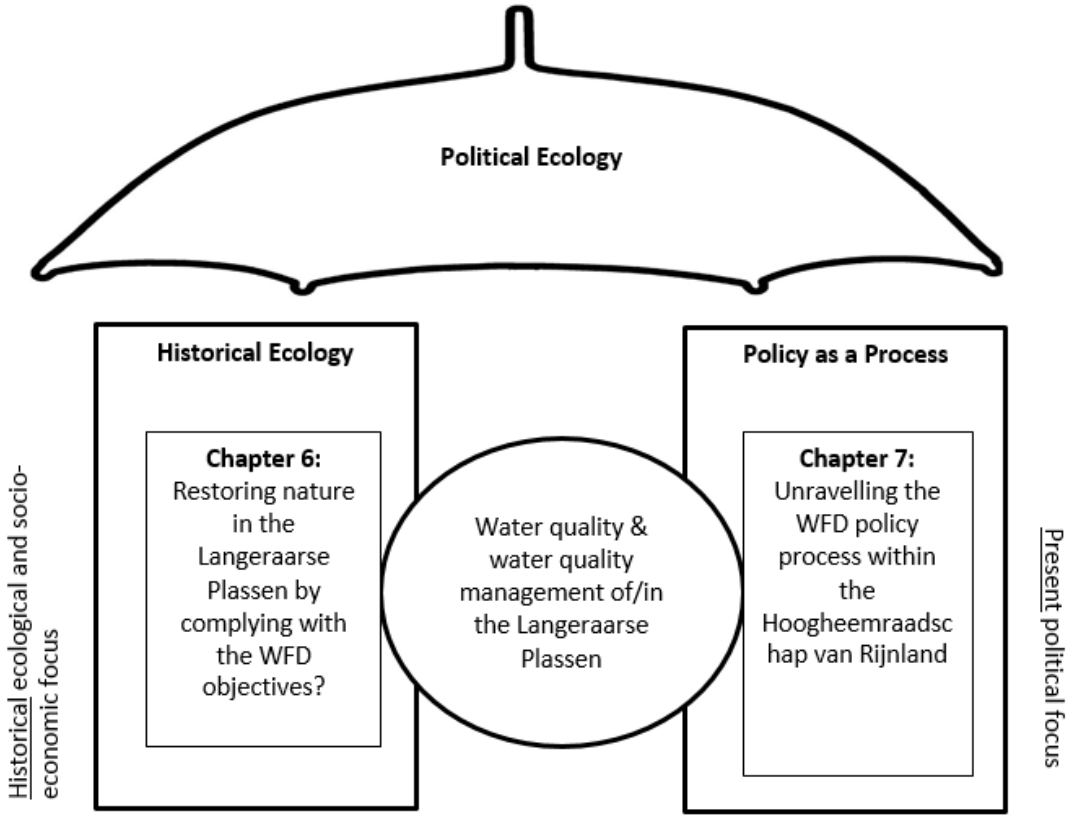


Figure 8: Structure of the thesis

3.2 Analysing the historical water quality situation in order to assess the appropriateness of the M27 reference condition for the Langeraarse Plassen

The overarching framework in the historical analysis is Historical Ecology which focuses on studying the interactions between people and the environment through time. A sub-concept that informs the analysis is water quality.

3.2.1 Historical Ecology

Historical Ecology is about studying the interactions between people and the environment through time (Crumley, 1987). It is an interdisciplinary approach as it requires information from various fields of study (such as biology, ecology, and political- and social science). Almost the entire biosphere is affected by anthropogenic influences, but these human influences do not necessarily lead to degradation of the environment (Balée, 1998). Landscape is an important concept within historical ecology and it is explained as *"the manifestation of the human-environment relation"* (Crumley, 1987, p. 6) (p. 6). The main goal of historical ecologists is to use the information of historical interrelations between humans and the biosphere, to enable managers to make holistic management decisions for landscapes and ecosystems (Crumley, 2007). In the Netherlands there used to be a historical ecological platform which believed that in ecological policies, management and research more attention should be paid to historical ecology (WLO, 2010). Using historical ecology for baseline data for management decisions has been subject to critique. One of the main arguments against using historical data as a contemporary reference point is that "*ecosystems are dynamic, fluid, and always changing"* (Alagona, Sandlos, & Wiersma, 2012, p. 50). So why would you identify one single point in time, one fixed state as your desired future? I agree with the argumentation of Alagona et al.

Nevertheless with the WFD, the intrinsic idea is that human pressures have damaged ecosystems (water bodies) and, one wants to return to the past state, or at least recapture some past aspects of it. The historical ecological situation has been taken into account during the creation of the reference conditions (Altenburg et al., 2012). For the Langeraarse Plassen the desired state is that of clear water dominated by aquatic plants, which is elaborately described in the M27 reference condition. However whether this is actually a historical accurate state of the Langeraarse Plassen is unknown. For this study, historical ecology will be used as an approach to verify whether the desired state has occurred in the past by studying the relationship between people and the Langeraarse Plassen through time. By doing so I can test if the basis of the WFD -the historical perspective taken from a wide variety of lakes- is applicable for the Langeraarse Plassen.

3.2.2 Water quality

There is a need to unravel the concept of water quality in order to be able to use it within this study. One of the parts of this research is to assess whether the historical water quality situation of the Langeraarse Plassen coincides with the nationally formulated M27 reference condition and the desired WFD policy objectives. In order to be able to compare the desired- and the historical water quality situation it is necessary to focus on certain water quality aspects.
To examine to what extent the historical water quality of the Langeraarse Plassen has complied with the nationally formulated reference situation it is necessary to use the WFD assessment categories. For this research the focus lies on assessing the historical ecological water quality status. The focus in analysis will be on the general physical-chemical water quality parameters such as nutrient concentrations, and on the biological water quality elements Phytoplankton, Aquatic plants, Macro benthos and Fish. Table 3 gives an overview of the general physical-chemical water quality indicators. A brief description of the four biological water quality indicators is given in Figure 9. Table 4 lists the current water quality and the WFD policy goals for the Langeraarse Plassen. The M27 reference water quality standards for the biological water quality indicators are all 0.6 EQR. The values for the general-physical water quality elements for M27 water bodies can be found in Figure 10.

Table 3: General physical and chemical water quality parameters

Indicator	**Unit**
Temperature	°C
Oxygen	%
Chloride	mg/L
Light penetration depth	m
pH	-
Total P	mg/L
Total N	mg/L

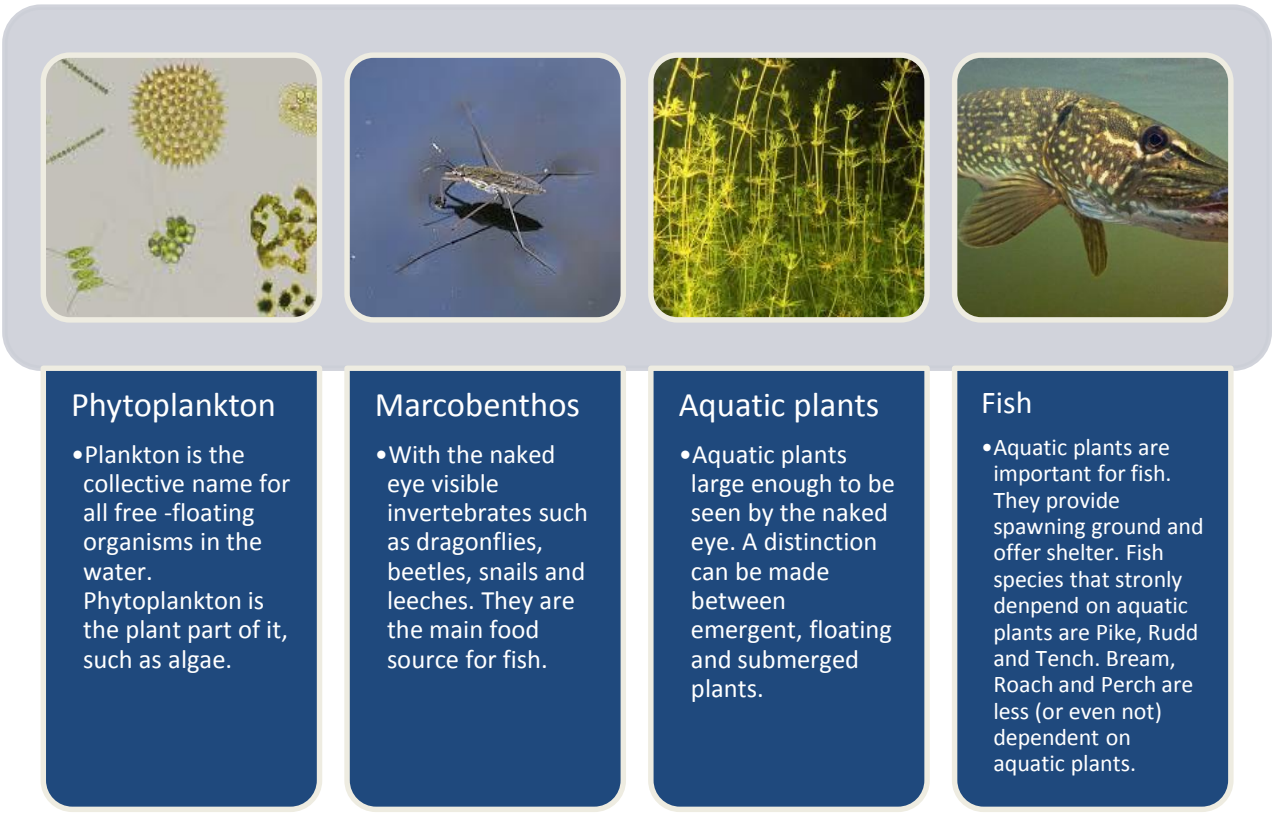


Figure 9: Description of the biological water quality indicators (based on information from (Bijkerk & Beers, 2010); (Siebelink, 2005); (Zoetemeyer & Lucas, 2007))

Table 4: Current water quality and water quality objectives (Vuister, 2015)

Parameter	Unit	Current water quality (based on latest measurements)	WFD policy objectives (GEP)
Phytoplankton	(EQR)	0.16	0.60
Aquatic plants	(EQR)	0.10	0.45
Macro benthos	(EQR)	0.39	0.45
Fish	(EQR)	-0.16	0.45
Temperature	(°C)	23.0	25.0
Oxygen	(%)	114	60-120
Chloride	(mg/L)	68.0	200
Light penetration depth	(m)	0.10	0.90
pH	-	9.20	5.5-7.5
Total P	(mg P/L)	0.19	0.06
Total N	(mg N/L)	4.40	1.30

Kwaliteitselement	Indicator	Eenheid	Zeer goed	Goed	Matig	Ontoereikend	Slecht
Thermische omstandigheden	dagwaarde	°C	≤ 23	≤ 25	25 – 27,5	27,5 – 30	> 30
Zuurstofhuishouding	verzadiging	%	60 – 120	60 – 120	50 – 60 120 – 130	40 – 50 130 – 140	< 40 > 140
Zoutgehalte	chloriniteit	mg Cl/l	≤ 200*	≤ 200	200 – 250	250 – 300	> 300
Zuurgraad	pH	-	5,5 – 7,5*	5,5 – 7,5	7,5 – 8,0 < 5,5	8,0 – 8,5	> 8,5
Nutriënten	totaal-P	mgP/l	≤ 0,04	≤ 0,09	0,09 – 0,18	0,18 – 0,36	> 0,36
	totaal-N	mgN/l	≤ 1,0	≤ 1,3	1,3 – 1,9	1,9 – 2,6	> 2,6
Doorzicht	SD	m	≥ 2,0*	≥ 0,9	0,6 – 0,9	0,45 – 0,6	< 0,45

* Aangepaste waarde ten opzichte van Heinis *et al.* (2004)

Figure 10: General physical water quality elements for m27 water bodies (Altenburg et al., 2012, p. 96)

3.3 Analysing the WFD policy process inside an implementation agency: the Hoogheemraadschap van Rijnland

The conceptual foundation of this part of the thesis is the intrinsic link between water and politics. The concepts that shape the analysis in this part are multi-level governance and policy as a process. The politics of water resources policy, boundary spanning, policy articulation and the unimplementability of policies are considered to be sub-concepts of policy as a process.

3.3.1 Multi-level governance

Although this study focuses on assessing the policy process in one organisation, the Hoogheemraadschap van Rijnland, at the regional governance level, it is important to keep in mind the dynamics of the various governance levels. Multi-level governance can be a useful concept in order to understand the WFD relations between different governmental levels (EU, National, Provincial, Regional and Local).

There are two different modes of how the EU can be seen: the state centric model - whereby the main belief is that national governments control EU decision making - and multi-level governance- whereby the idea is that state control is reduced (Hooghe & Marks, 2001).

The Multi-level governance concept can be used to understand the dynamic relationships within and between different levels of governance and government (Bache & Flinders, 2004). Multi-level governance refers to *"the reallocation of authority upward, downward and sideways from the central states"* (Liesbet & Gary, 2003). It thus refers to different government levels as well as the involvement of public and private sectors (horizontal shifts) at these different government levels (Kersbergen & Waarden, 2004).

Figure 11 shows the vertical government levels of the WFD process. The levels can be seen as different policy arenas which are linked to each other with respect to the WFD. The WFD organisation is situated at several levels. It starts from the European level where long term goals have been established in order to achieve waters with a good status (chemical & ecological) throughout Europe. The translation of the WFD in national policy principles, frameworks and tools is done by the central government (Rijksoverheid, n.d.). Basic monitoring principles and criteria for grouping the various Dutch water types are developed at a national level. Defining reference conditions and ecological norms for natural waters is done on a national level whereas the reference conditions and ecological norms for artificial waters is done at the provincial or regional level. For regional artificial waters it is the responsibility of the provinces and the regional water authorities whereas for national waters this is the responsibility of Rijkswaterstaat (a national public works agency). At a local level the organisation of the WFD establishes itself through public involvement- which is a key component of the WFD. In the

Netherlands the Dutch public is kept up to date and is able to participate in the decision-making process (Rijksoverheid, n.d.).

For this study, the focus lies mainly on the downward vertical shift (from international and national to regional and local level). The EU relies on the local agencies to implement and enforce the WFD regulations. The role of local agencies is said to be strengthened by this shift of governance (Kersbergen & Waarden, 2004).
The Langeraarse Plassen and all its users are situated at the local level. At the regional level the HHR is present. HHR formulates its own policy objective (GEP) per water body. Additionally, HHR has an executive task, i.e.: they have to make sure that the KRW surface waters within their management area- including the Langeraarse Plassen- comply with the WFD objectives. At the end of the second WFD phase, HHR has to report back to Brussels- via the Dutch central government- and let them know whether they succeeded or not in reaching the WFD objectives in their previously selected surface waters. The evaluation of the biological, hydro morphological and chemical water quality status is done with the classification system described in the background section. The eventual outcome of whether a water body complies with the WFD objectives is related to the one out all out principle (CBS, PBL, & WageningenUR, 2014). If one substance or one biological parameter is insufficient (has not reached the policy objective) then the entire water body is labelled as non-compliant with the WFD objective. The usefulness of this harsh judgement is questioned by some actors of the HHR.

Multi-level governance is an important framework frequently used to understand democratic governance in the EU. A critique towards the framework of multilevel governance, and network- and experimentalist governance frameworks, is that they undervalues political dynamics (Behagel & Arts, 2014). To circumvent this pitfall, the concept of "politics of policy", which is embedded in the Policy as a process theory, will be used to zoom in at the regional governance in order to study the WFD policy process of the HHR.

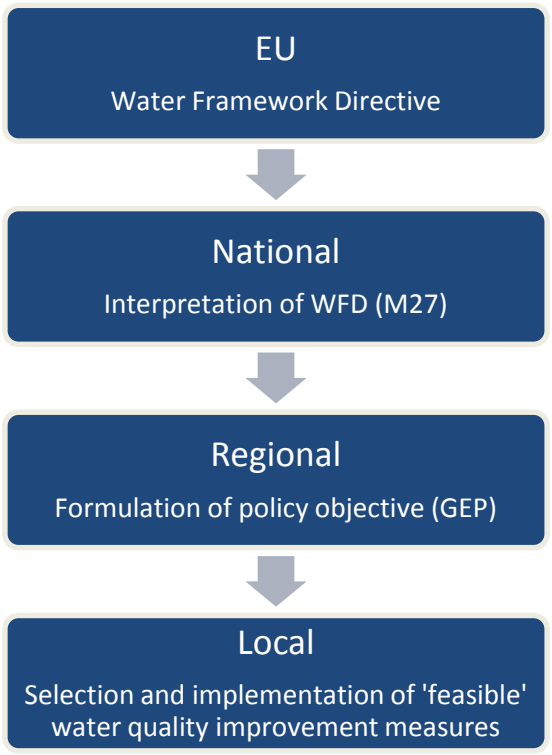


Figure 11: Visualisation of the vertical WFD governance levels

3.3.2 Policy as a process

Politics of water resources policy

An important part of this thesis is to understand the WFD (Policy) and clarify the problems which are faced during the implementation of the WFD.

Conventionally policies are seen as a top down prescription (Bolding, 2015a). They are considered to be tools to steer and regulate society. In this conventional view the policy process of formulation, implementation and outcomes is linear. Only one feedback loop is present which compares the outcomes to the intended objectives. (Bolding, 2015a) In this conventional context, policy is "*an intrinsically technical, rational, action-orientated instrument that decision makers use to solve problems and affect change*" (Shore & Wright, 1997, p. 5).

According to Wester (2008) the linear model follows the following sequential steps: formulation, political decision, policy implementation and impact evaluation.

The linear policy model ignores the implementation process as it assumes that the policy decision automatically results in implementation (Grindle & Thomas, 1990). This is a major error in the linear model as policies often change as they are implemented (Lindblom & Woodhouse, 1968). "*policy is negotiated and re-negotiated at all levels, and often transformed on its way from formulation to implementation"* (Mollinga, 2001, p. 736). Overall the linear model is far from reality (Sutton, 1999) and even though the rational model has been criticised a lot, it remains the conventional way of seeing public policy (Long & van der Ploeg, 1989).

A different look on policy is that of Mollinga. He sees policy as a process instead of a prescription. Mollinga regards policy as a political, nonlinear process which involves various stakeholders, is iterative and contested (Mollinga, 1993). Also Long and van der Ploeg 1989 propose an actor-orientated view on policy analysis. Mollinga proposes three levels at which water and politics can be studied: hydro politics (i), the politics of water resources policy (ii), and the everyday politics of water use (iii) (Mollinga, 2001). The focus of this research is on the politics of water resources policy. More specifically on the politics of implementing the WFD.

The following questions can be used in order to analyse a policy process within a certain arena (see Text Box A for an explanation of the Arena concept):

1. Who are the *actors* that participate in the arena? And, which actors are excluded?
2. What is *at stake* in the arena, what is the issue/are the issues? What is it that people talk/negotiate/struggle about?
3. Which *resources and strategies* do the different actors employ, and what are the 'rules of the game' (see Text Box B)?
4. How is the arena shaped in time and space? *When and where does interaction take place*?
5. What is the *outcome* of the interaction: what concrete results and effects does it produce?

(Mollinga, 1993, p. 6)

The different arenas (EU, National, Regional and Local) can be studied using the five key questions of Mollinga (1993). For this research the focus will be on the regional arena, specifically the HHR. By answering the 5 key questions in this form, a better understanding will be created about the policy process and the political struggles that take place within the arena.

Arena can be defined as: *"a place or scene of activity, debate, or conflict"* (Oxford University Press, 2016). It is a metaphor and is also referred to as a *"domain of interaction"* (Mollinga, 2003, p. 29). Arenas have social, spatial and temporal boundaries in which practices take place. According to Mollinga (1993) design and construction are examples of arenas in which social interaction takes place between multiple actors, which all have different interest and objectives, about the characteristics of the (irrigation) technology. The focus in this study is on design and construction of the WFD. Namely the design of the WFD plans by the Policy and Plan Development department and construction, or execution of these plans, by the Projects department. The interface between WFD plan development for the Langeraarse Plassen and the start of the WFD II project is an interesting moment which can be studied as it involves actors from two-or even more-departments in HHR. The arena or domain of interaction where I will focus on in this study is the WFD II policy process for the Langeraarse Plassen.

It is important to note that the arena model allows me to investigate how things are done, and not how things should be done.

Text Box A: Explanation of arena concept

"Rules (...) are prescriptions that define what actions (or outcomes) are required, prohibited, or permitted (…)" (Ostrom, Gardner, & Walker, 1994, p. 38). They can be either formal or informal.
'Rules of the game' is a concept which stands for how the government, or political actors, should behave. It is normative and procedural and frequently deals with informal rules, procedures and expectations (Matthews, 2008). It is about what is considered to be normal. The actors who set the rules for the game are the ones with power over policy agendas (Warner, Wester, & Bolding, 2008). Just as any other organisation, the HHR has formal codes that define procedures and relations between the various actors (e.g. hierarchical and the board is the final decision maker). Additionally there are unwritten or informal rules which you should follow in order to get along. One of these rules which I have come to know is that you should not surpass people in the hierarchy.

Text Box B: 'Rules of the game' concept

Boundary Spanning

Boundary spanning was coined as a useful concept in the water management context by Warner, Lulofs, and Bressers (2010). Whereas the politics of water resources policy concept focuses on analysing the WFD policy process within the HHR, boundary spanning allows for analysing networks outside of the HHR. Boundary spanning is *"the process in which members of an organisation participate in networks outside the organisation." (Warner et al., 2010, p. 138)* In order to comply with the WFD goals integrated water management is required and therefore boundary spanning is necessary. Boundary spanning can occur at various horizontal (e.g. state, municipality) and vertical levels (private, public, civil society). In order to reach the WFD objectives water managers need to negotiate and make agreements with policy actors in other domains, such as spatial planning and local economic development (Warner et al., 2010). Using this concept can help understand how HHR's actors involved in the WFD II process deal with uncertainty.

Policy articulation & unimplementability of policies

Causes of policy failure in the conventional linear view are frequently attributed to:

- Implementation failure
- Wrong policy (errors in the internal logic of the policy)
- Good policy but wrong context (Bolding, 2015c)

With the policy as a process view policy processes are seen as political processes rather than prescriptive recipes. According to Wester (2008) the commitment to policies is the outcome of struggles/negotiations between different policy actors, rather than a pre-condition. Different actors apply strategies to realise their own goals and therefore outcomes are evolving, and negotiated and definitely not predictable. Mosse (2004) questions whether good policy is actually implementable.

In his paper about the ethnography of aid policy and practice (2004) he wants to break open the black box that lies between policy and its desired effects. He states that these days development organisations are focussed on getting the policies right and that little attention is paid to the relationship between policy and practice. Mosse argues that good policies are actually unimplementable: *"good policy is unimplementable; it is metaphor not management"* (Mosse, 2004, p. 663).

Lots of people are obsessed with words like 'success' and 'failure'. A lot of energy is spent by practitioners in making it look as if the policy worked whereas researchers devote their time in making it appear that the policy has failed. Moreover Mosse argues that policies do not direct action, but follow action. Policies are a result of social processes. The following quote makes this clear: *"…all the diverse and contradictory interests that were enrolled in the framing of an ambiguous policy model and project design, all the contests and contradictions that are embedded in policy texts, are brought to life and replayed"* (Mosse, 2004, p. 664). It is very interesting to think about the idea that policies are produced by practice and that practice is thus not driven by policy. Whether this statement holds for the WFD process within the HHR, will be elaborated on in a later stage.

4. Focus of the study

This chapter presents the research objectives and research questions of this dissertation.

4.1 Research objectives

The primary objective of this research is to assess whether the HHR is restoring 'nature' in the Langeraarse Plassen by complying with the WFD objectives. I.e. to study to what extent the historical water quality of the Langeraarse Plassen parallels the nationally formulated WFD reference condition, and HHR's WFD policy objectives. In so doing this study gives insights into how viable it is for the HHR to reach the WFD policy goals in the Langeraarse Plassen, by taking into account historical developments. The results can be used by the HHR to make better informed decisions about taking water quality improvement measures in the Langeraarse Plassen.

This brings us to the second objective of the study which is to investigate the WFD policy process within the HHR. Shedding light on the WFD policy process, specifically for the Langeraarse Plassen, will increase the understanding of regarding policy as a political process and thereby contest the deeply held believes about policy processes. Additionally it gives the HHR information to enable policy evaluation.

In a broader sense, this study will contribute to the debate about whether the Netherlands will obtain the WFD objectives by 2027 and the discussion concerning which ecological water quality conditions the Dutch Water Boards are trying to reach in artificial waters.

4.2 Research questions

This research has been split up in two main research questions which are further operationalised with sub research questions.

1. To what extent does the historical water quality of the Langeraarse Plassen parallel the nationally formulated WFD reference condition for moderately large, shallow fen lakes (M27 water bodies), and HHR's WFD policy objectives?
    a. What is the origin of the Langeraarse Plassen?
    b. In what way have the spatial land and water distribution patterns of the Langeraarse Plassen changed during the past decades?
    c. Which socio-economic and technical developments influenced the water quality of the Langeraarse Plassen?
    d. How has the ecological and chemical water quality of the Langeraarse Plassen developed over time using historical ecology and political ecology?

2. How can the WFD II policy process of the Langeraarse Plassen in the Hoogheemraadschap van Rijnland be explained using Mollinga's (1993) five sub questions for describing a policy process?
    a. Who are the actors that participate in the WFD II arena, with specific reference to the Langeraarse Plassen? And, which actors are excluded?
    b. What is at stake in the WFD II arena, what is the issue/are the issues? What is it that people talk/negotiate/struggle about?
    c. Which resources and strategies do the different actors in the WFD II arena employ, and what are the 'rules of the game'?
    d. How is the WFD II arena shaped in time and space? When and where does interaction take place?
    e. What is the outcome of the interaction: what concrete results and effects does it produce?

5. Research methodology

This chapter describes and reflects on the undertaken research methodology.

5.1 Qualitative research

Although the first research question can be perceived as quantitative, this research is primarily qualitative. The main focus of qualitative studies is to understand, explain, explore, discover and clarify, situations, feelings, perceptions, attitudes, values, beliefs and experiences of a group of people (Kumar, 2011). The purpose of this study is to understand how one of the WFD executing agencies, the HHR, has translated, implemented and more generally deals with the WFD, specifically for the Langeraarse Plassen. Additionally the purpose is to study to what extent the historical water quality situation of the Langeraarse Plassen coincides with the desired WFD situation for M27 water bodies, and with HHR's WFD policy objectives. A commonly used qualitative study design and various qualitative methods, have been used to operationalise and help execute this study.

5.2 Study design

The distinction between study designs and research methods in qualitative studies are not very clear. Oral history can for instance be a method as well as a study design (Kumar, 2011). The most suitable study design for this research proofed to be the case study.

This research consists out of two distinct parts for which both an explanatory case study has been conducted. The two different objects I have studied are a location, the Langeraarse Plassen, and an organisation, the HHR. More specifically the cases are the suitability of the M27 reference condition for the Langeraarse Plassen and the assessment of the WFD policy process within the HHR. Incorporation of a time dimension is very important for explanatory case studies (de Vaus, 2001). A retrospective design has been used for assessing the applicability of the M27 reference condition for the Langeraarse Plassen. For the other case, the WFD policy process within the HHR, both a retrospective and a prospective design have been employed.

For the historical analysis of the lakes I focussed on the entire lifetime of the lakes. The period which I mainly focussed on in the Policy process analysis is the interface between the formulation of the WFD policy goals by the policy and plan development department and the realisation of these goals - or not- by the projects department. A major advantage of using the case study design, is that it is a flexible approach which allowed me to incorporate new ideas while I was collecting data.

5.3 Research methods

In qualitative research the researcher is the primary instrument for data collection and aims to increase in-depth understanding on the research object (in this study the Langeraarse Plassen and the HHR) in a variety of ways. Various qualitative research methods in order to achieve methodological triangulation have been employed during this research.

In order to answer the first research question (*To what extent does the historical water quality of the Langeraarse Plassen parallel the nationally formulated WFD reference condition for moderately large, shallow fen lakes (M27 water bodies), and HHR's WFD policy objectives?)* information has been obtained by means of literature study, studying archival records and conducting sixteen oral history interviews with nineteen (former) users of the lakes (horticulturalists, fishermen etc.). The interviews were conducted in October and November of 2015.

The age of the interviewees (all men) varies between 39 and 100, and the average age of the interviewed people is 73. After I attended a WFD stakeholder meeting in Langeraar on 29-11-2015 I

was able to start snowball sampling to recruit my sampling group. In order to overcome the impact of the stakeholder meeting bias, I also placed an advertisement in a local newspaper (which sadly did not result in any responses) and contacted some local organisations (including the billiards club and the senior club KBO).

Once I had formed a perspective on the history of the Langeraarse Plassen, I organised a session in the historical museum of Ter Aar on 18-2-2016 where I presented my results, asked for feedback, and held a brief workshop about the future of the lakes.

For the second research question I obtained information by means of literature study, studying policy documents, frequently attending the WFD II project team meetings (which are held once every two weeks), attending two stakeholder meetings (on 29-11-2015 and 19-4-2016) and by conducting eighteen semi-structured in depth interviews (mostly) in January and February of 2016 (with: 12 government officials within HHR, 1 political manager of HHR, and 2 external ecologists). Informal conversations, and observations during an eight-month period (September 2015-april2016) also played an important role in data collection. After I conducted, transcribed and partially analysed the interviews I organised a *WFD lunch meeting* for the government officials (on 7-3-2016) in which I presented some statements based on the results of the interviews (such as: Ecological water quality receives too little attention within the HHR) for which the participants had to vote and which triggered discussion.

The most important research methods, which made up a large part of the empirical data and require some explanation, are described in the following subsections.

5.3.1 Oral history interview

Oral history interviewing is a methodological tool used for research in history (and anthropology & folklore). Information about the past is collected from observers/participants in that past. For this study it has been used as a technique whereby through interviewing memories of the Lakes have been collected. Prior to this study I was unfamiliar with the technique. I got acquainted with it by reading some articles and two books of Selma Leydessdorf[13].

I started each interview (after explaining about myself: who I am, which study I am doing etc. to build trust) with a few general questions (date of birth, prior/current occupation, relation to the lakes etc.). The oral history interview actually really started after I asked them to tell me about the history of the lakes, and later on what they could tell me about the water quality of the lakes. To give some structure to this very loose interview, I took a large map of the area (and some pens) with me which guided the stories which were told. This proofed to be very useful. Follow up questions were asked where needed. Some participants needed a bit more prompting than others. Most interviews were one on one, but some interviews were held with 2 and one even with 3 participants, which in turn created different dynamics. Every interview itself was unique. All of the interviews, ranging from 45 minutes to approximately 3 hrs, were recorded with my mobile phone.

By means of stories and memories I have (partly, as also archival records etc. were studied) described the history of the water quality of the lakes. Is this actually possible? According to Selma Leydesdorf historiography and recollection are antonyms (Leydesdorff, 1993, 2011). *"The memory is life, and is carried by living groups and is therefore an on-going evolutionary process that is open to the dialectic of memory and forgetting."* (Leydesdorff, 1993, p. 57)

[13] '*De mensen en de woorden'* and *'Het water en de herinnering'*.

Despite the fact that all of the participants have shared both collective and personal memories with me, and sometimes these memories differed considerably, the people have helped me to form a more complete representation of the history of the (water quality) of the Langeraarse Plassen, and have told me things which I would never have come to know by merely studying the archives. In general the stories of the people enhance the image of the history water quality found by studying archival records.

5.3.2 Semi-structured interviews

Information obtained through semi-structured interviews provided the core empirical input for the policy process analysis. This interview type left flexibility to formulate and ask questions as they came to my mind during the interviews.

To keep my focus on the interview and interviewee I recorded the interviews instead of jotting down notes (and thereby only capturing part of each answer). By keeping all of the information from the interviews anonymous, I believe a lot of information was shared with me and not purposefully withheld. I got to know most of the participants (e.g. via unstructured interviews) before I interviewed them, as I started with the interviews for the policy process in January 2016, and started with my research at the HHR in September 2015. The interviews were not scheduled in a specific order. I adjusted my interview schedule to the agendas of the participants. Interviews with some actors, did lead to questions for other actors, which I could easily ask via unstructured informal conversations, as I was working at the HHR for 8 months.

Annex A contains a list with some details of the conducted interviews.

5.3.3 Observation

Another strategy I employed for gathering information about the policy process was observing. A distinction can be made between participant and non-participant observations. Participant observation refers to a situation whereby the researcher has close interaction with the members of the study population, and thereby 'lives' in the situation which is being studied (Kumar, 2011). As I was continuously at the organisation, which was also subject of analysis, participant observation was possible. Also non-participant observations, have been used in this study to gain a more in-depth understanding of the policy process.

Observations were for instance made during the WFD II project team meetings, during the two stakeholder evenings and during the semi-structured interviews. Besides observing at these formal gatherings, observations were conducted on a daily basis of more informal happenings (e.g. jokes made in the elevator and things said at the weekly coffee break talk of the Policy & Plan development department). To stop myself from jumping to conclusions I separated my actual observations from my interpretations in my narrative recording notebook(s).

5.4 Data analysis

I tried to transcribe the interviews (both oral history and semi-structured) as soon as possible. A minimum of one week was left between executing and transcribing each interview. Further analysis of the transcripts was done after all of the interviews were conducted. The oral history interviews, as they were very unstructured and contained a lot of information, took a lot of time to abstract the necessary information from and systematically record it in an excel sheet. Some water quality categories, such as drinking water from the Lakes, and the occurrence of otters, were water quality related parameters, which did not fit in the WFD water quality framework which was used. But which could be taken into account due to the historical ecology concept.

To structure my analysis of the historical water quality situation of the Langeraarse Plassen I identified three periods based on a combination of socio-economic developments, periodisation of interviewees and the emergence of the ecological shift in Dutch water management. These are the pre-industrial period < 1945, the industrial period from 1945-1970 and the post-industrial period of 1970 onwards. Any other person would perhaps have come up with other periods, and probably have named them differently.

The transcripts of the semi-structured interviews for the policy analysis were also systemised using an excel sheet. Information from the observations were also added. The concepts were used for processing the interview data and also systemised data ordering.

5.5 Discussion of methodology

The case study design, in combination with the selected data collection methods, proved to be valuable in gaining understanding of the social-environmental history of the Langeraarse Plassen, and HHR's WFD II policy process, specifically for the Langeraarse Plassen.

The oral history interviewing technique, was very time consuming, and left me with much more data than needed for this study. Perhaps a semi structured interview would have been a more appropriate- at least time saving- method. On the other hand with semi-structured interviews you run the risk in influencing the participants' answers with your questions, and certain topics which are relevant to understand the history of the Langeraarse Plassen might have not been covered.

For the policy process analysis 'living' in the situation which was being studied, I believe, helped me gain a much richer understanding and more accurate picture of HHR's WFD II policy process than for instance someone who would have come to HHR's office a few times to conduct some interviews. One of the disadvantages is that I have been influenced more by certain actors than others, as I have talked/ been around them much more often. By interviewing all of the actors involved with the WFD II policy process I made sure I took most of the different perspectives and views into account. Another downside is that I continuously obtained new information (which some researchers might consider a plus) which hampered me in my thesis writing.

All of the interviews were conducted, and transcribed in Dutch. The analysis was also done in Dutch. The results were translated to English for the thesis. Although time consuming- the effect of translation limitations is not considered to be significant, as I am both fluent in English and Dutch.

6. Historical water quality situation of the Langeraarse Plassen

This chapter starts by describing the creation of the Langeraarse Plassen. Secondly the water quality developments in the Lakes are discussed in three time slots: the pre-industrial phase from 1850-1945, the industrial-phase from 1945-1970, and the post-industrial phase of 1970 onwards.

Keep in mind that the focus of this study is not to give an extensive list of all of the available water quality data but to examine to what extent the historical water quality situation of the Langeraarse Plassen matches the M27 reference condition and the required WFD objectives.

6.1 From land to water

As many other relatively large and shallow Dutch lakes (De Haan, Van Liere, Klapwijk, & Van Donk, 1993) the Langeraarse Plassen are a result of peat mining. In this section the process of peat extraction is briefly described and the start of peat mining in the Noort Entse polder, creating the Lakes, is traced. For more information about landscape changes which the area has undergone in the past 400 years scan the following QR code which will bring you to a story map in which you can time travel through the history of the Langeraarse Plassen.

6.1.1 Peat harvesting

Peat extraction occurred widespread in the management area of the HHR. Peat was harvested, dried (to create turf), and then used as an important source of fuel. Initially peat cutters would dig until they reached the water table and would then move to another plot of land to harvest peat (van 't Riet, 2005). In Dutch this practice is called *delven* (van Iterson, Koese, & Manshanden, 2015). At the end of the 15th century there were not a lot of suitable lands left over for peat cutting due to the rising water table and subsiding lands (van 't Riet, 2005). As a consequence a lot of the lands were abandoned (van Iterson et al., 2015).

In the beginning of the 16th century the peat cutting process changed drastically due to the introduction of a new equipment: the hand dredge. This tool enabled the peat diggers to dig deeper (below the water table) and use the formerly abandoned lands. Peat cutters transformed to *"peat dredgers"* (van 't Riet, 2005). Due to peat dredging the landscape, gradually, transformed from land to water. The typical peat dredging landscape consists of peat holes filled with water alternating with strips of land (which were used to dry the peat on. In Dutch: *Legakkers*).

The lakes grew and grew which was enhanced by erosion. The lakes started to form a threat to the surrounding lands. Additionally the land could not be used in order to sustain livelihoods and as a consequence the water board could not claim taxes. In 1680 the HHR introduced new rules to better regulate peat dredging. A consent for peat harvesting was only given if the land would be reclaimed after extracting the peat (by draining the lakes). (van 't Riet, 2005; van Iterson et al., 2015)

6.1.2 The creation of the Langeraarse Plassen

In 1735, 35 people were harvesting peat in the Langeraar region (van 't Riet, 2005). In 1746 peat mining was occurring widespread in the *Noort Entse* polder and in the *Geer* polder (Douw, van Brouckhuijsen, & Bolstra, 1746). On a map from 1815 the Lakes are still not observable. A map dating from 1850 (see Figure 12) is the first map on which the Langeraarse Plassen are visible. The Lakes are thus somewhere between 200 (1815) and 165 (1850) years old. Only in the north part of the Geerplas, typical peat extraction patterns are visible in 1850. All of the *legakkers* in the other two lakes have probably already largely disappeared due to erosion (accelerated by human actions) and anthropogenic actions (e.g.:

peat harvesting). However, in 1850 there were many more islands, or *legakker* remnants, in the Zuidplas than there are now. Only a few of these islands, which have also decreased in size, still exist (see Text Box C).

The reasons for the wearing away of the islands, or *legakker* remnants, in the Langeraarse Plassen are not so straightforward. Erosion is one of the reasons of why the *legakkers* have washed away (Torenbeek, 2013a; Vuister, 2010). The degradation of *legakkers* is however not only a result of mechanical processes (wind and waves), but can also be caused by mineralisation of peat soils due to the inlet of external water sources to maintain the strict water level (Michielsen, Lamers, & Smolders, 2007).

Humans have also played a crucial role in the degradation of the islands as some of the islands have literally been removed for the purpose of using the soils to replenish the horticultural fields in the polder (Interviews 1, 3, 13 and 16, 2015). This was done manually and mechanically. Lack of or no maintenance is also brought forward as a reason for the washing away of islands.

Text Box C: Disappearing islands

Figure 12: Langeraarse Plassen in 1850

6.2 The pre-industrial phase: 1850-1945

6.2.1 Setting the scene

In the pre-industrial period, the land around the Lakes was used predominantly for horticulture, which was the main economic activity in the area. It was also the period in which the preservation factories developed, and when the lakes grew in popularity among fishing tourists from Amsterdam, Leiden, Den Haag and Rotterdam. In the beginning of the 20th century - until around the 1930s - a lot of people used to drink water from the lakes. The most important socio-economic developments are described in the following sections.

Horticulture

Horticulture gradually became more important after peat extraction was no longer a source of income. Peat dredgers and peat skippers gradually changed their livelihoods into being horticulturalists (Hogenboom, 1936). This was in the period in which the typical Dutch landscape, with polders and straight roads and ditches, was created (around the second part of the 17th century[14]). Based on historical maps, horticulture started, somewhere between 1815 and 1850 around the Langeraarse Plassen.

Horticulture used to be the main economic activity in the area. "*You could say that the income of the majority of the villagers had to come entirely from the plots of land*" (van Emmerik, 2013, p. 68). The

[14] The Wassenaarse Polder (located on the west side of the Lakes) was created in 1666 and the Vierambachtspolder (located to the south of the Lakes) was created in 1768 (Markus & van Wallenburg, 1969).

land on the eastern side of the Langeraarse Plassen, the side of Papenveer, was used to cultivate vegetables. But vegetables were also grown, to a smaller extent, in Langeraar. The vegetables were grown on bare ground, known as *koude teelt*. The cultivation of these vegetables was called d*e Veense Teelt*, which if literally translated means peat cultivation. Pods, peas, broad beans, string beans, green beans and pickles are the crops which characterise the Veense Teelt[15] (van Kessel, 2002).

Initially a lot of the horticulturalists lived in Langeraar and used a rowing boat, to cross the Langeraarse Plassen and move between their land and their home. The boat was the main form of transportation, up until the 1970s when the Paradijsweg was constructed. In the beginning of the 20th century the vegetable production increased and as a consequence Papenveer expanded as a real village (Berenyi et al., 2009). Up until the 1950s most of the horticulturalists were producing vegetables. In the post crisis years of the 1930s the demand for vegetables was especially high (Berenyi et al., 2009) (Oral history interviews, 2015).

Dredging

A practice which was done by and/or for horticulturalists was dredging (in Dutch: *baggeren*). People used to dredge in the lakes so they could replenish the soil of their fields. *"This was very good soil to spread over your fields. The vegetables grew very well on it."*[16] Dredging in the Langeraarse Plassen was a well-known practice done by almost everyone in the autumn and winter. But what kind of soil did the people use to replenish their lands? What were the sediments?

A distinction can be made between the more loose soils; the sludge, and the firm soils; the peat soils. Redeke (1923) describes it as having a brown colour and consisting of peat and remains of dead plankton organisms. In the interviews the term *molm* was used quite often. It was the *molm*, or the peat soils which were considered to be the most valuable for replenishing the horticultural lands with. It were these soils which the horticulturalists were after. I was told that everyone used to know the exact right spots within the lakes to find it.

Dredging also occurred in the canals. There the reasons for canal dredging were twofold: to deepen and keep the canals at a navigable depth, and to use the dredging to spread over the land. Additionally the canals used to be maintained, via dredging and removing water plants, in order to comply with the polder *Schouw*.

During WOII, due to fuel scarcity, a lot of people in the area went dredging in the Lakes for peat to make turf.

Preservation factories

In the pre-industrial era the preservation factories started to develop. The municipality of Ter Aar was once known for its preserving factories such as Uijttewaal, Koeleman, van der Pijl and ZHI. As one of the interviewees tells me the area was *"a centre of salting factories"*[17]. Three conservation industries were located in a close proximity to the lakes: Koeleman, the Zuid- Hollandse- Inleggerij (ZHI), and Uijttewaal.

The oldest conservation industry is the ZHI (which was called Mank untill 1932). In 1889 Johannes Mank started a salting business, whereby he salted vegetables in order to preserve them. The Koeleman business was founded in 1916 and Uijttewaal in 1911.

Water contamination

In the pre-industrial era, human excreta and manure, were used as fertilisers on the lands surrounding the Langeraarse Plassen. Human excreta was transported in barrels to the horticultural lands. This happened at least until the 1960s (Hofstede & Blok, 1964). Around April manure skippers from

[15] Around 1825 the people started to cultivate pickles. Before 1825 only string beans, pods and peas were cultivated (Vermeulen, Vaneman, van Tol, van Tol, & van Tol, 2000).

[16] (Interview 10, 2015)

[17] (Interview 1, 2015)

Schiedam came to the area by boat to sell liquid cow dung, this stopped when chemical fertilisers came on the market (after WOII) (van Kessel, 2002). Chemical pesticides were used on a very small scale in the pre-industrial phase (Interviews).

The sewage which was not used on the lands, was discharged into the surface water. Moreover wastewater from the industries was also discharged either directly or via a canal into the Langeraarse Plassen. Also other waste was dumped into the lakes, and surrounding channels. One of the interviewees tells me that *"everything that was broken was thrown in the lakes because there were no containers. Where else to put it?"*[18]

Protecting water bodies from waste dumping started in the first half of the 20th century. In 1934 the province of Zuid-Holland and the States-Provincial started with regulating the dumping of waste in various lakes in Zuid-Holland with *de plassenverordening* which stipulates that it is prohibited to dump waste, manure, soil, and similar substances in selected lakes ("De Plassenverordening," 1934). Initially the Langeraarse Plassen were not protected via this regulation. Unlike the Nieuwkoopse Plassen the Langeraarse Plassen were not considered to be of significance for landscape-, scientific-, provincial- or national perspective (Trouw, 1948, p. 185). The Langeraarse Plassen were enlisted as a protected lake via *de plassenverordening*, at least since 1943 ((HHR, 1948-1973);(HHR, 1943-1956)). This regulation did not stop dumping of waste entirely. Permits were granted by the polder board (for an overview of the Polder boards responsible for water management in the Langeraarse Plassen over time see the background chapter) to dump certain waste or fill certain parts of the lakes. A permit was for example granted to the municipality of Ter Aar to dump household waste along the north side of the *Kerkpad* to stop the path from eroding (HHR, 1948-1973).

Besides the regulated dumps there were also households, industries and horticulturalists dumping[19] waste alongside and in the lakes. All of the horticulturalists used to have a dumping ground. The horticulturalists with land bordering the Langeraarse Plassen had their trash dump on the lake side where they mainly dumped organic material (crop residues), but for instance also glass. The process of dumping was called *aandammen* and the dump itself was called the *aandam*. The reasons for these *aandams* were twofold:

1. There was no other place to bring your trash
2. To prevent erosion of the banks and thereby protect precious agricultural land from being washed away.

Up until the '50ies a solid waste management practice carried out by quite a few horticulturalists was goat keeping. A lot of horticulturalists had one or more goats who would eat the kitchen waste. The goat manure would be brought to the agricultural fields in the fall. People without a goat would throw their kitchen waste in the lake or canals.[20]

6.2.2 Water Quality

There is hardly any information of the water quality of the lakes before 1923. What is known from old newspaper articles (dating from 1906, 1910 and 1911) is that there were otters[21] in the area, which indicates that the Lakes were rich in fish and the banks were covered with a lot of plants (Lamers et al., 2001). Moreover it is known from the maps that since 1850 there has not been a typical peat

[18] (Interview 13, 2015)

[19] Dumping is perhaps not the correct word as it has a negative connotation. Nowadays we, in the Netherlands, are used to a solid waste system, but this has not been a reality for that long.

[20] (Interview 14, 2015)

[21] The otter, the ambassador of clean water (van den Brink & Sluiter, 2015), was considered extinct in the late '80s due to habitat fragmentation and poor water quality (Lamers, Klinge, & Verhoeven, 2001) In the Langeraarse Plassen the last otter, *"a devilish beast which ate all the fish",* was caught by one of the fishermen in 1960 (Interview 11, 2015).

dredging landscape in the Langeraarse Plassen, as the lakes were already large back then. In larger lakes it is often difficult for plants to develop and maintain themselves. In large, shallow lakes the wind has a huge effect on the turbidity. Even with low nutrient concentrations the water will be turbid, due to suspension of sludge, which in peat lakes, is continuously formed. For plants it is much easier to develop in ditches or in the turf ponds between the *legakkers* as the wind has much less effect.[22] The Lakes have thus probably been turbid, and therefore contained but few aquatic plants, from 1850 onwards. If a clear and plant rich situation has occurred in the Lakes it was somewhere between 1815 and 1850, and only lasted for a few decennia.

The two reports which give information on the water quality in the pre-industrial era, from 1923 onwards, are:

- (Redeke, 1923) In 1923 Redeke, a well-known hydro biologist, investigated the growth of Bream in several waters, including the Langeraarse Plassen. The research was done at the request of the inspector of fisheries with the goal to gain more insight into the growth and age of bream and investigate the causes of poor growth. Redeke does not specify in which lake he has carried out his research (he refers to *"de Langeraarse Poel"* which is not plural and could either be the Noord- or the Zuidplas). The Langeraarse Plassen were one of the first fish waters that were investigated, because most fishermen were complaining about *Scheerbliek.* That's how the small Bream was called. Redeke carried out his research in the Langeraarse Poel from august the 17th untill October the 16th in 1923.
- (Hogenboom, 1936) The Guide of Ter-Aar, which is actually a promotion booklet for the area, was released in 1936. The purpose of the guide was to inform the increasing flow of tourists from neighbouring Dutch cities, and to lure more tourists to the area. The natural beauty of the Langeraarse Plassen is described in the booklet.

Information from these reports, and the oral history interviews are used in the following subsections to describe the water quality in the pre-industrial era.

General Physical-Chemical water quality parameters

Salinity

In 1923, the water of the Langeraarse Plassen contained slightly more than 100 mg Cl/l (Redeke, 1923).

Transparency

In November and December of 1923 the water in the Langeraarse Poel (not specified whether it is the Noord- or the Zuidplas) was very turbid. The transparency measured with a white Secchi disc did not exceed 0.75m (Redeke, 1923).

During WWII (it is not specified in which year) a transparency of at least 1.20 m was measured twice in the Noord- and the Zuidplas. The text further does not specify by whom and where exactly this is measured (Hofstede & Blok, 1964).

Biological water quality indicators

Phytoplankton

Redeke also examined the intestinal contents of some breams after which he concluded that the Bream of the Langeraarse Plassen mainly ate plankton. According to Redeke the poor growth of the Bream in the Langeraarse Plassen was the result of the poor food situation. The presence of cyanobacteria is also mentioned by Redeke.

[22] Personal communication with a government official of HHR January 2016

Macro benthos
Redeke found some types of macro benthos in the subsoil, such as chironomidae larvae, that can live in oxygen-poor conditions. No other organisms can survive under such poor conditions. Because there are hardly any aquatic plants in the Langeraarse Plassen, there is no habitat for the macro benthos. The only available bream food are insect larvae of the chironomidae (and phytoplankton, which is the main food source of the bream in the Langeraarse Plassen). (Redeke, 1923)

Aquatic plants
In order to gain a better understanding of the causes of the poor growth of Bream Redeke examined the banks and the subsoil. The Langeraarse Plassen were in a completely different state than the Wijde Blik (part of the Loosdrechtse Plassen), also a peat lake, which at that time was characterised by clear water and a lot of submerged aquatic water plants. The following passage illustrates this difference:

"The Langeraarsche Poel gives a completely different picture. During the investigation the water was always so turbid that the white disk was never visible at greater depths than 75 cm. The bottom of the lake is almost entirely bare and consist of a smelly, soft mud, which is rich in hydrogen sulphide, in which almost no animals can survive. […] There are hardly any aquatic plants in the lakes. Only in some corners, called Kruidhoeken, we found Potamogeton pectinatus and Myriophyllum, and the banks were covered with narrow reed strips. Neither the characteristic Nymphaeaceeën, or the Stratiotes, nor were we able to find broad-leaved pond weed species which are of utmost importance for the fishery sector." (Redeke, 1923, p. 237)

In 1923 there were thus, besides reed along the banks, a number of different types of aquatic plants present in the Langeraarse Plassen. Potamogeton pectinatus is an aquatic plant that occurs in very nutrient-rich water (Bloemendaal & Roelofs, 1988). From the term *kruidhoeken* (Dutch word for: herb corners) we can conclude that there were no aquatic plants present in the middle of the lakes. Overall Redeke found the flora in the Langeraarse Poel very poor. The intensive annual dredging of the lakes for the benefit of horticulture is said to be the reason that there are no aquatic plants in the lakes. "*If the subsoil would be left untouched, aquatic plants would probably develop after a few years, just as in the Wijde Blik [...]."* (Redeke, 1923, p. 238)

The Guide of Ter Aar sketches a picture of the plants that are present in and around the lakes in 1936. In the guide you can read that the lakes and islands within the lakes were surrounded by a fringe of reed and rush. This is also in accordance with what the interviewees have told me. The plants that grew on the marshy islands were sphagnum, peat moss and drosera. In the vicinity of the Lakes honeysuckle, sorbus, birches and ferns were present. The writer also talks about aquatic plants, which the grebe uses to build its nest, but does not specify what types and where they occur (Hogenboom, 1936).

In contrary to the Lakes, the canals, bordering the Langeraarse Plassen, have been in a clear state with a lot of aquatic plants until 1934-1940. The water was so clear that you could see beetles walking on the bottom. Stratiotes aloides, yellow water lilies (Nuphar lutea), and reed and bulrush grew exuberant in the canals. [23]

Fish
The Langeraarse Plassen are classified as poor waters for bream fishing. From the report of Redeke it become evident that there are a lot of breams in the Lakes, but that most of the breams are very small. The poor growth is attributed to food shortage. This has been the case since 1919. Redeke is told that there once was a time that pike was frequently caught in the lakes but that due to overfishing the pike

[23] This is purely based on information from the eldest interviewee: (Interview 2, 2015).

has almost entirely disappeared. Redeke ends his report with the advice to release predatory fish (either zander or pike) into the lakes to eat the small bream. In this way the *"numerous and relatively worthless small bream"* (Redeke, 1923, p. 239) still indirectly benefit the fisheries.

According to the guide of Ter Aar anglers were the most loyal visitors of the lakes in 1936 as the lakes are rich in pike and zander (pike-perch). This contradicts with what is mentioned in the report of Redeke. The pike and carp anglers are mainly found along the Aarkanaal, which suggests that these species are less dominant in the Lakes.

The findings or the report of Redeke are considered to be more reliable as he was an important hydro biologist and did not write the report with the intention to lure more tourists to the lakes.

6.2.3 Sub conclusion

The Langeraarse Plassen have been turbid and bream dominated since 1923, but probably already since 1850. Back then there were already very few aquatic plants. Only in some corners, pondweed (*Potamogeton pectinatus) and* vederkruid *(Myriophyllum*) was present. Additionally there was a 'narrow' (it is not defined what is considered to be narrow) reed and rush strip present along the banks and the islands.
In the most favourable case, the transparency was 75 cm (where this is measured is unclear). In 1923 the Langeraarse Plassen belonged to the bream-zander fish water type. This cannot be said with 100% certainty, since there are no hard numbers on the percentage of fish species. Nevertheless, based on the low water plant coverage[24], and the prevalence of bream, it can be concluded that in the 20s the Lakes belonged to the bream-zander fish water type.

6.3 The industrial phase: 1945-1970

6.3.1 Setting the scene

After WOII the population growth accelerated in the Netherlands and many other countries in the west. The horticulture around the Langeraarse Plassen intensified. Also the preservation industries located around the Lakes, grew immensely. During the industrial era plans were made to drain and/or infill the lakes, while at the same time on a national level people started to advocate for nature and recreational benefits of lakes in general. The industrial era, specifically the 60s and 70s, is also the period of the strong eutrophication which is said to be the main cause of the disappearance of clear water, with lots of submerged aquatic plants in the Dutch shallow fen lakes (Lamers et al., 2001). From the 1950s there has also been an increase in the use of phosphate laden detergents, which, in combination with the absence of WWTPs, will have contributed to increased eutrophication of the Dutch water bodies. (Schmidt-van Dorp, 1978).
The most important socio-economic developments, and water pollution sources/causes, of the industrial era are discussed in the following sections.

To reclaim or not to reclaim?

In 1948 a book was written about peat lakes in the western part of the Netherlands. In his book J. Trouw tries to convince the Dutch government that the remaining peat lakes should not be drained or filled (to be made suitable for agricultural purposes), but should be kept for the recreational needs of people. The following quote illustrates this objective:

[24] Aquatic plants have the most important influence on the fish species composition (Personal communication with a government official of HHR in December 2015). There are species that are highly dependent on plants (such as pike, rudd and tench) and species that do not depend on aquatic plants (such as bream, roach and zander) (Zoetemeyer & Lucas, 2007).

"The increase of the population and especially in the last decades rising desire for recreation in nature, demand an intervention by the Government, if a catastrophe wants to be avoided. With respect to the lakes in the Netherlands, no delay can be permitted, because now many lakes can still be saved." (Trouw, 1948, p. 10)

Not only does he argue that there should be nature for people, but also that there should be nature for animals and plants. Trouw thus advocates for keeping the lakes for both recreational and ecological purposes.

From 1943 until 1956 there were plans to drain and/or infill the Langeraarse Plassen. One of the reasons for reclaiming the land was that the water erosion took away precious horticulturalist soils. Water was seen as a nuisance. In 1948 there were plans to infill the Noord and the Zuidplas with garbage from Zandvoort, Haarlem and Bloemendaal. Eventually the Langeraarse Plassen were not reclaimed, but this was not due to landscape, nature or recreational objectives. The reasons for not reclaiming the land were mostly economic. It would be very costly to reclaim such small lakes, the polder board lacked financial support, the demand for more agricultural land was not so high, and the possibility to dredge for precious sludge for the surrounding horticulturalists would disappear. (HHR, 1943-1956)

Horticulture intensification

In the period after WWII the demand for vegetables was especially high and most of the horticulturalists cultivated vegetables (Berenyi et al., 2009).
Around the 1950s and 1960s a shift from vegetables to cut flowers and pot plants took place in the area (Oral history interviews, 2015) (Berenyi et al., 2009; van Emmerik, 2013). This was also the period when the greenhouses came[25]. The two main drivers for this shift are: that the narrow and long plots of land divided by multiple canals inhibited necessary scale enlargement to keep vegetable cultivation profitable (i), and that the increased Dutch wealth also provided a demand for luxury goods such as cut flowers (ii).

Within the Netherlands the use of chemical pesticides started after the Second World War (den Tonkelaar, 1993). This was also the case for the horticulturalists in Langeraar and Papenveer. At least the massive roll out of pesticide use. *"In 1928 I used a pesticide for the very first time. I cannot remember its name. The one that came later was paratzion. It was a very dangerous thing. (…) I stopped my company* (horticulturalist) *in 1953 and that is when the use of pesticides among horticulturalists expanded tremendously"*[26]*.* Known chemical fertilisers and pesticides used in the area in the '60s are: A.S.F. korrels, sodium chlorate, Aadipon, Aldrin, Parathion, Cumotex, Lirothion and Caustic Soda (P3) (Hofstede & Blok, 1964). Uncontrolled use of these substances will have clearly polluted the surface water. Through various emission routes (e.g. direct surface runoff and via the air) the surface water can be polluted by these fertilisers and pesticides.

Industries

Especially after the Second World War the conserving factories expanded and the production process intensified. Parts of the Zuidplas made place for the growing ZHI (in Dutch: *dempen*).

The ZHI and Koeleman used to discharge their wastewater directly into the Zuidplas (Hofstede & Blok, 1964) (HHR, 1959-1961). The ZHI used water from the Zuidplas for rinsing out the barrels[27] whereas

[25] Of course there were already greenhouses before the 1950s. In 1920 the first small greenhouse was built in the area (in Langeraar, bordering the lake) (Interview 4, 2015).
[26] (Interview 14, 2015)
[27] (Interview 12, 2015)

the Koeleman preservation factory withdrew its process water from the Leidse Vaart. Also Uijttewaal discharged its wastewater in the polder water (a ditch nearby) and thereby contributed to the pollution of the Langeraarse Plassen. (Hofstede & Blok, 1964)

The wastewater of the conservation factories contained organic and chemical components. The organic pollutants were the residues of the processed fruits and vegetables such as seeds and juices, and the chemicals were soap and caustic soda. Chemical detergents were frequently used to clean the jars. (HHR, 1959-1961; Hofstede & Blok, 1964). Additionally large amounts of kitchen salt (NaCl) was present in the wastewater (Bax & Snijders, 2010; HHR, 1959-1961). The wastewater of the industries was of a very poor quality as the following description (of the wastewater from the Koeleman factory) illustrates: approximately 70 m^3 per day, for a period of 9 months a year, of stinking dark brown water with a BOD of 180 was discharged via a 300 m ditch into the Zuidplas (Hofstede & Blok, 1964).

From 1947 onwards horticulturalists would regularly complain to the polder board (of the Noordeind- en Geerpolder) about salinization of the water in the lakes, which they used in order to irrigate their crops, and salinization of the sludge, which they used for replenishing their lands. They argued that the conserving factories were responsible for the salinization (HHR, 1959-1961).

In a response to these complaints, the polder board (Noordeind- en Geerpolder) requested some studies to be carried out. Based on the results, which showed that the water quality in numerous water samples appeared to have a salt level higher than the irrigation water threshold level of 450 mg/l, the board decided to withdraw the right to discharge wastewater in the Polder (HHR, 1959-1961). This was on the 1st of December 1959. From that time onwards the Uijttewaal factory started to discharge its wastewater directly into the Aarkanaal. Also the factory of Koeleman shifted its wastewater discharge to the *boezemwater*, namely de Leidsevaart. This transfer was realised in 1962(Hofstede & Blok, 1964). The ZHI did not want to follow the changed rules and appealed to the decision of the polder board. On the 9th of September 1961, the polder board withdrew its ban on discharging wastewater onto the polder water for the ZHI. During its existence (from 1889 until 1977), the ZHI has thus discharged its untreated wastewater directly onto the Zuidplas.

Another industry which was known to directly discharge its wastewater into the Zuidplas in the industrial era is a construction industry where steam soda was used to clean metal (Hofstede & Blok, 1964).

Dredging

Also in the industrial era dredging occurred on a large scale for the horticulturalist. A shift in the dredging practice took place around 1955. Around that time Willem Vermeulen started to provide a dredging service to the horticulturalists with his mechanical dredging machine. The practice thus shifted from manual dredging (with a hand dredge) to mechanical dredging. Additionally it developed from a practice done by almost everyone (In the 1920s, each winter, thousands of boats were filled with sludge from the lakes to benefit the surrounding lands (Redeke, 1923)) to only one person dredging the lakes[28] (Oral history interviews, 2015). The relation between dredging and the effects on water quality are discussed in Text Box D.

Waste dumping

Waste dump sites, or *andams*, still occurred on a large scale in the industrial era. Besides wastewater discharges, the preservation factories, at least the ZHI, used to have a waste dump, similar to the ones the horticulturalist used to have, where they would dump glass jars and green waste as is evident from the following quotation:

[28] There were still a few people who continued to manually dredge for themselves.

> *"What did happen was of course that the jars, the gherkin jars, everything that was broken. Yes it all went to the back of the Lakes. That's where we would look for rubber bands in the glass from which we made a ball. There was no ball or anything ... we did not have that back then." (Interview 13, 2015)*

Not only the agricultural and industrial sector were responsible for waste disposal in or on the sides of the Lakes, also the citizens threw garbage in the lakes. The lakes were literally used as a waste disposal site for old bikes, tools, glass, and matrasses as the following quotes illustrate:

> *"Seriously, everything you can imagine is in these lakes." (Interview 3, 2015)*

> *"Old bikes, a motorcycle frame, old boats (…) I'm telling you it used to be a waste disposal site. Everything was thrown into the lakes. My dad once told me that one morning when he was hunting on one of our islands, and it was very foggy. He heard someone rowing, and once the haze disappeared he thought what is all that noise, and then he saw plastic bottles, an old matrass and all sorts of rubbish floating in the water. That was just someone who was getting rid of his waste." (Interview 7, 2015)*

The relation between dredging in peat lakes and water quality is not so straight forward.
Redeke indicates that this very intensive use of the bottom of the lakes, through dredging, is the reason for the absence of water plants in the Langeraarse Plassen (Redeke, 1923).
On the contrary the HHR, and many other water managers, use dredging as a water quality improvement measure (of course it is not carried out in such a high frequency). The idea being that the continuous forming sludge layer contains large amounts of nutrients which are removed by dredging. A research which studied the effects of removing organic sludge in fen water bodies shows that the removal of sludge improves the water quality (for instance a higher water transparency) and can contribute to ecological restoration (Verberk & Esselink, 2007). On the short term dredging results in a more turbulent system and in the long run dredging can improve the water quality. It is however very case specific whether it really leads to lasting improved water quality (Personal communication with a government official of HHR 2015). A study on internal eutrophication in peat lakes showed that dredging in peat lakes can even be counterproductive (Michielsen et al., 2007).

Text Box D: Dredging and water quality

6.3.2 Water quality

In the period of 1945 until 1970 a series of studies, which give insights into the water quality of the Langeraarse Plassen in the industrial era, have been carried out:

- (HHR, 1959-1961) In response to a number of complaints from horticulturalists[29] regarding salinization of the water and soil from the Lakes, the board of the Noordeind- en Geerpolder carried out a number of studies to investigate the usefulness of the water for irrigation. The results of the survey in 1958 made the polder board decide to cancel the licenses of the factories to discharge wastewater into the polder water, commencing from the 1st of April 1960. For the ZHI this decision was later reversed as can be read in the 'setting the scene' section. Studies carried out to determine the salinity of the water of the Langeraarse Plassen:

[29] The flower grower CJ. Mank complained in 1947. In 1950 and 1957 more and more horticulturalists complained to the polder board.

    - In the period from October 1948 to October 1949, 125 water samples, from 5 different sites, have been studied. In 1950 and 1951 the chloride content of some dredge samples from the lakes was determined.
    - The ZHI had a laboratory in Utrecht investigated the salt content of a couple of water samples (12) in 1955 and 1985.
    - The technical service of the HHR launched an investigation in 1958 (February until December) to investigate the suitability of using the polder water (including the Langeraarse Plassen) for irrigation of the horticultural fields. Every two weeks samples were taken from 7 different places and examined on chloride concentrations.
- (Leentvaar, 1963) contains results of a hydro- biological study carried out in 1960 of surface waters in the Netherlands. One of the examined waters was the Langeraarse Plassen. It is not specified where the samples- in spring, summer, and autumn- have been taken.
- (Hofstede & Blok, 1964) An extensive report on the water quality of the Langeraarse Plassen was published in 1964. The board of the Noordeind- en Geer Polder requested the inspection of fisheries to study the lakes because of the declining zander catches. The survey was conducted in 1960 and 1961. The report consists out of two distinct parts: a fishing and a biological-chemical part. A comprehensive investigation was conducted because the lakes show a *"biologically different picture" (HHR, 1960-1964).* All in all, the report gives a good picture of Langeraarse Plassen in the 60s.
- On Monday, July 8th 1963 there was a mass death of fish in the Zuidplas of the Langeraarse Plassen (HHR, 1960-1964), which resulted in two one day water quality studies:
    - The first investigation (8-7-1963) was conducted by H. A. de Boer in the presence of the chairman of the board of the Noordeind- en Geer Polder. In situ is oxygen, salinity, pH and temperature were measured.
    - The day after the massive fish death (9-7-1963), HHR (the lab) carried out a number of water quality measurements in the Zuidplas.

Information from these reports, and the oral history interviews are used in the following subsections to describe the water quality in the industrial era.

General physical-chemical water quality parameters

During the chemical water quality investigation in 1960/1961, Hofstede and Blok (1964) measured the pH, oxygen binding ability, chloride level, and the oxygen content in situ. Periodic analyses were performed for a period of 1 year (starting in august 1960). In addition, occasionally samples were sent to a laboratory in Utrecht for further analysis (that is where the nutrient concentrations were measured).

The water quality measurements that were carried out after the massive fish death in the Zuidplas, are in contrary to the periodic investigation of Hofstede & Blok, more a snapshot in time. The results of the first one-day water quality investigation is presented in Table 5.

Table 5: Results of water quality measurements in response to massive fish death in the (HHR, 1960-1964)

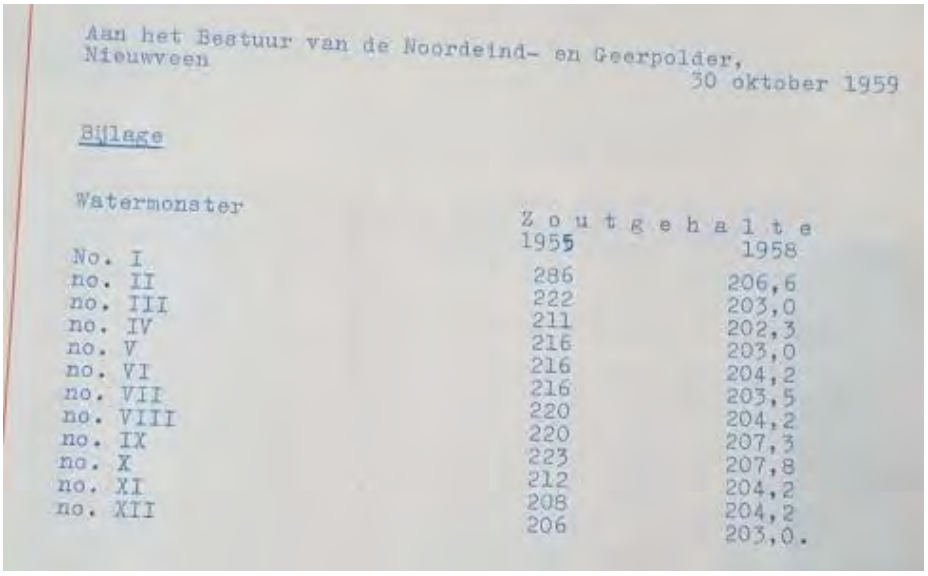
	Geer- en Noordplas	**Zuidplas**
Water colour	intense green	Dark brown/black
Temperature (°C)	19	20
Oxygen(mg/L)	10.7	0.9-1.2 (along the banks); 1.8 (in the centre of the lake)
Salinity (mg Cl/L)	225	180-200
pH (-)	8.4	Ranging from 6.8 (near the ZHI) up to 8.4

Salinity

In the period from October 1948 to 1958, a number of studies were conducted to determine the chloride content of water and soil samples of the Langeraarse Plassen. During the investigation of 1948-1949 very high salt concentrations were measured. For example in the ditch where the preservation factory of Uijttewaal discharged its wastewater, an average of 640 mg Cl/L was measured which is significantly higher than the "harmfull irrigation" limit of 500 mg Cl/L (HHR, 1959-1961). The highest measured value was 1500 mg Cl/L. The WFD limit for chloride (specifically for the Langeraarse Plassen) is much lower, namely 200 mg Cl/L. In the Noord- and Zuidplas the average salinity was respectively, 240 and 280 mg Cl/L.

Concrete values of the mud sample examination have not been found. The research did reveal that the salt content of all the soil samples was too high, and could therefore not be used safely in horticulture. This suggests that the mud samples contained salinity levels exceeding the 'harmful' 500 mg Cl/L limit. The soil samples taken next to the ZHI and close to the pumping station did not have significantly higher chloride levels than the other soil samples.

The results of the measurements carried out in the name of one of the preservation factories (the ZHI), are shown in Figure 13. The locations of the sampling points are not known. Probably a majority of the sampling points are located in the Zuidplas as that is where the ZHI discharged its wastewater. One might be sceptical of the results since not one sample seemed to exceed the harmful irrigation limit. Which is of course positive for the image of the ZHI.



Aan het Bestuur van de Noordeind- en Geerpolder,
Nieuwveen

30 oktober 1959

Bijlage

Watermonster	Z o u t g e h a l t e 1955	1958
No. I	286	206,6
no. II	222	203,0
no. III	211	202,3
no. IV	216	203,0
no. V	216	204,2
no. VI	216	203,5
no. VII	220	204,2
no. VIII	220	207,3
no. IX	223	207,8
no. X	212	204,2
no. XI	208	204,2
no. XII	206	203,0.

Figure 13: Results salinity measurements by the ZHI (HHR, 1959-1961)

An overview of the results of the study carried out in 1958 , which led to the polder board to terminate the wastewater discharge permits of the preservation companies[30], are shown in Figure 14. Except from one sampling point, the average chloride levels do not exceed the WFD objectives of 200 mg Cl/L. In 1960 the highest chloride value was higher than 200 mg Cl/L, while the highest value in 1961 was 140 mg Cl/l (Hofstede & Blok, 1964).

[30] Consequently, the firms Uijttewaal and Koeleman shifted their wastewater discharges from the polder to the boezem water.

plaats van de monster-punten	chloride-gehalte in mg/l in 1958			zuurstofgehalte in mg/l in 1958		
	laagste	hoogste	gemiddeld	laagste	hoogste	gemiddeld
sloot nabij de inleggerij van Koeleman	120	264	186	3	7	5
Zuidplas nabij polder-gemaal	120	160	138	5	8	6
Zuidplas nabij Z.H.I.	124	308	151	5	7	6
Zuidplas nabij Kerkpad	120	144	133	5	7	6
Noordplas, nabij Kerkpad	96	132	117	6	8	6
Geerpolder, nabij Pulmot	100	132	113	5	7	6
sloot nabij inleggerij Uijttewaal	132	460	236	0	4	2

Figure 14: Summary of the results of the water quality investigation conducted by the technical department of the HHR in 1958 (HHR, 1959-1961)

pH

The pH was actually almost always above 8 and sometimes some measurements reached values of 9 and 10 (Hofstede & Blok, 1964). If you compare this with the WFD benchmark for M27, the Langeraarse Plassen were inadequate (pH 8-8.5), and sometimes even in a very poor condition (pH > 8.5) based on the pH, in 1960 and 1961. Peat, and thus peat lakes are naturally acidic (low pH), but the inflow of *gebiedsvreemd'*[31] water to maintain water levels, can make the water more calcium rich[32]). The pH of the Leidse Vaart, a canal which is occasionally used to let water into the lakes, was on averaged 7.3. P3 discharges may also have increased the pH of the Langeraarse Plassen.[33]

Nutrients

That there are algae blooms throughout the year (Hofstede & Blok, 1964), is clearly a feature of eutrophication. In particular the enrichment of the system with nitrogen (N) and phosphorus (P) can lead to eutrophication. The periodic analysis of Blok showed that the measured nitrate levels (NO_3^-) stayed below 1 mg/L. Also only small quantities of ammonium (NH_4^+) were measured (mainly values of 0.125 mg/l). The phosphate levels (PO_4^{3-}) reached values of 1 mg/L, especially in summer time. The orthophosphate summer average in the Geerplas was 0.17 mg/L in 1961. (Hofstede & Blok, 1964)
The research of Leentvaar (1963) shows that the Langeraarse Plassen had an ammonium (NH_4^+) content of 2.5 mg/L and a phosphate (PO_4^{3-}) concentration of 1 mg/l. Altogether Leentvaar classifies the Langeraarse Plassen as a moderately to highly eutrophic water body.

Transparency

After 1935-1940 the canals, bordering the Langeraarse Plassen, were very turbid, just like the Lakes. There were however moments when the ditches, especially the Keetsloot, were clear for a while. *"My father used to say: 'I can pick up the coins of the dredging'"*[34] The difference in turbidity in the Lakes and the keetsloot is attributed to the fact that the sluice to the Aarkanaal, on the southeast side of the Lakes, was opened a lot (e.g. to access the vegetable auction in Papenveer).

[31] If literally translated it means area strange. It refers to water with a quality that does not naturally occur in an area. Usually, *boezemwate*r is meant.
[32] Personal communication with a government official of HHR on 15-12 2015
[33] Personal Communication with a government official of HHR on 15-12-2015
[34] (Interview 10, 2015)

In July and august of 1960 the highest measured transparency was 50 cm. Transparencies of 25-30 cm were however mainly observed (Hofstede & Blok, 1964).

Stakeholders from the area reported to Hofstede & Blok that the water had a peculiar green colour. According to some, this colour had been present for 40 years while others said that this this green colour had appeared after the war. In the winter of 1957, the water was clear (Hofstede, 1964). Hofstede and Block state that "*the most striking feature of Langeraarse lakes is the intense green colour, of the water, both in summer and winter."* (Hofstede & Blok, 1964, p. 42)

Other

The investigation of Leentvaar (1963) shows that the Langeraarse Plassen contain more coli bacteria per 100 cm^2 than average. The lakes contain more than 300 per 100 cm^2. This can be explained by the untreated sewage that gets discharged directly or indirectly into the lakes.

Biological water quality indicators

Phytoplankton

The Langeraarse Plassen are seen as an *"exceptional water body"* (Hofstede & Blok, 1964, p. 2). Almost continuously there are algae blooms present in the Lakes. The causes of the constant hypertrophy is attributed to the stagnant nature of the water in the lakes, in combination with the many pollutants (no sewers and the discharge of organic and chemical wastewater from companies and the horticulture).

From the periodic sampling it can be concluded that cyanophyceën (O. agardhii and O. Redekii) were permanently blooming. Both blue-green algae species were constantly dominant, especilly O. agardhii. None of the other studied water bodies - the Nieuwkoopse Zuidplas, de Leidse vaart and the Aarkanaal - showed similarities with the plankton analysis results of the Langeraarse Plassen (Hofstede & Blok, 1964). Also Leentvaar (1963) shows that there are a lot of cyanobacteria present in the Langeraarse Plassen in every season.

Macro benthos

Hofstede and Blok (1964) conducted a macro benthos inventory on the 13th of July in 1960. In general the soil of the bottom of the lake gave a sterile impression (which also indicates that submerged aquatic plants were not present). Only at one location fish food, macro benthos, was found (chironomidae and nematodes). The almost complete absence of macro benthos, and thereby fish feed, corresponds with Redeke's findings in 1923.

Aquatic plants

Before 1947 there was still a protective reed barrier present in the Langeraarse Plassen. The reed protected the precious horticultural land from eroding. (HHR, 1943-1956).

Hofstede and Blok (1964) have indicated the presence of aquatic plants on a map (Figure 15). There are reeds along the banks. Moreover, potamogeton is present in the Geerplas. Hofstede reports that the reed strips are not very wide. If you look at Figure 15 you can see that almost all of the banks are covered with reed. De ditches in the horticultural area are usually covered with duckweed (sample point 24, 25 and 36). This is in accordance with the stories of the interviewees, who mention that from the 50's onwards all of the canals were most of the time covered with duckweed.

The following quote illustrates that there are not a lot of aquatic plants in the lakes:
"The Langeraarse Plassen have a limited Pike environment (with many aquatic plants and plant overgrown riparian zones)" (Hofstede & Blok, 1964, p. 16). Most of the plants are located in the eastern part of the Lakes. In Figure 15 these are the points 1, 5, 7 and 26 (Hofstede & Blok, 1964). Three of

these points are located in the Geerplas, and all four points are located in bog holes or in close proximity to an island.

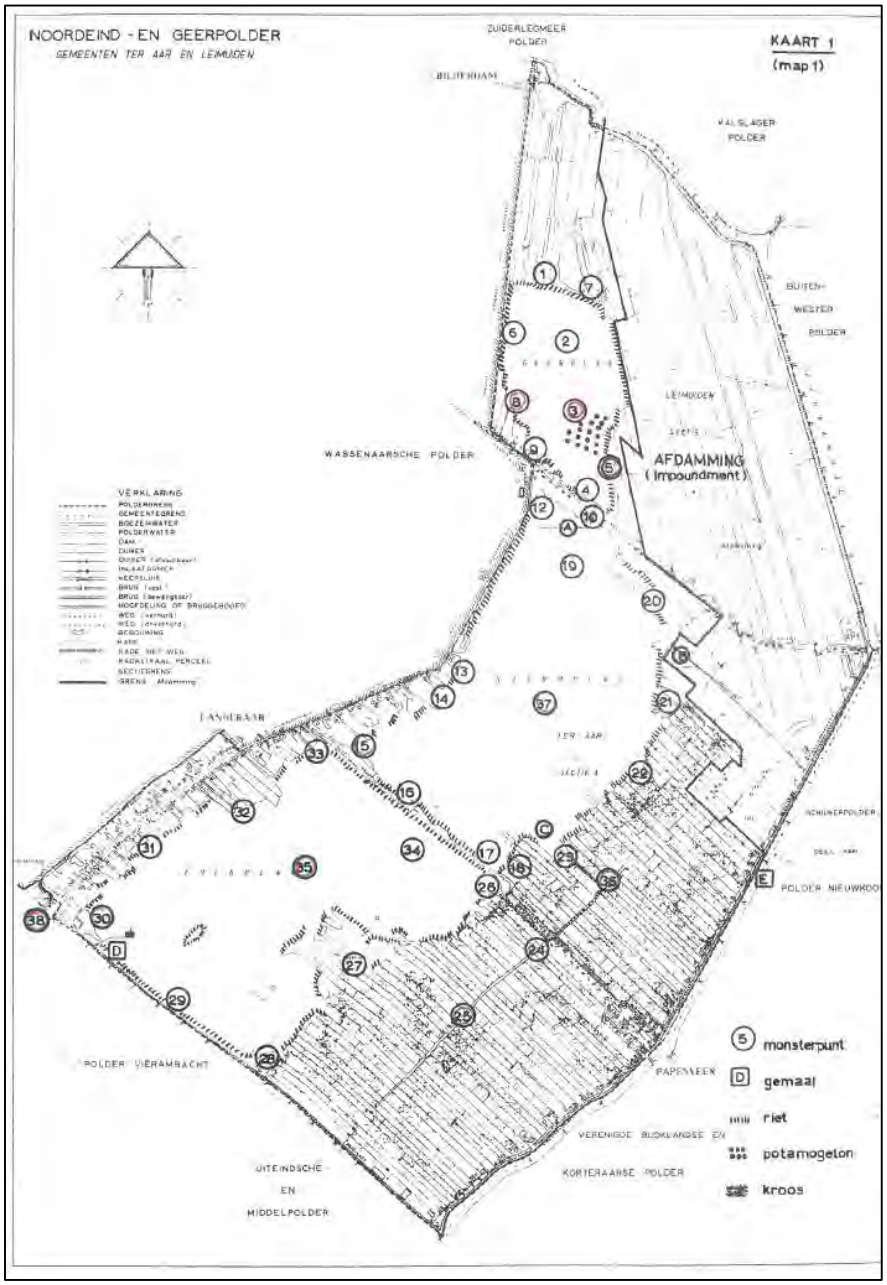


Figure 15: Map with sample points of the water quality study carried out by Hofstede & Blok (Hofstede & Blok, 1964)

Fish

1960-1961

On 11-3-1960 the Board of the Noordeind- en Geerpolder expressed their concerns regarding the fish water quality of the Langeraarse Plassen to the inspector of fisheries. The polder board announced that the zander had almost entirely disappeared. (HHR, 1960-1964).

Commercial fishers in the lakes focussed on eel and zander. Until 1957, there would have been a good zander yield (Hofstede & Blok, 1964). However, during the investigation of Hofstede and Block the zander catches appeared to be good.
Of course there are problems with the water quality of the lakes since dead fish, and air gasping fish, (most likely) indicate low oxygen levels. The fish deaths in the Langeraarse Plassen mainly occur in the South west of the Zuidplas (Hofstede & Blok, 1964).

In 1960 and 1961 there was not a lot of Pike in the lakes. Also the Perch yield was low. Low Pike yields are attributed to the absence of a plant rich Pike environment in the lakes (Hofstede & Blok, 1964).

A fish species which was widely present in the lakes was smelt (Oral history interviews, 2015) (Hofstede & Blok, 1964). The smelt were mainly under the reed (islands) and were scooped out of the water in large numbers to use as bait to catch eel[35].

The dominant fish population in the 60s was however clearly Bream. On a quantity basis 96% of the fish population consisted of Bream, and on basis of weight 97% was Bream (Hofstede & Blok, 1964, p. 38). Smelt, Bream, and Zander are vegetation- averse fish species (Bloemendaal & Roelofs, 1988).

1963
On Monday the 8th of July 1963, there was a massive fish death in the Zuidplas of the Langeraarse Plassen due to low oxygen levels. Already early in the morning there were dead fish and air gasping fish in the lake. Along the banks Smelt, Ruffe, Roach and Bream were seen gasping for air. Dead fish – Smelt, Zander and Eel- was found in the nets of fishermen. In the Noordplas no dead fish or air gasping fish were seen and the water quality was good. (HHR, 1960-1964)

6.3.3 Sub-conclusion
The water quality of the Langeraarse Plassen has deteriorated compared to the previous era. This is for instance evident from the increased turbidity (transparency decreased from 75 cm to 35cm). With an increased population and an intensification of the agriculture and the industries in the area the nutrient loading on the system has increased a lot. The Lakes are very highly eutrophic which becomes evident from the high nutrient concentrations and the permanent algae blooms. Besides a narrow reed strip there are hardly any water plants in the lake. It can be said with certainty that the Langeraarse Plassen could be classified as a bream-zander fish water type in the industrial era. It is known that the amount of whitefish consists of more than 90% out of Bream, which is an indication of the Bream-Zander fish water type (Zoetemeyer & Lucas, 2007).

6.4 The post-industrial phase: 1970 onwards

6.4.1 Setting the scene
The post-industrial period is a period of change in the area. Nutrient loading to the Langeraarse Plassen decreased due to multiple developments which are described in the following sections.

Introduction of wastewater treatment
In 1970 the Surface Water Pollution Act[36] was introduced. According to this Act, the regional water authorities were legally obliged to purify wastewater (Vinke & Ilff, 2009). Since December 1973 the municipal wastewater from Langeraar is treated in a WWTP (HHR, 1981).

Before 1973, most of the households had a cesspit in which sewage was temporarily stored. The pit had to be emptied quite frequently. This was done on the surface water or the excreta was used on

[35] (Interview 13, 2015)
[36] In Dutch known as *Wet Verontreiniging Oppervlaktewateren (WVO)*.

the agricultural lands. This still happened to some extent in the 60s. Some cesspits were directly connected with a sewage pipe to a canal. The remaining household water, such as the kitchen water, was also connected to surface water via a pipe. After a while the cesspits made place for septic tanks. Currently there are three houses which are not connected to the WWTP and still have a septic tank.

In 1967 the municipality of Ter Aar constructed a sewer pumping station, which was taken over by the HHR in 1974, at the A.J. van der Hoevenstraat in Langeraar which pumps the wastewater to the WWTP. The first WWTP was constructed before 1971 by TNO (an independent research institute) as a test installation. The installation only treated part of the municipal wastewater of Langeraar moderately. The somewhat treated water was discharged in the Wassenaarse Polder and still numerous households were discharging their untreated wastewater directly into the Langeraarse Plassen. In 1971 the polder board noted down that there was an urgent need to replace the test WWTP with a new one. This WWTP was built in 1973 by the HHR. From that moment, most of the municipal wastewater was no longer discharged on the surface water without receiving treatment. (HHR, 1959-1986)
The municipality constructed, managed and maintained the sewage drainage system whereas the HHR was responsible for building, operating and maintaining the WWTP. This task and responsibility division between municipalities and water boards is still present.

The WWTP of Langeraar is currently still being used. However there are plans to close the WWTP and transport the wastewater from Langeraar to Alpen aan den Rijn via pressured pipes. The two WWTPs in Alphen aan den Rijn have enough capacity to treat the wastewater originating from the surrounding villages, including Langeraar, for the coming 20 years. (Nieuws regio, 2011)

Industries

In the post-industrial era the three preservation industries located near the Langeraarse Plassen, moved away or closed their doors.
In 1977 Aptito in langeraar was shut down. The reason for this were the too stringent requirements of the HHR for the quantity and quality of the effluent water (van Amsterdam, 1977). In 1984/1985 the municipal area kuiperserf was built on the former location of the ZHI.
In October 2006 Koeleman (which was founded in 1916), went bankrupt and closed its doors (EVMI, 2008). In 2007 the last conservation factory of the area, Uijttewaal (founded in 1911 and taken over by Kuhne in 1999) also closed down (EVMI, 2007) (Historisch Museum Ter Aar, 1985).

Area in transition: decline of horticulture

The practice of *andammen* continued on a large scale until the 1970s. From that moment onward the horticultural companies had large bins to dispose of their garbage in[37]. *Andammen* however did continue, and it is said that even today, some of the remaining horticulturalists have a dumping ground[38].

In 1994 the area was still very much a horticulture area and there was no discussion possible about transforming it: *"the area was horticulture and would stay horticulture" (van Tol, 2006).* Currently only a few horticulturalist companies are left in Papenveer. A lot of horticulturalists have stopped or moved away to areas which provide a better structure needed for contemporary horticulture[39]. The future of the area with regard to the horticultural industry is uncertain[40] (Berenyi et al., 2009). Greenhouses, especially along the western side of the Paradijsweg (known as *de natte kant* which means the wet side) are now considered to be landscape barriers[41] (Berenyi et al., 2009). Since 2006 greenhouses

[37] (Interview 10, 2015)
[38] (Interview 3, 2015)
[39] (Interview 15, 2015)
[40] (Interview 3, 2015)
[41] (Interview 15, 2015)

have to disappear in favour of the landscape (van Tol, 2006). Landscape and nature aspects have become more and more important over the last couple of years.

Within horticulture, fertilisers and pesticides are widely used and can result in water quality problems. Through various emission routes (e.g. direct surface runoff and via the air) the surface water can be polluted by these fertilisers and pesticides. From the 90s onwards, the Dutch government has implemented several policies in order to minimise the polluting effects of the agricultural sector in the Netherlands. (Rijksoverheid, 2015a) Specifically for the horticultural sector the Netherlands is striving for greenhouses without emissions in 2027 (NWP, 2014).

6.4.2 Water quality

There is quite a lot of information available about the water quality of the Langeraarse Plassen from 1970 onwards. Since 1970 phytoplankton is measured multiple times a year in the Noordplas for the water quality assessment of HHR's water bodies (van den Hove, 1988). Furthermore, an integrated eutrophication project started in 1989 for which water quality measurements have been done in the Geer- and Noordplas until 1995 (Oranjewoud, 1987). Since 2007, HHR is yearly measuring the water quality for the WFD (HHR, 2015b).
The following reports give a good impression of the ecological water quality of the lakes in the post-industrial era:

- (Schmidt-van Dorp, 1978) In 1974 (from April until July) water samples were taken from 5 different places in the Noord- and Zuidplas, and tested for some general physical-chemical parameters. De Mooie Nel, het Brassemermeer, de Kager plassen, de Westeinder Plassen and the Nieuwkoopse Plassen were also investigated in order to describe eutrophication in the shallow lakes in HHR's management area.
- (van den Hove, 1988) In 1988 a report was published in which the results of plankton studies from 1985 & 1986 of the Langeraarse Plassen are summarised.
- (Frinking, 1992) The ecological water quality situation of the Langeraarse Plassen before 1989 (the start of the integral eutrophication control project) is described. It provides the baseline situation.
- (van Schaik, Frinking, Vuister, & van Duin, 1999) This report evaluates the eutrophication control project.
- (Michielsen, 2012) This report contains a system analysis of the Langeraarse Plassen. It presents the baseline situation before HHR started with the WFD. The report gives a good overview of the water quality developments in the Lakes in the past decennia (1980 until 2011).
- (Pot, 2015) In September 2015 a research and consultancy firm (*Roelf Pot*) investigated the possibilities for the development of aquatic plants in the Langeraarse Plassen.

Just a selection of the water quality of the Langeraarse Plassen in the post-industrial era is presented in the following sections. For a more complete overview it is recommended to consult van Schaik et al. (1999) and Michielsen (2012).

General Physical-Chemical water quality parameters

Transparency

In August/September of 2012 the transparency of the Langeraarse Plassen was only 20 cm (atkb, 2012). Also in 2013 the transparency was on average 20 cm (Torenbeek, 2013a). The report of the most recent water quality investigation (September 2015) states that the water of the lakes was extremely turbid and that the measuring depth was on average 20 cm (Pot, 2015).

Biological water quality indicators

Phytoplankton

The phytoplankton composition of the Langeraarse Plassen was dominated by cyanobacteria (O. agardhii, O. redeki, O. Angustissima en Aphanizomenon flos-aquae) in 1974. Only in a small part of the Nieuwkoopse Plassen cyanobacteria were dominant at that time. In the northern part of the Langeraarse Plassen- where the typical peat lake landscape of turf ponds alternating with narrow strips of land which were used to dry peat on (in Dutch: *petgaten en legakkers*) is present- there were no dominant blue algae blooms present. The dominant occurrence of cyanobacteria indicates highly eutrophic water. (Schmidt-van Dorp, 1978)

In 1985 and 1986 Chlorophyta and Cyanophyta were the dominant plankton species in the Noordplas (and the Geerplas). Also cyanobacteria (mainly Lyngbya limnetica but also Oscillatoria redekei) were present. In the summer of 1985 almost no blue-green algae were found and the Chlorophyta was the dominant species. (van den Hove, 1988) The summer of 1985 is however an exceptional year as since the beginning of the 20th century blue-green algae are dominant in the Langeraarse Plassen (Frinking, 1992).

In 2013 the Langeraarse Plassen were turbid and rich in algae. Blue-algae blooms, also the scum-forming species, occurred regularly (Torenbeek, 2013a).

Macro benthos

In 1986 two samples (in spring and autumn) from two locations (in the ditches around the Geerplas and Noordplas) were examined. Not a lot of different species were found. Some of the macro benthos in the samples- such as spercheus emarginatus, psectotanypus varius en chironons gr. Plumosus- are indicators for poor water quality. However in one of the sampling locations also species indicating a good water quality- Mideopsis orbicularis and Cryptocladopelma- were found. (Frinking, 1992)

Aquatic plants

In 1978 there were hardly any submerged aquatic plants in the Langeraarse Plassen whereas they were widely present in the Nieuwkoopse Plassen (Schmidt-van Dorp, 1978).

In 1979 and 1982 the following plants were found in the Geerplas: water fern (*Azolla filiculoides*), hornwort (*Ceratophyllum demersum*), frogbit (*Hydrocharis morsus-ranae*), star duckweed (*Lemna trisulca*), gibbous duckweed (*Lemna gibba*) and common duckweed (*Spirodela polyrhiza*) (Frinking, 1992).
All of the above mentioned plants are typical for nutrient-rich (frogbit and star duckweed) or very nutrient-rich water (water fern, hornwort, gibbous duckweed and common duckweed) (Bloemendaal & Roelofs, 1988, p. 120). Where the plants have been found (in shallow bog holes or in the Lake), and whether the survey is thus similar to the Noord- and Zuidplas is unclear.

Aquatic plant inventories have been conducted in 1988 (by the province of South-Holland) and in 1995 (by the HHR) in the Noordplas and Geerplas. In 1988, 42 different types of plants (especially bank plants) were found in and round the Noordplas, while in 1995 only 8 different plants were found in/round the Noordplas. From the in 1988 inventoried plants, 11 were aquatic plants, namely: water fern (*Azolla filiculoides*), water starwort (*Callitriche*), hornwort (*Ceratophyllum demersum*), Nuttall's Water-weed (*Elodea nuttallii*), lesser duckweed (*Lemna minor*), star duckweed (*Lemna trisulca*), white water-lily (*Nymphaea alba*), Brandy-bottle (*Nuphar lutea*), longroot smartweed (*Persicaria amphibia*), saltmarsh bulrush (*Bolboschoenus maritimus*) and common duckweed (*Spirodela polyrhiza*). Also Reed, and the small and large bulrush, which can grow in water, were among the inventoried plants. In 1995 only reed, saltmarsh bulrush, and the small and large bulrush were found in the Noordplas. (van Schaik et al., 1999).

Besides some emergent vegetation in the riparian zone (reed and bulrush), a small bunch of waterweeds (Elodea) was found in the Langeraarse Plassen in 2012 (atkb, 2012).

The most recent research which provides insights into the occurrence of aquatic plants in the Langeraarse Plassen was conducted in September 2015. There is currently no vegetation along large stretches of the banks. Only 1/3rd of the banks are covered with vegetation. In addition, virtually no aquatic plants grow in the water. Only a number of reed polls are growing in the water, but if no water quality improvement measures are taken, these will also disappear. Some people have planted water lilies in the water bordering their gardens. (Pot, 2015)

Fish

The Langeraarse Plassen are dominated by Bream. The bream are small compared to the bream in the Westeinder Plassen (van Leeuwen, 1973). A newspaper article of 1982 also reported that the bream are a lot smaller than the bream caught in the Westeinder Plassen and the Kagerplassen (van Leeuwen, 1982). In 1923, Redekes research gave the same results and attributed food shortage (little or no zooplankton and macro benthos) as the main cause of the poor growth of the Bream.

In 1989 a fish stock recording was made for the Geerplas to get a good picture of the initial state before the Integrated Eutrophication control project started (see Table 6). The results are similar to the stock assessment carried out by Hofstede & Blok in 1960/1961. Also in 1989 Bream is dominant. The fish species present in the Noord- and Zuidplas will largely correspond to the ones in the Geerplas (Frinking, 1992).

Table 6: Stock assessment of the Geerplas in 1989 (Uyterlinde and Duinkerken)

Species	Mass (kg)	Mass (%)
Pike	64	2
Zander (Pike-Perch)	273	10
Perch	10	0
Ruffe	0	0
Bream	2377	84
White Bream	94	3
Common rudd	9	0
Common roach	9	0
Crucian carp	6	0

In 1995 another stock assessment was done in the Geerplas. This time, in order to investigate the effect of the taken water quality improvement measures. In 1995 the fish stock is still dominated by Bream and thus corresponds to the fish population of previous years. Bream with a length of 10-35 cm are however absent. Predation by cormorants seems to be the main cause of this (Witteveen en Bos, 1995).

In 2012, 10 different fish species were found in the Langeraarse Plassen. The Eel, Perch, Common roach, Bream, White bream, Ruffle, Zander, Common Rudd, Smelt, and Pike. The fish community is dominated by Bream. On a quantity basis 77% of the fish population consists of Bream, and on basis of weight 84% is Bream. The bream population consists mainly of relatively young fish (<26 cm). The absence of larger and older Bream can probably be attributed to predation by cormorants. (atkb, 2012)

6.4.3 Sub-Conclusion

Also in the post-Industrial era the lakes are eutrophic. The water is turbid (average transparency of 20cm), rich in algae, there are hardly any aquatic plants, and the fish stock is dominated by Bream. The pollution load on the water system has decreased since a sewerage and wastewater treatment system have been constructed in the late 20th century. In addition, the industries have left and most of the greenhouses have also moved away from the area. Moreover the lakes are no longer used as a garbage dump.

6.5 Conclusion

"The ecological quality of the Langeraarse Plassen is currently bad. The water is turbid, there are hardly any aquatic plants, and the fish population is dominated by bream." (Pot, 2015, p. 1)

This recent description of the water quality of the Langeraarse Plassen corresponds with the water quality of the lakes in the past decades. Already in 1923 the lakes were turbid, dominated by bream, and there were hardly any aquatic plants. Also cyanobacteria have been present in the lakes since 1923. Between 1923 and 2015 there has been no time when the lakes were clear, rich in aquatic plants, and could be classified as a rudd-pike fish water type which are the characteristics of M27 water bodies.

Although the Langeraarse Plassen have been eutrophic since, at least, 1923 and have belonged to the bream-zander fish water type since then, the water quality of the lakes has changed over time. A brief overview of the water quality in the three eras is depicted in Table 7. The transparency has for instance declined from 75 cm to during august and October of 1923 to an average of 20 cm in 2015. In addition the amount of aquatic plants has deteriorated.

Redekes report from 1923 for instance showed that there was a narrow strip of reeds along all of the banks and that in some corners there was pondweed (*Potamogeton pectinatus*) and watermilfoil (*Myriophyllum*). The flora was already in a poor situation back then (compared to other shallow fen lakes, specifically the Wijde Blik) and has deteriorated since the aquatic plants, and *zuddes*[42] have almost entirely disappeared. Also the reed strips have declined and in some places even disappeared. The canals, bordering the Langeraarse Plassen, have, in contrary to the lakes, been in a clear state with a lot of aquatic plants until 1934-1940. The water was so clear that you could see beetles walking on the bottom. Stratiotes aloides[43], yellow water lilies, and reed and bulrush grew exuberant in the canals. Since 1950, most of the canals are however covered with duckweed.

[42] Floating reed islands.

[43] In Dutch it is also known as Krabbenscheer.

Table 7: Summary of some of the water quality parameters in the three identified eras

	WFD policy objectives	**Description of the EQRs (based on information from MEMO)**	**Pre-industrial phase (1850-1945)**	**Industrial phase**	**Post-industrial phase**
Dominant mind-set. Water as friend or enemy?	-	-	Lakes as source of fish, irrigation water and fertile sludge	Lakes as source of fish, irrigation water and fertile sludge. Water was also seen as an enemy due to the eroding away of precious horticultural lands.	Lakes as nature and recreation area
Phytoplankton (EQR)	0.6	The average summer chlorophyll-a content will be 25 g/additionally the transparency is 90 cm and cyanobacteria-scum layers do not occur.	Permanent algae blooms (also cyanobacteria)	Permanent algae blooms (including scum layer forming cyanobacteria)	Permanent algae blooms (including scum layer forming cyanobacteria)
Macro benthos (EQR)	0.45	-	-	-	-
Aquatic plants (EQR)	0.45	There will be a small amount of submerged aquatic plants (3%) and some floating plants (0.5%). Furthermore some emergent plants (reed and bulrush) will grow on the banks.	Very poor water plants coverage. At some places in the corners, pondweed and feathery herb occurred. There was a "narrow" reeds present along the banks.	Besides reed and bulrush along the banks, hardly any aquatic plants in the Lakes.	Hardly any aquatic plants in the Lakes. Some reed is still present along the banks.
Fish (EQR)	0.45	An EQR of 0.45 corresponds with a fish water type of Roach-Bream. Globally the fish stock will contain: 25% Bream as a proportion of the biomass, 20% Perch and Roach biomass, 20% of the biomass plant-loving fish, and 3% oxygen tolerant fish.	Bream-Zander	Bream-Zander	Bream-Zander
Transparency (m)	0.9	-	0.75	0.35	0.2

7. Unravelling the WFD policy process at the Hoogheemraadschap van Rijnland

Whereas the previous chapter - *which focussed on the history of the water quality of the Langeraarse Plassen* - actually contributes to the quest of the HHR in getting the policy 'right'. This chapter zooms out and tries to better understand the WFD policy process for the Langeraarse Plassen. The first section describes the organisational structure of the HHR. In the second section the WFD policy process is reconstructed as a linear model. The third section deconstructs the linear step model by using the *policy as a process* concepts.

7.1 The political and organisational structure of the HHR

The HHR can be seen as an arena or domain in which there are various departments and numerous actors. The organisational structure of the HHR is depicted in Figure 16. The different functions and roles are briefly discussed in Text Box E. Approximately seven-hundred people work at the organisation (HHR, 2016e). The board of directors consists of three people: two directors and a secretary general manager who is secretary for the board and is the managing director of the organisation. He forms the bridge between the political management and the HHR.

The figure does not include the political management structure of the HHR. A distinction can be made between politicians - which make up the board of the HHR and have administrative tasks - and government officials or bureaucrats - which have executive tasks. The organisation of the board of HHR is frequently compared with a municipality. In the Netherlands each municipality has a council, councillors and a mayor. HHR has a general board consisting of thirty-nine members (in Dutch: *Algemeen bestuur or Verenigde Vergadering)* and a daily board (in Dutch: *dagelijks bestuur or college van dijkgraaf en hoogheemraden (D&H)*) containing seven members, including a *Dijkgraaf (*the president, or mayor of the organisation). (HHR, 2015e, 2016c, 2016d)

The general board consists members who represent the public interest (residents within the water management area of HHR (in Dutch: *ingezetenen*)) and members who represent specific interests (farmers, owners of nature areas and businesses). The members of the general board who represent the public interest are directly elected by the inhabitants of the water board management area (ProDemos, 2015). The elections take place every four years (the previous elections took place on 18-3-2015) and are held at the same time as the provincial elections (Kiesraad, 2015). The representatives of the three interest groups are appointed by organisations representing these interests. The members of the general board are thus elected or appointed for a 4-year period. The tasks of the general board are to inaugurate the policy of the water board, to appoint or select the daily board, and to check whether the daily board implements the policies correctly (ProDemos, 2015).

The daily board consists of a chairman, the Dijkgraaf, and number of members elected by the general board (called: *Hoogheemraden*). The members of the daily board remain part of the general board. The daily board members have their own management area (Annex B contains a map with the management areas of the different *Hoogheemraden*) in which they are the spokesperson of the HHR, and their own responsibilities such as water security and clean & healthy water (which cross the boundaries of their management area). The daily board is primarily responsible for the preparation and implementation of policy. The *dijkgraaf* of the water board is appointed by the central government - based on a recommendation of the general board - for a period of 6 years. The Dijkgraaf leads the meetings of the general board and the daily board. Within the general board the chairman does not have the right to vote (ProDemos, 2015).

Within the daily managing board of the HHR one *Hoogheemraad* is responsible for "clean and healthy water", which includes the WFD (HHR, 2015e). Other tasks, such as water security and ensuring adequate water levels, belong to the duties of other board members.

Most of the government officials of the HHR that are involved with the WFD, specifically for the Langeraarse Plassen fall under the Policy and Plan Development department and the department of Projects. Of course there are also actors within other departments that are involved with the WFD. The WFD II project team has for instance already involved the responsible person of the water systems department. People from the maintenance department will become involved with the WFD in the Langeraarse Plassen at a later stage.

The HHR knows multiple functions: Managers (9), Project leaders (7), Advisors (8), Management and Maintenance Contractors (12), and people with a Supporting function (10). The number between brackets indicates how many different types of that function there are. There are for instance eight different types of advisors. This is related to educational level and responsibilities. (HHR, 2015a)

Besides functions, there are also roles. In 2015 the IPM (Integral Project management Model) system was introduced in order to organise the projects (HHR, 2015c). The IPM project organisation method is also used by provinces and the public works agency (Bekwaam, 2012). Each project team consists of five people which each have their own role. The five key roles are:
Project manager: is responsible for achieving the project results within the pre-conditions (time and money).
Project controller: is responsible for comprehensive project management of the project on the aspects of scope, time, money, risks, information documentation and reporting. Good project control should ensure quality of the project.
Technical manager: is responsible for the technical aspects of the projects.
Contract manager: is responsible for process-based controls to determine the purchasing needs, contract preparation, and tendering.
Stakeholder manager: is the link between the project and the stakeholders in the project area. In the project team the stakeholder manager is responsible for serving the interests of the different local stakeholders.

In most projects the roles are fulfilled by people working in the Projects department. The stakeholder manager role is however frequently fulfilled by the policy and plan development department.

Text Box E: Functions & roles in the HHR

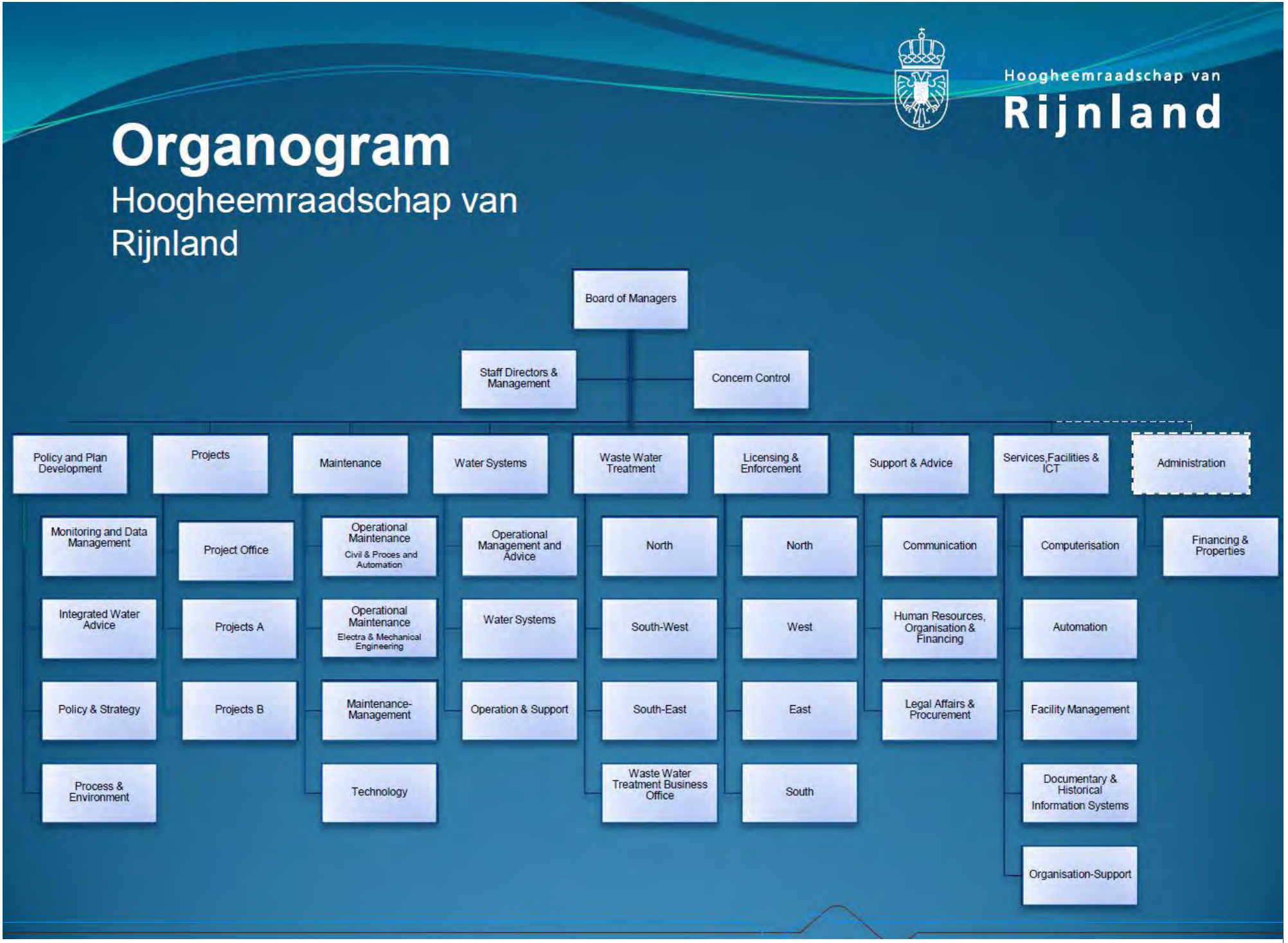


Figure 16: Organisational Structure of the HHR (adapted from: (HHR, 2007))

7.2 Reconstructing the WFD II policy steps of the HHR

In the linear policy model, the assumption is that the following sequential steps are followed: formulation, political decision, policy implementation and impact evaluation Wester (2008).

From the interviews it becomes clear that most of the interviewees also think about the WFD policy process in this way. Additionally the linear policy model is also interlocked in the organisational structure of the HHR. The Policy and Plan Development department translates European and National Policy to HHR's policy and creates plans (which have to be decided on by the general board) whereas the Projects department is responsible for the execution of the plans. The formulation and implementation of policies falls thus under the responsibility of different sub-arena's.

The planning and control calendar[44] of 2016 also contains a figure which makes a clear distinction between administrative (strategic) and civil (operational) tasks, and visualises policy as a plan-do-check-act cycle (see Figure 17). The civil servants are only responsible for the Do part of the cycle. Also here the policy formulation and implementation are decoupled, and more importantly the figure clearly illustrates that the implementation of policy by the government officials is a-political.

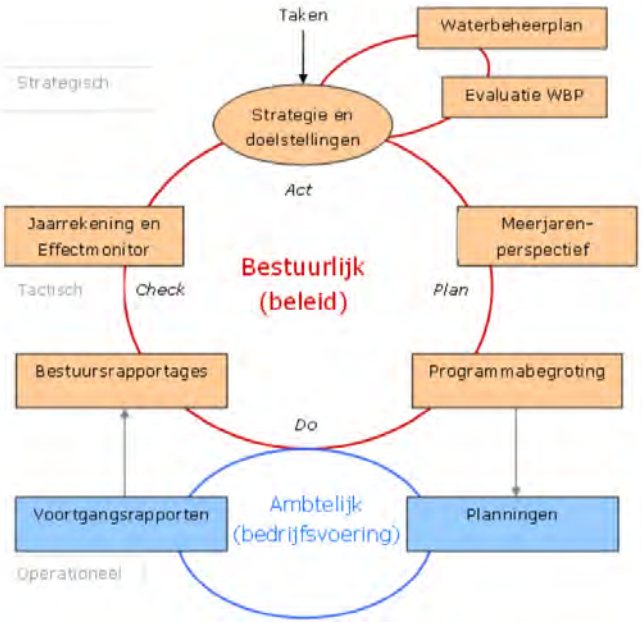


Figure 17: Plan-Do-Check-Act cycle the HHR uses (HHR, 2015f, p. 2)

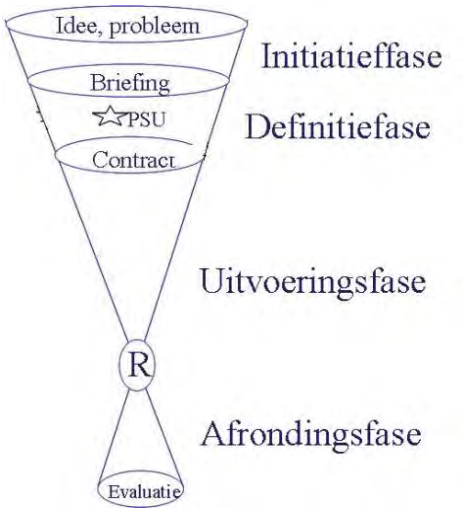


Figure 18: Project phases (HHR, 2015g)

WFD II policy steps

Based on information from the interviews and from studying HHR's policy documents, the traditional policy steps for the WFD have been reconstructed and the most important steps and end products have been listed (see Text Box F). The list is not exhaustive, but contains the most important outputs of and steps in the WFD II policy process, specifically for the Langeraarse Plassen.

[44] The P&C calendar gives the general board, the daily board and the organisation insights in what (and when) to expect the coming year with regard to official documents (such as the *meerjarenperspectief* (multi- annual perspective), *waterbeheerplan* (water management plan) and the *programmabegroting* (programme budget)) (HHR, 2015f).

Together the budget, multi annual perspective, and water management plan make up the direction the organisation wants to take and the prioritisation and programming which has been decided on by the board.

The program managers[45] are responsible for drafting plans for these three important strategic documents. These proposals go to the board of managers and are subsequently sent to the board who make a (political) decision about the plans. The task of the program managers now is to make sure that what is noted down in the yearly budget, and the other strategic documents, is actually carried out by the organisation. At the start of the operational phase (or the Do phase) an internal client, a team leader or a department head will receive the task from the board of managers to carry out a certain assignment which is mentioned in the yearly budget. The program managers help the board of managers to divide the various tasks. Based on a very brief assignment description defining the scope (made by the program managers) from the board of managers, the internal client, team leader or department head can start his/her work. For the WFD II project, one of the three internal clients is responsible. Based on the scope, the internal client has made a project letter. A project manager receives this project letter which allows him to start arranging a project team and start with the execution of the WFD II project.

In the meantime the program managers will monitor throughout the year whether everything stays within budget and is going according to plan. The internal clients, team leaders and department heads play an important role as they have to report to the board of managers themselves. The program managers make the administrative reports, create the financial statements with the concern & control department and provide advice to the board of managers all year round.

If we use Figure 17 the WFD II for the Langeraarse Plassen is currently at the Do phase. The project contract has been written, and the project team has been formed. The WFD II project team follows the following steps: initiation phase, definition phase, implementation and completion phase (see Figure 18). The figure belongs to *Project Matig Creëren (PMC)* approach which is widely used within HHR in projects. The idea behind the figure is that if a lot of time and energy is put in the beginning of the project -to clearly define the assignment, perform a risk analysis, involve stakeholders etc.- the implementation is easy[46].

The project manager is momentarily busy with finalising the project contract[47] (definition phase) and part of the project team is preparing to start with the implementation of water quality improvement measures within the Langeraarse Plassen[48]. The project team will finish the project in 2021, after which maintenance and effect monitoring will take place.

It seems that the WFD II policy follows the sequential steps of formulation, political decision, policy implementation, and impact evaluation. Whereby policy implementation has recently started and will continue until 2021 (when the third WFD phase will start). The following sub chapter will however deconstruct these steps and show that in reality the process is much more messy and contested.

[45] In HHR there are 5 programmes (Clean & Healthy Water; Water Security; Water Quantity; Water Chain (wastewater treatment); and Board Management & Support Services) and 4 programme managers (Clean & Healthy Water and Water Quantity fall under the responsibility of one programme director since 2015).
[46] (Interview 10 & 13, 2016)
[47] Draft project contract has been uploaded on 16-3-2016
[48] The Langeraarse Plassen are a frontrunner compared to the other water bodies that are part of the WFD II project since they are still in the initiation and definition phases.

Text Box F: Important outputs of and steps in the WFD II policy process, specifically for the Langeraarse Plassen:

"Systeemanalyse Langeraarse Plassen" (system analysis Langeraarse Plassen)

- January 2012
- The report describes the current water quality state and contains possible measures for improving water quality and ecology in the Langeraarse Plassen.

"Gebiedsdocument Langeraarse Plassen" (area document Langeraarse Plassen)

- October 2013
- Possible measures for improvement of the ecological quality
- Derivation of GEP (WFD policy goals)

"Informatiebladen" (Information sheets)

- December 2014
- During the preparation phase for the second WFD phase, HHR has developed information sheets for the 40 water bodies in their management area. The information sheets give a general description of the water body including a problem description. Moreover they contain information about the WFD status, give a brief overview of proposed measures to improve the water quality and elaborate on the ecological norm (the Good Ecological Potential) for the specific water body.

Area processes

- 2014
- Based on the information sheets, a selection has been made of 13 water bodies. For these water bodies HHR has organised meetings to discuss the WFD with the local stakeholders. These processes are called area processes (in Dutch: gebiedsprocessen).
- On 17-11-2014 the second stakeholder meeting in Langeraar took place.

Selection of WFD II water bodies (also called prioritised water bodies)

- Based on the area processes a selection has been made of 6 water bodies in which HHR will make WFD investments in the second WFD phase (2016-2021). The six water bodies which have been prioritised are: the Amstelveense Poel, the Bovenlanden, the Nieuwe Meer, the Langeraarse Plassen, the natura2000 area de Wilck and the Westeinderplassen. (HHR, 2015h)
- The selection is based on: N2000 areas, committed local stakeholders, subsidy possibilities and whether it is an isolated area (preferred) or not.

"Nota Schoon Water II" (Policy strategy for Clean Water II)

- December 2014
- The *Nota Schoon Water II* sets out the WFD program for the second WFD implementation period.
- On 4-2-2014 the daily board published a proposal of the plan for the General board meeting.
- The General board approved of the *Nota Schoon Water II* on 15-12-2014

"Intentieverklaring Langeraarse Plassen" (Memorandum of understanding Langeraarse Plassen)

- February 2014
- The HHR, Staatsbosbeheer and the municipality of Nieuwkoop signed a memorandum of understanding on 12-2-2014 about the need for cooperation between the three parties to achieve improvement and restoration of water quality and nature in the Langeraarse Plassen.

Participation evening water quality plans

- January- February 2015

- In the period from 6-1-2015 until 16-2-2015 the WFD measure list for the second WFD phase was open for perusal by the public. All of the government organisations in Rhine West had similar sessions around the same period.

Assignment description Langeraarse Plassen –WFD II water body

- 2014
- The assignment description is a 1 pager containing information about the WFD II project for the Langeraarse Plassen. It specifies who the the internal client (*opdrachtgever*) is and states the most important things that need to be done in order to start the project namely: forming a project team and creating a project letter in which the assignment is concretised.

Project letter

- February 2015
- The project letter is written by the internal client for the WFD II project and provides the starting point for the project manager. The letter provides background information on the problems, the intended project goals, the budget and the scope of the project.

28-3-2015 New General Board
22-4-2015 New Daily Board

Addition of Zoetermeer as a WFD II water body by the new board

In Zoetermeer HHR has recently started with a water plan whereby the focus is usually only on water quantity within the area. The new board wanted to increase their ambition and decided that it would be a good opportunity to also work on water quality aspects in the waters of Zoetermeer. At least one and possibly four water bodies in Zoetermeer will be labelled as WFD II water Body and measures will be taken in order to improve the water quality and ecology (HHR, 2015c). This is one of the first times that a water plan is done in an integral manner (combining water quantity and quality objectives) (Interview 1, 2016) (Interview 2, 2016).

MEMO WFD goals Langeraarse Plassen

- November 2015
- In a response to the abstractness and un-clarity of the Ecological Quality Ratio's a memo was written by an ecologist at the HHR to describe the WFD goals (GEP) for the biological water quality parameters.

"MJP 2016-2019 en Programmabegroting 2016" (Multiple Year Perspective 2016-2019 and Program budget 2016)

- November 2015
- The General Board adopted the Multiple Year Perspective and Program Budget at once. Normally the general board decides about the Multiple Year Perspective in June and the budget in November (Personal Communication with a government official of HHR on 15-3-2016).

"Waterbeheerplan 5 (WBP5)" (water management plan 5)

- March 2016
- On 9-3-2016 the new water management plan was adopted by the General Board. The WBP5 gives direction to the water management of the period 2016-2021.
- The *Nota Schoon Water II* has been integrated in the WBP5.

Project contract WFD II

- 2015-2016 (under construction)
- The project contract is made by the project manager. In the contract the plans from BPO are fine-tuned and concretised.

7.3 Deconstructing the policy process

7.3.1 Actor analysis

The question which is central in this section is: *"Who are the actors that participate in the arena? And, which actors are excluded?"(Mollinga, 1993, p. 6)*.

As stated previously the HHR can be seen as an arena in which there are various departments and numerous actors. Also the daily board, and the general board can be seen as arenas or domains of interaction. All of the board members have different interests and objectives and negotiate, talk and struggle about actual end results. The budget for 2016 (see Annex C) is for example an end product which is most likely the result a lot of social interaction processes. Of the 700 HHR employees only a handful of people (approximately 15) are, or have been involved in the WFD II policy process, specifically for the Langeraarse Plassen, which is the focus of this study. The WFD II is a policy arena. A distinction can be made between two (sub) arenas or domains of interaction:

1. design, or planning of the WFD plans (mainly by the Policy and Plan Development department)
2. construction, or execution of these plans, by the Projects department

In the design and construction of the WFD plans and measures for water quality improvement for the Langeraarse Plassen different people from different departments are or have been involved. The people from Policy- and Planning Development have different interests and objectives than the people from the Projects department. I am also told that the two departments have completely different cultures and have noticed that they joke about each other (People from PPD are said to be *zweverig* whereas jokes are made about the people from Projects that they only understand tables and figures). The different departments should however not be seen as uniform entities as they contain people with different functions, backgrounds and specialisations (Managers, Ecologists, Engineers, Policy experts, etc.) and therefore also have different interests and objectives.

Design arena

Within the design arena the Langeraarse Plassen have been selected as WFD II water body, and WFD policy goals (GEP) have been formulated. Additionally a list of possible measures in order to arrive at the WFD policy goals has been derived. The design arena mainly contains actors from the Policy and Plan Development Department (see Table 8). Some of the actors in the design arena are also participating in networks outside the arena. The Water Quality Advisor is part of the Rhine West Regional Water Counsil, specifically the Regional Formal Gathering (in Dutch: *Regionaal Ambtelijk Overleg RAO*), which contains officials from the organisations that are in the Regional Managerial Gathering (in Dutch: *Regionaal Bestuurlijk Overleg RBO*). The RAO advises the political managers of the RBO and basically functions as a platform where discussion, consultation and coordination between the various actors takes place.

The RBO is a formal network outside of HHR which has specifically been set up for the WFD. Also a WFD fish migration and a monitoring platform, for Rhine West, have been created specifically for the WFD. Besides these formal platforms and their networks to which some actors of HHR belong, there are also some more informal networks at play. One of the interviewees tells me that he is actively involved in his knowledge network which comprises of actors (he considers them to be colleagues) with the same professional background that work at other water boards, consultancy firms and at universities. They keep in touch to help each other solve ecological problems and disseminate knowledge.

Table 8: HHR actors of the design arena

Nr.	Department	Team	Function	Role
1	Staff Directors & Managers	x	Project Manager	Programme Manager (including ecological water quality until 2015)
2	PPD	Policy & Strategy	Project Manager	Internal Client WFD I & WFD II programming
3	PPD	Policy & Strategy	Project Manager	Programme Manager (including ecological water quality since 2015)
4	PPD	Policy & Strategy	Water Quality Policy Advisor	x
5	PPD	Integrated Water Advice	Water Quality Advisor	x
6	PPD	Integrated Water Advice	Water Quality Advisor	x
7	PPD	Monitoring & Data Management	Fellow worker policy and research	x
8	PPD	Monitoring & Data Management	Advisor policy and research	x
9	PPD	Process & Environment	Process Leader	Stakeholder manager

Construction arena

The construction arena consists of the WFD II project client, the WFD II Project team members (mainly from the Projects Department) and advisors from the PPD department. The stakeholder group for the Langeraarse Plassen, which has been formed by the stakeholder manager of HHR, is also part of the construction arena as they are involved in the actual measures which will be taken. The approach of the project team is to come up with measures for the Langeraarse Plassen together with the local stakeholders[49]. The actors of HHR which are part of the construction domain of interaction are listed in Table 9.

The WFD II project team is responsible for carrying out the WFD II plans in the WFD prioritised water bodies, including the Langeraarse Plassen. Within the WFD II project team all of the IMP roles (see Text Box E and Text Box G) are fulfilled. The project team however consists out of more than 5 people. For each of the WFD II prioritised areas (the Langeraarse Plassen, de Wilck, and the waters in Aalsmeer) there are sub- stakeholder managers. The stakeholder manager for the Langeraarse Plassen is thus the link between the stakeholders and the WFD II project. Stakeholder participation is ensured by having regular meetings with a stakeholder group. The different interest and objectives of the various stakeholders have been assessed and the actors are involved in the process. The stakeholders are very enthusiastic and some have even made their own designs for example for creating islands in the lakes.

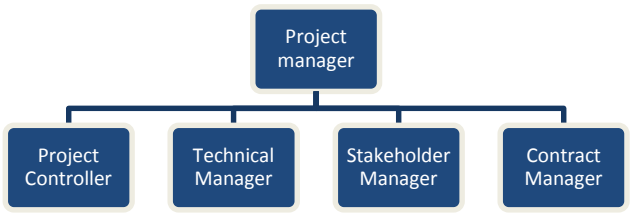
[49] This participatory approach is something which has resulted in discussions between PPD and PRO departments as you will find out further on.

The project manager- and the stakeholder manager- consult water quality-advisors (2) (from the project and plan development department) about various topics. Consultation is very important as the project manager only knows a little about each topic.[50]
Five actors which are, or have been involved, in the construction arena were also involved in the design arena (nr. 7 until 11 of Table 9). An important actor which is not involved in the construction arena is the Water Quality Policy Advisor.

Table 9: HHR actors of the construction arena

Nr.	Department	Team	Function	Role
1	Staff Directors & Managers	x	WFD II Project client	x
2	Projects	x	Project Leader	Project Manager
3	Projects	x	Advisor	Project Controller
4	Projects	x	Specialist	Technical Manager
5	Projects	x	Project Leader	Contract Manager
6	PPD	Process & Environment	Process Leader	Surroundings Manager
7	PPD	Process & Environment	Process Leader	Sub-Surroundings Manager
8	PPD	Integrated Water Advice	Water Quality Advisor	x
9	PPD	Integrated Water Advice	Water Quality Advisor	x
10	PPD	Monitoring & Data Management	Fellow worker policy and research	x
11	PPD	Monitoring & Data Management	Advisor policy and research	x

The organogram of the core WFD II project team is depicted in the figure below. The project team receives the project scope from one of the three internal clients, who is accountable, or end responsible for the project. The Project manager is responsible for executing the project. The core project team members (IPM roles) have a supportive function in executing the project. The project team members consult advisors in the organisation. Also the stakeholder group (*werkgroep Langeraarse Plassen*) is consulted by the project team.



Text Box G: WFD II project organisation

[50] Personal communication with a government official of HHR in January 2016.

Situating the WFD II policy arena in a wider context

Within HHR there seems to be a clear difference between the content experts and the managers. *"I'm not a content expert but a manager"* is a sentence which I have heard a lot. Most of the content experts- for ecological water quality- belong to the PPD department.
Then there is also a difference between the amount of people with knowledge on, or working on the *clean and healthy water* programme (to which ecological water quality, and thus the WFD, belongs), and the rest of HHR's programmes (e.g. water safety, water quantity and wastewater treatment). There are no documents indicating how many people are involved in the various programmes, but the budget of 2016 reveals that from the 182,5 million euros, 5% (=10 million) will be invested in the programme clean and healthy water. Various explanations have come forward of why ecological water quality receives the least amount of money. The budget might explain why there are only a few actors (approximately 15) within HHR that are or have been involved in the WFD II policy process, specifically for the Langeraarse Plassen. About 50% of this group of 15 people actually has extensive knowledge on ecological water quality, and even a smaller amount of actors (4) of this group are (basically the only) ecological water quality content experts within HHR. The larger arena in which WFD plans and water quality measures for the Langeraarse Plassen are effectuated thus contains fifteen actors (2% of the organisation) of which four of them represent almost 100% of the ecological water quality knowledge.

7.3.2 Issues

The questions which are central in this part are: "*What is at stake in the arena, what is the issue/are the issues? What is it that people talk/negotiate/struggle about?"(Mollinga, 1993, p. 6).* During the interviews quite a lot of discussion points or struggles came forward. Different issues are, or have been, faced in the arenas. However there are also some on-going discussions in the larger WFD II policy arena. And also a continuous issue or struggle taking place in an even larger arena: the HHR and its political management structure. Twelve struggles, disputes, or deliberations in which particular actors, engage in or have engaged in are presented in this section.

Issue within the entire HHR arena

1. **Clean & Healthy water is an *ondergeschoven kindje* (Dutch saying meaning neglected) in the HHR**

From the various interviews it becomes evident that 'Clean and Healthy Water' is a programme which is not taken seriously, or at least not as serious as the other programmes, by a lot of the government officials and political managers. The programme receives less attention than the other programmes and is considered to be *hobbyisme* (amateurism) or *luchtfietserij* (setting unrealistic plans) by some people in the organisation and in the political board. Of course the organisation and the daily- and general board contain a variety of people from the political spectrum, and opinions differ, but nevertheless if a water board member asks: *"should we really invest millions in yellow/green stripped frogs?"*[51]*, t*his clearly indicates that one of the tasks - ensuring clean and healthy water - is ridiculed. A number of people tell me that water quantity always goes before water quality, but that the position of ecological water quality has improved due to the WFD. Nonetheless it remains a topic for which you need to fight for to ensure it is placed on the agenda, money is reserved for it and that there are enough people that can work on it.

The following two quotes illustrate the discussion. If you read between the lines the first quote carries some frustration, and in the second quotation, the speaker clearly acknowledges that ecological water quality is not the number one priority.

[51] (Interview 1, 2016)

> *"Since 2005 we are integral water managers, but in reality we only care about dry feat. Wastewater treatment is a secondary task and then eventually we also care about ecological water quality." (Interview 1, 2016)*

> *"Since the merge we've thought about what's really needed. A major part of our investment currently goes to eliminating maintenance backlogs in wastewater treatment plants, pumping stations, etc. We expect to be ready in 10 years, after which continuous maintenance is still required, but no mayor investments. We're now investing more than 100 million euros per year and expect to have to invest 60 to 70 million … that's when there's some space … I don't mean this denigrating … to do fun things." (Interview 10, 2016)*

The Hoogheemraad for clean & healthy water is very much aware of the position which ecological water quality has in the organisation (see quote) and tells me that she has got a lot of work cut out for her in order to *"bring the whole peloton in motion"* as currently ecological water quality has been isolated to a few water bodies[52], and only a select group of dedicated people in the organisation is working on the topic.

> *"You have a lot of people here that think that water quality is a hobby of a few geitenwollensokken (Dutch word for: people that are perceived as alternative, unpractical and unworldly) types. That's definitely not the case and it is something which we should work on with everyone." (Hoogheemraad Clean & Healthy Water, 2016)*

Résumé: the struggle in the larger HHR arena is that working on water quality within the water board is inferior to water quantity and water safety.

Struggles, disputes and deliberations in the WFD II policy arena

2. Ecology is unpredictable

One of the main struggles in the WFD II policy arena is that ecology is unpredictable, and that you never know if the system will react as you expect it to react. *"The ecology is much more stubborn, or more difficult to predict than we think."*[53] Frequently the comparison is made with water quantity measures, which are straight forward:

> *"One of the most important things is that you can come up with water quality improvement measures, but you don't have the guarantee that they will produce the expected effects. This is different with water safety. If we have to work on the safety norms of a dike, you just throw 20 cm of clay on top of it and you're ready. Of course you have to make some stability calculations, but then it's finished. With clean water it isn't that simple."(Interview 8, 2016)*

[52]It is important to note that HHR does more on water quality than only invest in water quality improvement measures in its prioritised water bodies. There is currently an ongoing project to formulate WFD goals for non-WFD water bodies, and also work on water quality improvement in these non-WFD water bodies. Additionally, the HHR has started with WFD synergy, whereby on a yearly basis 1 million euros is reserved for WFD investments in other projects (*meekoppelkansen/ een plus op een klus*).

[53] (Interview 7, 2016)

Although everyone (I interviewed) seems to be aware of the fact that you never know if the ecosystem will respond to a measure as you assumed, there is a discrepancy in expectations of measures. The content experts say that they would really want to believe the expectations of these actors, but that it is just unrealistic, whereas the actors that expect more from the measures consider themselves to be optimistic instead of pessimistic. One of the (ecological water quality) content experts formulates his frustrations as follows:

> *"One of the things I struggle with is conveying the message that we are not almighty, and that the promises which we have made to Brussels, in some cases, are totally unfeasible without setting the world upside down". (Interview 6, 2016)*

Résumé of the issue: aquatic ecology is difficult to predict and therefore there is a high uncertainty with which the actors in the WFD II arena have to deal with.

3. Ecological Walhalla versus hygiene

There is an on-going discussion in the WFD II policy arena about the WFD goals and whether these are actually realistic. Some people compare the WFD goals to an ecological Walhalla. Aiming at a lower goal called *hygiene* (which means that: *"the water is not dangerous. That it does not pose risks to public health, and that the various water uses are hindered as little as possible. Blue-green algae (scum layers) development should be minimized to allow for the water to be safely used to swim in"*[54]) is prompted as a solution or alternative than trying to obtain the WFD goals. Several others believe that this ecological Walhalla discussion does not entirely make sense as the HHR has adjusted the national reference description (M27: which can be considered to be the ecological Walhalla for peat lakes) to lake specific WFD policy goals (GEPs). A water plant coverage of 3% does not seem like an ecological Walhalla. Nevertheless, the discussion regarding the WFD goals, and whether they are realistic and how on earth the project team should try to reach them with the budgeted money, is present.

I am told that knowledge on the actual policy objectives is lacking, which is consequently leading to the assumption that the WFD policy goals are too ambitious and not realistic. There are still people in the organisation that think the policy goals are to obtain clear water with water plants and a diverse fish stock. This is indeed the target situation, point on the horizon, or direction the HHR wants to go in, but not what it believes is realistic for the Langeraarse Plassen. There is thus a gap between what people think HHR wants to achieve in the Langeraarse Plassen and what HHR actually wants to realise (or has promised Brussels it will realise).[55] Although the GEPs might not represent an ecological Walhalla, most of the actors believe that attaining the GEPs is not realistic from an economic point of view. An estimation of the costs for dredging- which is a required measure to arrive at the WFD goals- are 20 million euros[56], which could, in combination with other measures, potentially lead to a transparency of 90 cm, and consequently possibly to 1.5% floating, and 3% submerged aquatic plants, which the users of the lakes will probably not even notice.[57] A number of questions arise among the various actors: Do we really want to do that? Even if the money was there, would that be a wise decision? Why are we going to invest this money (approximately 3.5 million euros has been budgeted for the Langeraarse Plassen), when we already know we are not going to reach the WFD objectives? Why don't we invest the money in a more promising water body? Should we not just tell Brussels that it will cost a disproportionately amount of money and we will not do it?

[54] (Interview 6, 2016)
[55] (Interview 5, 2016)
[56] The estimation of the costs of the various measures was executed by a consultancy firm, commissioned by the PPD department, and according to the project team the estimated costs do not make sense at all.
[57] (Interview 3, 2016) (Interview 6, 2016)

On the other hand almost all of the actors do agree that the water quality in the Langeraarse Plassen should be improved: that the water should meet the swimming water quality standards, and/or that with the budgeted money the Langeraarse Plassen can be made more attractive (with for instance nature-friendly banks).

Résumé of the issue: WFD goals and measures imply big results and are thought to be too ambitious and unrealistic by a lot of actors in the WFD II policy arena.

4. (not) Obtaining the EUWFD goals by 2027 & dependency on others

Another discussion which is present in the WFD II policy arena, and also to some extent in the entire organisation, is whether HHR will obtain the EU WFD goals by 2027. At a national level the state secretary of Infrastructure and the Environment has recently said that the Netherlands will obtain the WFD objectives by 2027. This statement resulted in quite some discussion in the WFD II policy arena. A first question which arises from her statement is: which goals does she mean? WFD goals should be made realistic, and then if it appears that these goals are not socially feasibly and affordable, goal reduction is also possible (in 2021). So far HHR has only made the WFD goals realistic. Goal reduction is something which the ministry of Infrastructure & Environment used to propagate, but they are currently not sending this message anymore.[58] Also within HHR, the Hoogheemraad responsible for the WFD has stated that goal reduction is something which will not be done for the water bodies of Rijnland.

In the Water Management Plan for 2016-2021, HHR indicates that it will probably only obtain the WFD goals by 2027 if the overall water quality in the Netherlands is improved by national regulations and commitment from the agricultural sector. Only then there is a good chance that HHR's water bodies will reach a good status by 2027. The WMP5 also indicates that if monitoring shows that the implemented water quality improvement measures do not have sufficient effect, additional measures will be taken if they are expected to be cost effective. (WMP, 2016-2021)

Rijnland is very much aware of its dependency on other parties (such as Rijkswaterstaat, the Provinces, and especially the agricultural sectors) in order to reach the WFD objectives, and truly sees obtaining clean and healthy waters as a shared responsibility. This however is also challenging and difficult as the following quote shows:

> *"We can do a lot of things … but when you take water quality improvement measures whilst the pollution tap is still open, it does not make sense. In Brussels and The Hague they are busy with fertiliser policies etcetera. Of course we can exert some influence, but that is not up to us. We are in discussion with the different agricultural sectors in our area to talk about how we can further improve the water quality together." (Interview, 10)*

The Hoogheemraad who is responsible for Clean & Healthy water prioritises, or puts more effort into, lobbying for more stringent national agricultural emissions policies (Delta Plan Agrarisch Waterbeheer) and talking with the different agricultural sectors, over lobbying within the organisation to invest in more water bodies, as she believes that *"you should pick you're battles well"* and she believes that you can achieve more by looking at the broader picture than only *"fiddling in your own system"*. The Hoogheemraad is thus clearly a *boundary spanner*, as she is talking, negotiating and making agreements with actors in other (policy) domains. She is also involved in the RBO of Rhine-West, as was explained in the actor analysis.

[58] (Interview 2, 2016) and (Interview 12, 2016)

From all of the in depth interviews it appears that no one agrees with the statement of the state secretary of infrastructure and environment: that we (the Netherlands) will obtain the WFD goals by 2027. Actually all of the actors of the HHR (which I have interviewed) are pretty sure that Rijnland will definitely not obtain the WFD goals by 2027 in all of the 40 water bodies. However, due to goal reduction (no one in the organisation seems to know that the *Hoogheemraad* does not want to allow goal reduction for the water bodies of HHR) it will seem like HHR has reached the goals as the following quotes illustrate:

> *"Ofcourse we're not going to reach the Water Framework Directive objectives, and almost everyone knows it. But eventually we're going to score green everywhere." (Interview 3, 2016)*

> *"Seriously, we're going to meddle a lot to pretend like we have done a good job." (Interview 9, 2016)*

Résumé issue: complying with the WFD goals by 2027 is considered to be very difficult and unrealistic. In order to obtain the WFD goals in HHR's waters, HHR is also highly dependent on actions taken by other parties.

5. How far should we go in involving local stakeholders?

"Van buiten naar binnen" (from outside to inside), or participation, is something which you hear a couple of times a day in the HHR. Within the Water Management Plan it is described as follows:

"*We work from outside to inside. Already from the exploration phase we align our plans with the environment (=local stakeholders). We listen to the opinions and ideas of the environment and consequently adjust our plans as good as possible. We are willing to go even one step further and plan and execute our projects together."(*WMP, 2016, p.10)

This slogan is increasingly being used since the Organisation Improvement Plan of three years ago which stated that the HHR should focus more on working from outside to inside. Some actors state that it is a strategical change to ensure the life of the HHR and that without participation the organisation would not exist anymore in 20 years. How participation is done within the WFD II project for the Langeraarse Plassen is subject to discussion.

> *"We are doing it for someone, so you have to involve them, but how far should you go?" (Interview 13, 2016)*

The project team is looking for solutions together with the stakeholders. Some actors in the PPD department would rather see it differently. If HHR decides to build a de-phosphating system, in order to improve the water quality of the Langeraarse Plassen, and arrive at the WFD policy goals, the stakeholders are involved to come up with a good location for this purifying system. Some of the actors from the PPD department do not see why the stakeholders would come up with new ideas, as all the possible water quality improvement measures are listed in the *Gebiedsdocument.* The project team members however do not see it as new ideas, but as integration ideas (*inpassings ideeën*) which further operationalise the proposed ideas of the Gebiedsdocument.

Résumé issue: in the WFD II policy arena there are deliberations regarding the concept of participation, what it entails and how it should be used within the WFD II project.

Struggles, disputes and deliberations in the Design Arena

6. Formulating WFD policy goals, or GEPs and possible water quality improvement measures

The GEPs (WFD policy goals) and possible water quality improvement measures for the Langeraarse Plassen have been derived by the PPD department, by a select group of experts. It involved multiple discussions and group meetings after which a consensus was reached. It was a complex process which was led by a consultant[59], who also contributed to macro benthos knowledge. One of the major difficulties was to apply the general WFD framework to the system specific characteristics. *"At a certain moment choices had to be made. If no choices are made, nothing will happen and if too much choices are made the end product is too fixed and unusable."*[60] Overall it was a struggle to say something about a complex water body which is not understood fully, using fixed WFD parameters. If the same or a slightly different group of people would sit in a room together and derive the GEPs again the end result would probably deviate from the current objectives[61].

Résumé issue: in the design arena multiple deliberations took place to arrive at the WFD policy goals (or GEPs) for the Langeraarse Plassen.

7. Selection of prioritised water bodies

A past issue in the design arena was the selection of prioritised water bodies. The water quality advisors (or experts) had advised, from a content (or technical feasibility) objective not to prioritise the Langeraarse Plassen (yet) as:

- The results from the pilot project Sloene (also a peat lake) were not yet available. Lessons learned from this pilot could therefore not be taken into account for the Langeraarse Plassen.
- There are serious doubts whether the Langeraarse Plassen can comply with the WFD objectives (based on historical experiences in ineffective water quality improvement measures and the results of the investments made in the Nieuwkoopse and Reewijkse Plassen in the first WFD phase which turned out to be a bit disappointing), unless unrealistically high investments are made.
- The lakes are a hopeless case and it would be wise to invest the money in a more ecologically valuable water body.

Despite these points the Langeraarse Plassen were prioritised. This can be explained by all of the other factors which were taken into account during the prioritisation process. Nevertheless some people felt excluded during the selection of the prioritised water bodies for the second WFD phase, and/or did not feel taken seriously. They would have liked to be informed on what was communicated to the board. A small group of government officials (3) made the decision of the prioritised water bodies to put forward to the board. From the interviews it seems that they did not experience (and might not have been aware of) these struggles during the selection of water bodies. The selection of prioritised water bodies is however not (always) as transparent as the above mentioned criteria. A response one of the actors got when asking why the Wilck was selected as prioritised WFD II water body was: *"de Wilck floepte ertussendoor"* (sneaked through).

Résumé issue: selection of prioritised water bodies resulted in disputes as the content experts were left out of the decision making process and/or their input was not taken serious.

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[59] Who created one format for all of the *Gebiedsdocumenten* and helped the government officials arrive at WFD goals and measures for all 40 water bodies. It took the actors of HHR a lot of energy and persuading to allow them to hire the consultant for 1 year for the WFD process. This illustrates the difficult position clean & healthy water has within HHR.

[60] (Interview 6, 2016)

[61] (Interview 1, 2016)

8. Crossing the content-management line

As pointed out previously there are content and management functions within HHR. Of course some people see themselves as a manager with a solid content knowledge. But the content managers do not always agree with the things that are said and the decisions which are made. When actors cross the content-management line, this frequently leads to friction. *"He interferes too much with the content"* and *"He is making decisions not based on facts"* are two sentences which illustrate this discussion.

Résumé issue: competence quarrels.

9. Reinventing the wheel & changing the objective

An issue which is also present within the design arena is that some actors have the feeling that the people in the project team are carrying out tasks that already have been done by the PPD department: *"They are doing the same things we've already done".* In the *Gebiedsdocument* for the Langeraarse Plassen there is a list with water quality improvement measures suitable for the Langeraarse Plassen. If a combination of these measures is taken, the system can potentially reach the WFD goals. The objective for making this list is obtaining the WFD goals.

The project team is currently busy with making a list with the measures, their costs and effectivity, and is also taking into account ideas from the people in the area. For instance creating islands in the lakes. Some of the actors in the design arena feel that if the project team has decided to let the WFD objectives go, and has changed their objective to making the people in the area happy, they should go back a step and see which measures will lead to an increased happiness of the people. This list will probably deviate from the list of measures mentioned in the *Gebiedsdocument.*

Construction Arena

10. Unachievable assignment

The challenges in the construction arena are dealing with insecurity of the ecological system, and with the financial constraints. Attaining the WFD policy objectives in the Langeraarse Plassen with the budgeted money (approximately 3.5 million euros) is unattainable. Everyone appears to be aware of this mismatch, but is still continuing to carry out the assignment. "*We're just doing as the board tells us to do"* is a sentence which is mentioned in the following quote, and which I have heard a lot.

> *"The assignment of the board is: reach these goals, with this amount of money, and make sure it's carried out well. And we're going to do what the board tells us to do. So my task is to make sure that we will attain the WFD objectives whilst I already know that I probably don't have enough money. So actually you could say that I've got an impossible task." (Interview 13, 2016)*

11. Dealing with insecurity & defining the project goal

The main issue which is faced by the project team in the construction arena is that there are ambitious[62] WFD policy goals on one hand and limited[63] means (financial) on the other hand. They are struggling with clearly defining the project goal. According to the project letter, *"the objective of the WFD II project for the Langeraarse Plassen is to implement measures which will ensure that the*

[62] Within DDP some actors stress that the WFD II policy objectives which have been formulated for the Langeraarse Plassen are not too ambitious, and that knowledge on the actual policy objectives is lacking which is consequently leading to the assumption that the WFD policy goals are too ambitious and not realistic.

[63] There are also people that do not agree with this word. Limited however here means that there are currently limited finances available to reach the WFD policy objectives.

Langeraarse Plassen will meet the standards of the EUWFD in 2021" (Project letter, p.3) The project letter also concretely states that the WFD II project end products should be:

- An implementation plan for water quality improvement, based on stakeholder involvement, and using the measure list from the system analysis as a starting point.
- Realisation of the planned water quality improvement measures.

This WFD II project is different than other projects of HHR. Normally the PPD department decides what has to be built and the Projects department builds it. Or at least the goal of the project is clear. With the WFD this is different as the following quote illustrates:

> *"If you have to build a pump, then you're goal is to be able to pump more water from the polder to the boezem system, and you're result is a pump. Very clear. With the WFD project you have the WFD policy goals on one hand and on the other hand experts tell me that these goals are unattainable within certain financial limits." (Interview 9, 2016)*

With the WFD project it is different as from the start the project team did not know what to build. The projects team is currently busy with a number of feasibility studies in order to make a well-funded decision on which measures to spend the money on in order to improve the water quality. Involving the stakeholders is very important for them.
Some actors are of opinion that these feasibility studies should have been carried out by the PPD department and that the process- project boundaries are more fluid in this project, which is not helpful.

The project team has transformed the project objective from the project letter to: "*We will do the best we can, supported by local stakeholders, with the money we have"*[64]This has however not been officially noted down as the project contract is still under construction and negotiations (between the Client and the Project Manager) are still taking place on how to define the project goal in the project contract. A presentation by the Hoogheemraad Clean & healthy water, about the vision for the WFD II project, will help the actors in the construction arena to clarify the project objective. It appears that the goal of the WFD II project is an effort commitment rather than an obligation commitment to produce results (as the project letter suggests)[65].

12. Interaction with the PPD department

The WFD policy goals and a list with possible water quality improvement measures (+ the estimated costs) for the Langeraarse Plassen is the starting point of the project team. This is the information which they receive from the PPD department. The Project team is currently busy with further concretising the plans, to eventually end up with a water quality improvement plan for the Langeraarse Plassen which they will carry out. The estimation of the costs of the measures was done very poorly, and therefore the Project department is redoing this job. A response of the PPD department is that this cost estimation is, as the name already suggest an estimation, which they should not take too seriously and merely acts as an indication.

The actors in the project department sometimes have the feeling that people from PPD just *"dump ideas over the fence",* without thinking about reality. With the WFD project this is going quite well, as the ecological water quality specialist from PPD are pragmatic. Nevertheless there are still some actors some of the actors of the PPD department that are unable to concretise.

[64] WFD II Project meetings 2015-2016
[65] Personal Communication with a government official of HHR on 22-3-2016

7.3.3 Which resources and strategies do the different actors employ, and what are the 'rules of the game'?

The main issue of the previous section, which links to almost all of the other struggles, is that ecology is unpredictable, and that the HHR is thus dealing with uncertainty. That a good water ecology cannot be as easily engineered as for instance a dike or a pump, and that if money is invested in water quality improvement measures, there is no definite guarantee for expected results, complicates things politically. In order to stress the importance of working on clean & healthy water systems, the Hoogheemraad responsible for ecological water quality organised a meeting with the daily board to talk about water quality in the summer of 2015. The intention was to come to a common understanding of water quality to which all of the daily board members could relate to.

Meetings and brainstorm sessions are also common among actors of the HHR. Besides using meetings to keep everyone up to date (e.g. with the progress of the WFD II project) it is also a strategy which actors employ to voice their own interests and try to convince others that their vision/strategy is the best. *Polderen*, compromising and working together, is common in decision making in the Netherlands.

A completely different form of communicating which is done by only two of the actors, which disagree with one another on a number of fronts, is avoiding each another. Similarly, excluding certain people from meetings - most likely in order to simplify decision making and have a speedy process - has also occurred.

The Dijkgraaf has once said that 'the process is more important than the outcome'[66]. It seems that the WFD II project team uses this, and the popularity of 'participation', to deal with insecurity of the project. "*If the people in the area are happy, the board will be happy then I will have succeeded.*"[67]
To create order and attempt to reduce uncertainty, and to make well-grounded choices for water quality improvement measures for in the Langeraarse Plassen the project team is also busy with making a Multi Criteria Analysis, as a foundation on which they will make their decision (which will then of course be presented to the board for approval).

7.3.4 How is the arena shaped in time and space? When and where does interaction take place? And: What is the outcome of the interaction: what concrete results and effects does it produce?

As is evident from the previous sections, there are a number of actors, some arenas, and a lot of discussions and issues involved around the implementation of the WFD by the HHR in the Langeraarse Plassen. Some arenas and their corresponding issue already belong to the past (e.g. the formulation of WFD policy goals) whereas there are also some on-going struggles taking place. The temporal and spatial delimitation of the arenas - so when and where does interaction take place - will be discussed in this section. Moreover some of the concrete outcomes of interaction are described.

Time

The EU WFD has a clear time line with deadlines. By 2015 all of the surface waters in Europe should have reached a good status. Within the Netherlands this deadline has been postponed to 2027. The boundaries of the WFD have thus been negotiated. For the second WFD phase from 2016-2021 the water quality of the Langeraarse Plassen, and the other WFD II water bodies will be improved by the HHR. The construction arena, responsible for the implementation of the WFD policy in the Langeraarse Plassen, has to stick to this fixed time frame of 6 years. The design arena already started with translating the EUWFD policy to HHR's policy in 2003, and specifically started with the design of the

[66] Personal Communication with a government official of HHR on 8-4-2016.
[67] (Interview 9, 2016)

WFD plans for the Langeraarse Plassen in 2012-2013. In December 2014 the *Nota Schoon Water 2* was approved by the general board, and the Langeraarse Plassen were officially selected as a prioritised water body for the second WFD phase. From that moment onwards officially the involvement of the design arena should have finished, and the project should be handed over to the projects department, or the construction arena. In reality these lines of Planning and Executing (or such as some actors within HHR refers to them as process and a project phases) are not so hard but rather fluid. Design also occurs in the construction arena. The WFD policy is amended, or made concrete to be able to implement it.

The construction period of 6 years is said to be fixed and not flexible, however as the Water Management Plan points out: if it becomes apparent that after all of the effort put into the water body during these 6 years does not result in the expected outcomes, there is a possibility to further invest in water quality improvement measures. If this occurs, a new design and construction arena will form around the new problem.

The reaction time of the system - not: Will the system react to the water quality improvement measures?, but How long will it take before improvement is visible/measurable?, and For how long will the improved state stay? - is also a temporal element within the WFD which makes water management complex for the HHR.

Space

Most of the interaction among the actors in the design and construction arenas takes place within HHR's office in Leiden. There are formal meeting rooms which can be reserved and also some meeting rooms which can be used for more informal conversations (no reservation is necessary). The WFD II project team has a meeting every two weeks to discuss the progress of the WFD II project.

Also outside of HHR's office interaction takes place between the various actors. A clear example is the stakeholder group of the Langeraarse Plassen who come together a few times a year. These meetings are organised by an actor of HHR and are held in Langeraar. Besides these formal organised interaction moments (to which also the meetings of the Rhine-West Regional Water Council belong) there are also informal moments when negotiation between actors takes place, for instance during lunchtime and during *borrels*[68] that take place from time to time.

According to (Mollinga, 2003) time and space are flexible boundaries of arenas. The boundaries are frequently used strategically and are negotiated in the practices which take place within the arenas. A clear spatial boundary which was debated on in the design arena was the selection of the prioritised water bodies. The spatial boundaries were changed along the way as the waters of Zoetermeer were added as a WFD II water body.

Concrete results

There are several results of interaction of the various actors. For instance all of the official WFD documents, a list of the selected water bodies for the WFD II phase, but also more vaguely and/or informal: a consensus definition of water quality, and a memo explaining the WFD goals. The latter two are discussed:

[68] Having drinks in a bar.

- Water quality definition

A concrete result of a meeting of the daily board in the summer of 2015 is a definition of water quality to which everyone in the daily board relates to. The shared vision, although not literally tangible, is as follows:

> *"Water quality is that you should be able to swim in the water without getting rashes. You should also be able to look a meter down and see your toes. It is also nice if something swims in the water and some plants grow in the water." (Interview 12, 2016)*

Another thing which all of the daily board members have in common is that they want to leave the world better than they found it, also for future generations (Interview 12, 2016). Not all of the actors in the general board can relate to the water quality definition of the daily board. There are some that principally disagree. But a larger section is neutral, because they simply do not know a lot about it.[69] There is thus the need for a definition of water quality (consensus about the broader goal), without WFD goals and nutrient concentrations, which is understandable and relevant for the political board members, but also for people living in an apartment building in Leiden[70].

Surprisingly, no-one within the organisation seems to know this shared water quality definition of the daily board. According to the ecological water quality experts the definition is quite ambitious, and it is not realistic to expect that you will be able to see your toes whilst swimming in 4 years' time in HHR's water bodies. If this shared definition would have been conveyed to the experts, they would have advised to lower the expectation of the board members[71].

A strategic communication advisor, which was hired by HHR last year[72], conveyed the message that water security, wastewater treatment water quantity management are services which people expect to just work. As an organisation you will not score *"sexy points"* with these topics. Water quality, ecology and recreation are on the other hand topics with which HHR as an organisation can score points with among the tax payers.[73]

- Memo WFD objectives for the Langeraarse Plassen

In November 2015 one of the ecologists in Rijnland issued a memo in which she described and explained the WFD policy goals. The intention was to clarify the EQRs for the project team.

[69] Meeting about the WFD vision with the Hoogheemraad for Clean and Healthy Water and the WFD II project team on 5-4-2016.
[70] (Interview 12, 2016)
[71] *Verwachtingsmanagement:* Dutch word for expectation management
[72] The precise reasons for hiring him/her are unknown.
[73] (Interview 10, 2016)

7.4 Conclusions

- The results show that the WFD II policy process is much messier and contested than appears from the Plan, Do, Check and Act cycle. Of course it makes sense that the process is simplified, but one should not forget that due to its simplified representation it is apolitical and thereby unrepresentative.
- Policy is transformed as it progresses from formulation to implementation. Project objectives have changed: from doing everything we can to ensure that prioritised water bodies such as the Langeraarse Plassen obtain the WFD goals, to improving the water quality of the Langeraarse Plassen within financial limits and with extensive stakeholder involvement. This has resulted in a (largely) unspoken clash between actors in the design arena and actors in the construction arena.
- Some water management interests are more politically powerful than others. Clean & Healthy Water, under which the WFD falls, is clearly one of the least politically powerful interests of the HHR. The seriousness with which it is taken varies considerably. It is even ridiculed by some. Moreover, more money is spent on other programmes, and the number of people with knowledge of ecological water management is limited. Nevertheless, the HHR is working towards improving the ecological quality of its waters and, unlike many other water boards in the Netherlands, it seeks to involve non-WFD water bodies. These are smaller water bodies which, since the implementation of the WFD (circa 2003), have been neglected. Despite its shortcomings, the WFD has enabled actors at the HHR to place ecology and water quality more prominently on the agenda.
- A select group of government-officials high-up in the company hierarchy is in charge of selecting the issues which will be subsequently brought to the board's executive attention. Meeting WFD deadlines, and choosing policies which will expedite progress, are choices which have been made in the past, and which will probably be made in the future, without the full participation of or the unanimous agreement of all parties concerned.
- Most of the issues-disputes-deliberations which have been discussed are interlinked. 'Past' issues such as "*Why did we ever choose the Langeraarse Plassen? They are hopeless"* are continuously reopened and rehashed. Such interminable discussions lead to negativity towards the project, and could inhibit its progress. On the other hand, open discussions about contrasting visions and beliefs, and an honest examination of how and why prior choices are made, can improve future choices; but only if the parties concerned actually listen to each other.
- It is true that the position of ecological water quality has improved due to the WFD, but some ecologists at the HHR are struggling with the categorisation and generalisation of the WFD. Thus, although the WFD has placed water quality on the political agenda and has thereby secured investments, it is tied down in inflexible technocratic regimes and rules. These technocratic rules could be seen as a strategy employed by ecologists to deal with uncertainty: systematisation helps them to grasp the complexities of systems by pinpointing key factors. Technocratic regimes are perhaps also necessary in order to place ecology on the political agenda of water management organisations.
- All of the actors in the WFD II policy arena deal with uncertainty and operate within a complex environment. Boundary spanning is a strategy used by some of them to reduce uncertainty and to deal with complexity.

8. Conclusion

This thesis set out to investigate the extent to which the historical water quality of the Langeraarse Plassen parallels the nationally formulated WFD reference conditions for moderately large, shallow peat lakes (M27 water bodies), and HHR's WFD policy objectives for the Langeraarse Plassen. In so doing, I have tried to gain an insight into whether or not the HHR is actually restoring nature in the Langeraarse Plassen by complying with the WFD objectives. In addition, this study has also sought to understand the WFD II policy process within the HHR. The main theories and concepts which framed the analysis are political ecology, historical ecology, water quality, and policy as a process. A wide variety of ethno-historical sources were used to describe the socio-environmental history of the Langeraarse Plassen, in particular the historical water quality. An ethnographic approach, which included amongst other things semi-structured interviews, observations, and policy document analysis, was also employed to unravel HHR's WFD II policy process, with specific reference to the Langeraarse Plassen.

The social-environmental history of the anthropomorphised Langeraarse Plassen shows that:

I. although the water quality in the three identified eras (pre-industrial, industrial, and post-industrial) exhibit differences (e.g. the decrease of reed), the Langeraarse Plassen have been eutrophic since 1923. Since the beginning of the 20th century they have thus not matched the M27 reference condition, and HHR's WFD goals. The Lakes, which are around 200 years old, have been turbid, and bream - dominated, and contained few aquatic plants for over 90 years. History, one of the four pillars[74] of the WFD reference condition is not in accordance with the research findings for the Langeraarse Plassen. It is not known if the Lakes have ever been clear, and rich in aquatic plants, as stipulated in the M27 reference condition and HHR's target image. If this did indeed occur, it was somewhere between 1815 and 1850 and lasted but a few decennia. By complying with the WFD objectives, HHR is therefore not restoring 'nature' in the Langeraarse Plassen.

II. management of the Lakes, and thereby the water quality, is dependent upon the effects of human decisions and actions. A clear example is that the horticulturalists have exerted influence on the polder board to investigate the water quality and to take action to prevent industries discharging wastewater into the Lakes. Horticulture and industrial production have led to prosperity in the area, but have also taken their toll on the water quality. Resource perception, or construction of the lake as natural (or not) affect its use and management. On the one hand the Lakes, or more specifically the water, was once conceived to be the enemy as the water was eroding away precious horticultural lands. At the same time, the same people, the horticulturalists, were also highly dependent upon the Lakes' resources: they used the water for irrigation and the sludge to increase productivity of their lands. Furthermore, Man's relationship with Nature has changed over time, and this too has affected the management of the Lakes. Now the water is no longer regarded as a nuisance but rather as an area of natural beauty and a source of recreational activity.

Policy analysis has revealed that the traditional, apolitical, linear way in which the HHR envisages policy, does not represent the more chaotic and contested reality. Multiple issues, ranging from deliberation to struggles involving the actors in the WFD II policy process for the Langeraarse Plassen, have been identified. Some light has thereby not only been shed on the politics of water resource management, but also on organisational politics (e.g. competence quarrels). One of the main issues which affects water quality management in the organisation is that the *Clean & Healthy Water* programme, under which the WFD falls, is clearly one of the least politically powerful interests of the HHR. Another struggle in the WFD II policy arena is that ecology is unpredictable: you never know if

[74] History, expert judgement, model outcomes and national & international comparable water bodies

the system will react as expected. This uncertainty does not make it popular among board members. Another frequently mentioned struggle is the dependency on other actors, organisations or policy domains. Overall the policy analysis gives insights into how the actors of the HHR deal with ecological uncertainty and the ambiguity of the WFD: they operate in a complex organisational environment, in order to work on the water quality in their management area.

I would like to conclude by responding to the quotation given at the start of the introduction:
Dear Melanie Schultz van Haegen-Maas Geesteranus, let us stay realistic. *"Of course we're not going to reach the WFD objectives"*. This is not because actors at the HHR are not working hard to improve the water quality, but because ecosystem management is extremely difficult; consider the rigidity of the WFD (e.g. the *one out, all out* principle) and, more importantly, the intrinsically technocratic conditions under which the Hoogheemraadschap van Rijnland has to work. I believe ecological water management throughout the Netherlands, is still trapped in an underdog position.

9. Discussion & Recommendations

In this final chapter I reflect on some of the theories and concepts used in this research and discuss my research findings. The discussion ends with a number of suggestions for possible follow-up research, and gives some recommendations for the HHR, the organisation which was both the subject of analysis, and the organisation for which I carried out part of my research.

9.1 Reflection on used theories & concepts

This research is embedded in the research domain of Political Ecology which is concerned with explaining how the management of the environment, in this case the Langeraarse Plassen, is influenced by politics. Political ecology provides the link between the historical- and the policy analysis. It is important to note that I put on these political ecology glasses only half way through my historical research, which might explain why I have perhaps focussed more on the biophysical data, the what, and less on the why.

My second reflection is upon the relevance of Mollinga's key questions, in order to understand the WFD II policy process within the HHR. His framework guided my analysis and help structure the results. The concepts, such as issue and struggle, which are embedded in Mollinga's framework are quite heavyweight concepts for this particular topic. In order to overcome this a distinction has been made between an actual issue or struggle and, for instance, a deliberation.

A third reflection is upon the relevance of the concepts of historical ecology and water quality in order to investigate the social-environmental history of the Langeraarse Plassen. The water quality concept, derived from the WFD definition of water quality, provided a concrete lens through which I could study the various data sources. It must be noted that by using this lens, the study was structured and feasible to execute within the time frame, but that it also meant that various aspects such as hydrology, which is very important for understanding the water quality in peat lakes[75], were not systematically taken into account. The historical ecology concept helped (to some extent) overcome narrow-mindedness in studying the data, as it provided a broad, albeit much less workable, framework to understand the relationship between humans and the environment over time.

Overall the concepts which have been used in this study proved to be a suitable framework for my research. It is important to note that my findings are based on my approach, which was influenced by my constructivist research perspective, indicating that if someone else had carried out this research, (s)he would probably have used a different set of concepts, thereby gaining a different view of 'reality'.

9.2 Discussion of results

It is not possible to generalise the results of this social-environmental history of the Langeraarse Plassen. The results are specific to the Langeraarse Plassen and the stories told by the various participants are unique. Concerning the policy analysis, I also question whether I can extrapolate my findings beyond the HHR, and apply them to other regional water authorities, or even to a national level. This was not the intention of the study, however. It purposefully reflects the steps and experiences of the various actors in one of the WFD implementing agencies in the Netherlands. The results are context specific (e.g. situated in the organisational history) and experiences of the various actors are unique. This is also the strength of this study.
When seen as part of the larger discussion taking place in the Netherlands about attaining the EU WFD goals, the implications of this study are that, given the actors involved in the HHR are aware of the unattainability of the WFD goals in the Langeraarse Plassen (see chapter 7), then it seems highly unlikely that the Netherlands will obtain the WFD goals, assuming that they are not all lowered in 2021, of course. The research findings are in accordance with the study conducted by the Planbureau voor

[75] Personal communication with a government official of HHR in December 2015

de Leefomgeving (PBL), and contradict the statement made by the Minister of Infrastructure and the Environment, cited at the beginning of the thesis.

Her statement, that the Netherlands will obtain the WFD goals by 2027 is, of course, highly political in its nature. Currently, the House of Representatives is working on a new national strategy: *Delta Aanpak Waterkwaliteit en Zoet Water* (Delta Approach Water quality and Fresh Water). This integrated strategy will be an addition to the River Basin Management plans. It is a response to the idea that with the present, disjointed approach, the Netherlands will not obtain the WFD objectives. The Ministry of Infrastructure and the Environment wants the Netherlands to put more effort into improving the water quality ("*een tandje erbij doen"),* and hopes to achieve this with a new approach in which cooperation between all of the involved parties is the basis. (Unie van Waterschappen, 2016) (HHR, 2016a)

Water quality

A first reflection upon the water quality results is that the biological water quality data is considered to be more valuable than the general, physical- chemical measurements, as they are often only a snapshot. The biological descriptions give a more reliable picture of the water quality. Another remark which should be made is that knowledge about ecosystems and water quality has increased over the years. Redeke found the flora condition in the Langeraarse Plassen to be very poor in 1923. Perhaps if today's ecologists had been able to go back in time and classify the Langeraarse Plassen, they would have classified it differently. Nevertheless, in 1923 Redeke did compare the water quality of the Langeraarse Plassen with the Loosdrechtse Plassen, which gave a completely different picture as the latter did correspond to the M27 reference description.

The generic image is that until the mid-20th century, the Rudd-Pike fish water type prevailed in Dutch peat lakes (Lamers et al., 2001; Zoetemeyer & Lucas, 2007). Back then M27 lakes were characterized by clear water with lots of water plants, mostly submerged, both in the lakes and in the bog holes (Lamers et al., 2001). Due to intensive eutrophication in the 60s and 70s, the water plants deteriorated, sometimes disappearing completely. The inflow of water from other areas, the disappearance of *legakkers,* reduced maintenance of canals, and the rise of recreational boating are also mentioned as causes of turbidity and the disappearance of aquatic plants (Bloemendaal & Roelofs, 1988; Lamers et al., 2001; Zoetemeyer & Lucas, 2007). As this study has shown, the Langeraarse Plassen do not fit this generic description. The Lakes have been intensively used by humans and have been turbid, dominated by bream and practically devoid of aquatic vegetation since the beginning of the 20th century. But what of other M27 water bodies?

The Wijde Blik (the most northern lake of the Loosdrechtse Plassen) was clear and filled with aquatic plants in 1923, while the Langeraarse Plassen were turbid, rich in algae, and contained but few aquatic plants (Redeke, 1923). In the 40s stoneworts (in Dutch *Kranswieren*) were common in the Loosdrechtse Plassen whereas in 1980 there were hardly any of them left. The Nieuwkoopse Plassen show a similar picture, although there the stoneworts had already almost entirely disappeared by the 30s (Lamers et al., 2001), and in 1940 the aquatic plants in the larger Lakes had all but disappeared (Hoogenboom, 2013). Nevertheless, there was a lot of submerged aquatic vegetation in 1974 in the Nieuwkoopse Plassen while there was none in the Langeraarse Plassen (Schmidt-van Dorp, 1978). These findings were probably based on the smaller lakes, bog holes or ditches, as water plants in Nieuwkoopse Plassen thrived in these locations until the 60s (Hoogenboom, 2013). All in all, the Langeraarse Plassen have shown a different aquatic condition when compared to similar water bodies.

Future of the Langeraarse Plassen
Results show that the Langeraarse Plassen have not matched either the M27 reference condition or HHR's WFD goals since the beginning of the 20th century. In light of this, the WFD goals can be considered to be a bit too ambitious and with the currently budgeted money the goals are unrealistic. The WFD project team is dealing with this by trying to improve the water quality locally. Achieving local water quality improvements through a number of pilot projects (e.g. creating lee) HHR hopes to achieve less turbid water and more aquatic plants. Local water quality improvements offer opportunities for improving the water quality of the Lakes and improving the way the area looks (and thereby enhancing the experience of the stakeholders).

9.3 Recommendations

9.3.1 Suggestions for further research

- This study shows that ecological water management is not taken as seriously as other water management tasks by actors and political board members within the Hoogheemraadschap van Rijnland. It would be very interesting, and might possibly provide useful insights into how to alter Dutch Water Management, if one were to investigate why ecological water quality has an underdog position. A merger between the HHR, the major water quality board, with its minor water quantity boards in 2005 is said to have been a tipping point in the current approach to ecological water management. In the Hollandse Delta (another Dutch regional water authority) a similar merge has taken place, which some feel has placed ecology in an undervalued position. Further investigation to check this hypothesis, and to unravel other reasons for the current position of water quality in Dutch water management, is necessary.
- Extensive analysis of the hydrological features of the Langeraarse Plassen has not been conducted for this study. Was the water regime more flexible than it is now? If so, how much did the water levels vary? Answers to these questions concerning hydrology could, if available, clarify the water quality results, and give more accurate insights into the historic water quality situation. More variation in water levels, for instance, gives reed the chance to germinate and to grow.
- The main focus of the policy analysis was on the HHR, and to unravel the WFD II policy process in the organisation. Although boundary spanning has been elaborated upon, and has been used in this research to some extent, a full understanding of how boundary spanning is deployed by the various actors is missing. Analysis of the negotiations and alliances with actors from other organisations and policy domains will complete the WFD policy process analysis, as it will provide useful insights into how HHR (politically) operates within a larger context.
- In line with the previous point, further analysis is needed to understand the influence that the tax payers, or stakeholders, exert upon the various actors of the HHR: if and how they influence the WFD II policy process choices and actions. One of the local stakeholders in the WFD II policy process for the Langeraarse Plassen has made designs for water quality improvement measures which have been used by the project team for the designs of the proposed pilot projects. The stakeholders thus clearly exert influence on the WFD II project.
- An additional recommendation is to unravel this newish trend of focussing on participation. How and when, and under the influence of whom, did this concept gain in popularity in the HHR? What are the different visions of participation, and which or whose vision is dominant? Is it, as one of the participants in my study pointed out, a strategy used by the HHR to survive? Finally, who decides who gets to participate and who does not?
- During my study I have been influenced by some actors of the HHR with whom I have had the most contact. A subject which popped up from time to time is *'ecocratie'* (a combination of the Dutch words for ecology and democracy). Why, if at all, do ecologists, have the biggest say in defining water quality standards? Initially I set out to investigate this, but due to time constraints, this part of the study could, unfortunately, not been executed.

9.3.2 Recommendations for the HHR

Although my research was conducted to gain an understanding of how the WFD II policy process - with special reference to the Langeraarse Plassen - actually works rather than how it should work, I would still like to take this opportunity to give the actors from the HHR some advice, based on the results of my policy analysis.

- As history has shown that the Langeraarse Plassen do not coincide with the M27 reference or with HHR's WFD policy objectives, one recommendation which a lot of people might expect is the formulation of new WFD policy goals. This will not, however, occur. The ecological water quality experts have formulated the WFD policy objectives for the Langeraarse Plassen, based on extensive analysis and expert judgement. I am not in a position to criticise this. I can recommend the actors of the HHR who are busy with the WFD not to fixate too much on the WFD policy goals.
- The WFD objectives contain a high degree of uncertainty which, as this study shows, is not entirely known by all of the actors. My analysis also shows that there are misconceptions regarding the water quality which the HHR wants to reach in the Langeraarse Plassen and other water bodies. More internal communication about the actual image that is being pursued might help to counteract this discrepancy. Perhaps more realistic images of the WFD goals should be used instead of target images which portray ecologically, beautiful, clear, and plant-rich waters. Externally this realistic communication is already taking place, at least during the Langeraarse Plassen stakeholder platform meetings, because there the HHR spokespeople do not use unrealistic images of clear water filled with water plants.
- Based upon remarks given by some of the participants, I would recommend an additional selection criterion for the 3rd WFD period.[76] Involving the content experts (the ecologists) more closely in the selection procedure should lead to the selection of water bodies where there is more certainty (e.g. due to available information from pilot results in similar water bodies) that water quality improvement measures will be effective. Better choices could be made.
- An additional recommendation I would like to give is that policy evaluation can be useful. I believe a lot can be learned from the former WFD projects for the upcoming WFD III process. Learning from the past can provide insights in the process and content for the WFD III policy process. Although it is part of the culture of the HHR to carry on and move quickly (e.g. to the WFD III project), and the board might not prioritise evaluation, structuration of this evaluation (which is now occurring on a voluntarily and informal basis) is necessary, to make it of use.
- Finally, I would like to recommend that actors should acknowledge that everyone has a different image of WFD attainability and participation, and that this can lead to discussions. Policy also changes along the way and this too can cause disputes and discrepancies in vision. Being aware of these differences and discussing them on a regular basis might speed up the process of mutual understanding.

[76] Assuming that not all of the remaining water bodies will be selected, which in order to comply with the WFD should actually be done.

Annexes

Annex A: Overview of conducted interviews

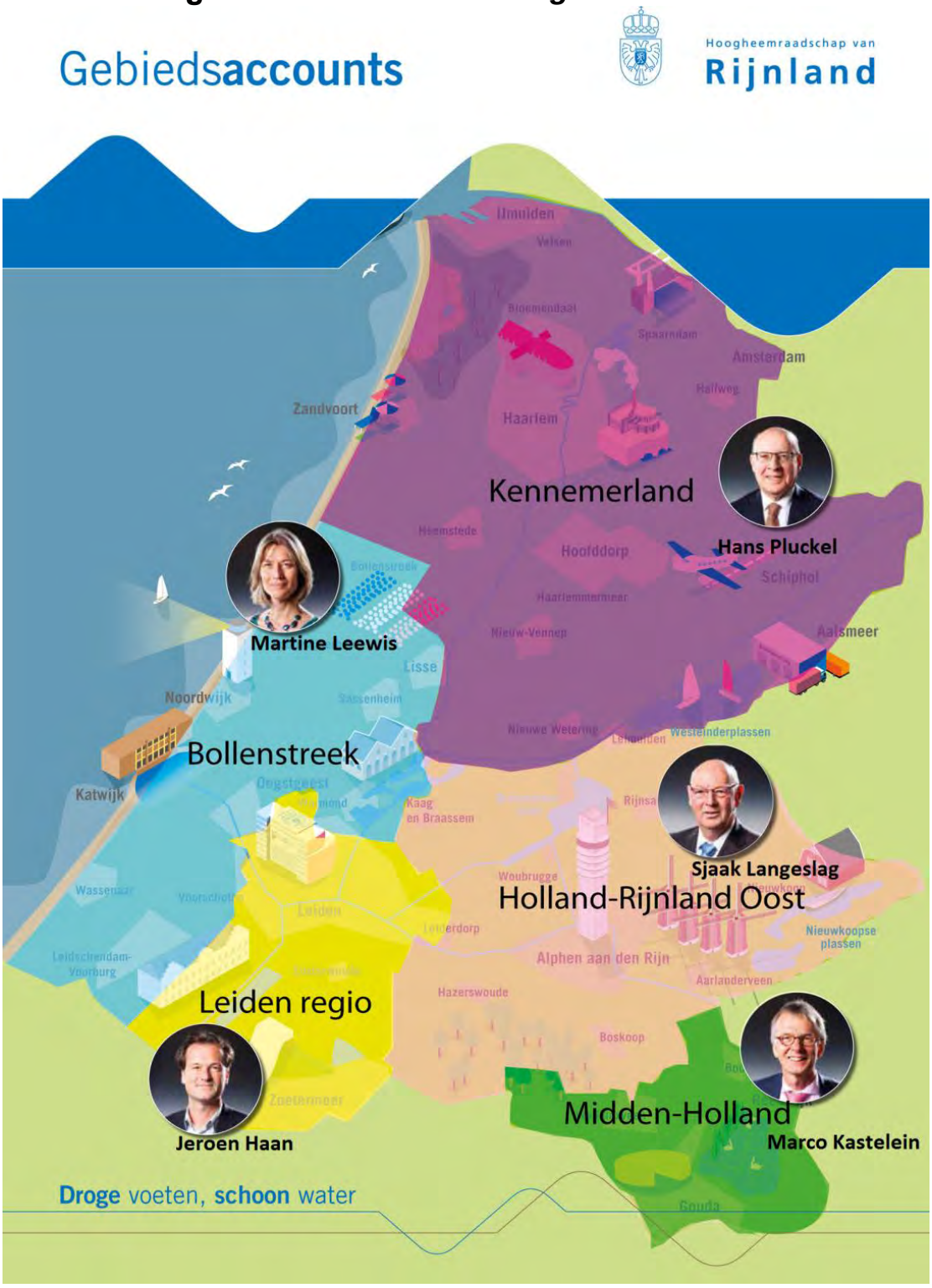
Table 10: Oral History interviews

Oral history interview number	Date	# Of participants	Location of interview
1	21-10-2015	1	participants home
2	21-10-2015	2	participants home
3	28-10-2015	1	participants work
4	28-10-2015	1	participants home
5	29-10-2015	1	participants work
6	29-10-2015	1	participants home
7	31-10-2015	1	participants home
8	2-11-2015	1	participants home
9	4-11-2015	1	participants home
10	9-11-2015	2	participants home
11	9-11-2015	1	participants home
12	10-11-2015	2	participants home
13	10-11-2015	3	participants home
14	11-11-2015	1	participants home
15	11-11-2015	1	participants home
16	13-11-2015	1	participants home

Table 11: Policy process interviews

Participant number	# of interviews	Date	Location interview
0	2	12-2015/18-2-2016	Langeraarse Plassen (1), HHR's office (2)
1	1	7-1-2016	HHR's office
2	2	21-1-2016/1-2-2016	HHR's office
3	1	22-1-2016	HHR's office
4	1	22-1-2016	HHR's office
5	2	11-2015/25-1-2016	HHR's office
6	2	11-2015/27-1-2016	HHR's office
7	1	28-1-2016	HHR's office
8	1	29-1-2016	HHR's office
9	1	29-1-2016	HHR's office
10	1	4-2-2016	HHR's office
11	1	8-2-2016	HHR's office
12	1	9-2-2016	HHR's office
13	1	10-2-2016	HHR's office

Annex B: Management areas of the *Hoogheemraden*



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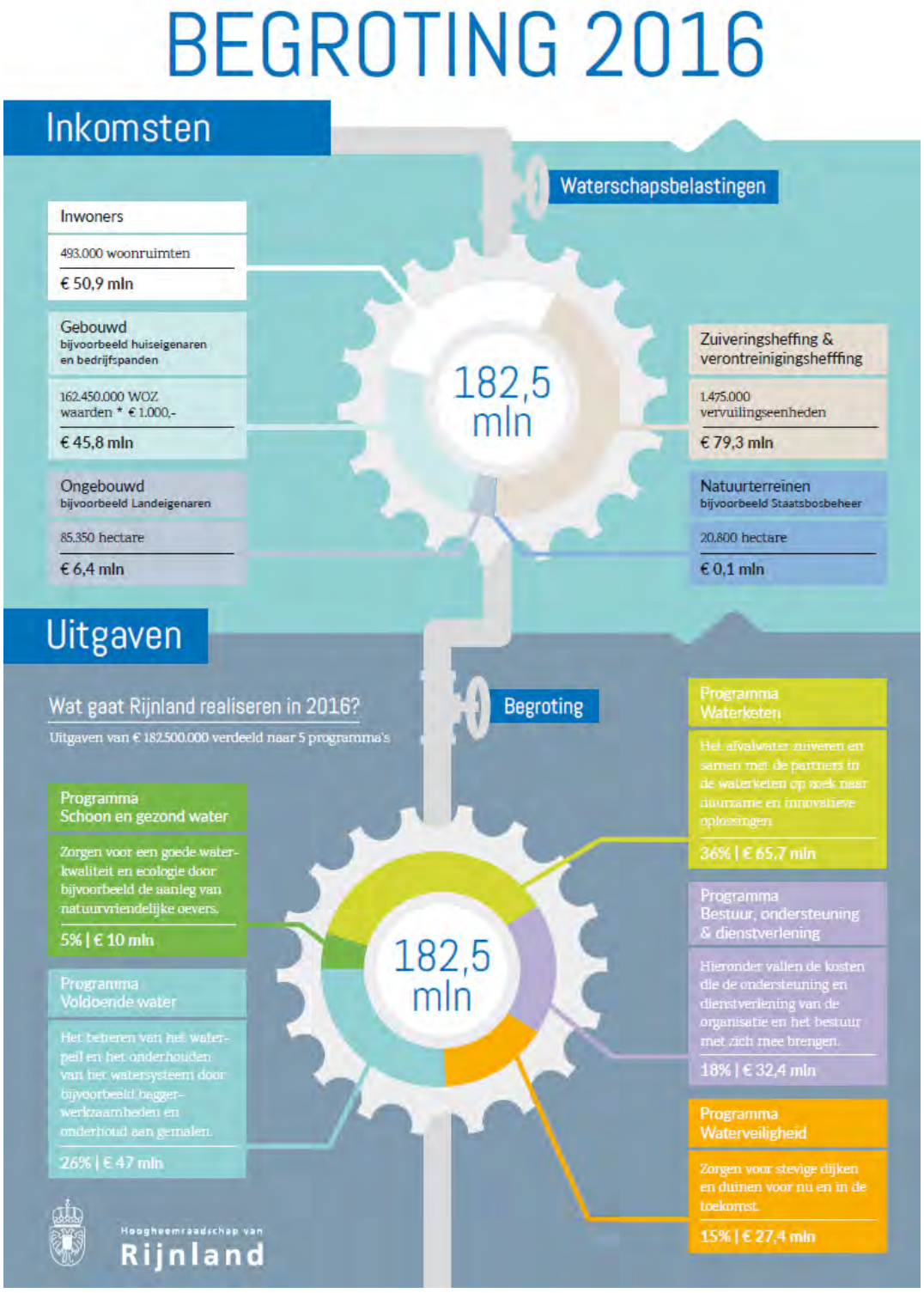
[77] Hans Pluckel (VVD), Marco Kastelein (CDA), Martine Leewis (Water Natuurlijk), Jeroen Haan (PvdA) and Sjaak Langeslag (Agrarisch & Bedrijven)

Annex C: Budget 2016



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