



Cultural Heritage Agency
Ministry of Education, Culture and Science



MAN-MADE LOWLANDS

A future for ancient dykes in the netherlands



Summer dyke near Eemnes. Kolk lakes and potholes mark the places where the dyke has been breached in the past. Because they were too deep to close up again, new sections of dyke were built around them, which explains why many dykes now follow a winding path.

CONTENTS

PREFACE	05
INTRODUCTION	07
1 DYKES IN THE NETHERLANDS	13
2 DYKES AND SPATIAL POLICY	27
3 FOUNDED ON KNOWLEDGE AND RESEARCH	37
4 TOOLS FOR DYKE RESTORATION AND DESIGN	43
APPENDICES	49
1. Existing overviews of dykes	49
2. Further reading	52
3. Useful addresses	54



PREFACE

Dykes are part and parcel of the Netherlands. Down through the centuries they have played a role in every attempt to make this country inhabitable – in the reclamation of peatland and marshland, as coastal embankments and to enclose polders and flank rivers. This means they are often cultural heritage features of the highest order as they have helped shape the unique character of a particular area. They are icons that reflect our age-old engagement with water.

To this day dykes continue to protect large parts of our country from flooding by river or sea. They are defining features of the landscape. Because of climate change, many of these dykes are being reinforced to withstand higher water levels than ever before. And there is growing pressure on the cultural heritage value of old dykes that have lost their water-defence function.

As the Cultural Heritage Agency it is our job to protect this country's heritage. This includes advising on how to deal with cultural heritage values when changes are proposed that may affect dykes. Since 1 January 2012 local authorities have had to take account of structures with a high cultural heritage value, including dykes, when establishing their land use plans. Since the Netherlands boasts thousands of kilometres of dykes, how do you decide whether a particular dyke is special? How can local authorities and other stakeholders ensure that dykes are treated correctly and appropriately? This book provides answers to these and a host of other frequently asked questions.

This publication offers practical guidelines. It sets out our vision on issues concerning the inventorying, valuing, managing and designing of dykes.

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Amersfoort, May 2014



The role of the Cultural Heritage Agency

The central government is responsible for the protection and sustainable preservation of nationally significant cultural heritage. It has delegated this task to the Cultural Heritage Agency (RCE), which is part of the Ministry of Education, Culture and Science. The tools at the Cultural Heritage Agency's disposal are a knowledge of Dutch moveable and immovable heritage, laws and regulations, and a grants budget for the conservation of immovable heritage. The Agency also looks after state art collections that are not managed by former state museums.

INTRODUCTION

The Netherlands is home to thousands of kilometres of dykes. Some still serve as flood barriers, while others are dyke relics that have lost their water-defence function. A sizeable portion are centuries old and as such they strongly define the character of the areas where they are located.

The cultural heritage value of dykes is coming under greater pressure than ever before. The climate is changing and in decades to come we will need to be prepared for milder winters, warmer summers, longer dry periods, as well as for higher precipitation levels, more torrential rainfall and rising sea levels. Rivers will have to cope with greater volumes of water and the incidence of extremely high water levels will increase. A further rise in temperature will also trigger a rise in sea levels. All of this means that dykes will have to withstand higher water levels than they do at present. At the same time, peat dykes and embankments may weaken as they dry out following long periods without rain. This was what caused the dyke breach at Wilnis in 2003. To tackle all these problems, people are seeking a more sustainable and climate-resilient form of water management, one involving the essential and ongoing processes of dyke reinforcement and water buffering. This approach can be found in a raft of plans and projects yet to be implemented that will have implications for the cultural heritage value of dykes.

In the decades ahead, more and more space will be needed for housing, work and recreation in the low-lying parts of the Netherlands. Agriculture too, will continue to increase in scale. This in turn will keep up the pressure on the cultural heritage value of inland dykes and embankments that do not have a flood-defence function. Dyke relics are often excavated or levelled as part of a local initiative, without proper knowledge of the dyke's cultural heritage significance. Old dykes can also be affected by agricultural practices, most notably levelling or the conversion of pasture into arable land. Creeping erosion is a further threat, caused among other things by cattle trampling the soil. Unlike their flood-defence counterparts, functionless dykes are not usually maintained and raised on a regular basis. As a result, they gradually lose their original shape and develop an uneven crestline.

The Spatial Planning Decree (BRO), which took effect on 1 January 2012, stipulates that local authorities must take account of cultural heritage values when establishing their

land use plans. This includes dykes and embankments. Local authorities cannot take these values into consideration without first inventorying and analysing them. A great many local authorities are currently working on their own heritage policy documents, often in combination with maps showing local cultural heritage values. Through *Man-made lowlands* the Cultural Heritage Agency hopes to encourage these authorities to include relevant water-defence dykes and dyke relics in their local heritage policy documents and maps. This publication does not offer any ready-made solutions for the route from inventorying cultural heritage aspects to valuation and on to maintenance and development. The unique characteristics of each dyke and its surroundings are much too diverse for this to be possible. It does, however, provide tools for adopting a sound approach to the cultural heritage value of dykes.

Dykes and embankments

In this publication the term 'dyke' refers to an earthen bank that runs alongside or encloses a body of water and serves as a water barrier. This definition therefore excludes elevated roads, which are often also called dykes. We make no distinction here between dykes and embankments (the Dutch term *kade*, or embankment, usually refers to low dykes). Thus in the river region we find both high winter dykes and low summer embankments. Embankments keep the forelands dry until water levels rise so high that this land can serve as an additional water storage area. But there are also embankments that function as primary water defences, such as those along the Meuse River in Limburg and North Brabant. Peat dykes and peat embankments form a separate category. These tend not to be raised, or only slightly, and are the result of different settling levels along waterways in peat areas or of excavations for turf extraction. These differences in settling levels occur because peat that is located close to ditches and other watercourses dries out and subsides to a lesser degree than peat that is further away.

Flood-defence dykes and dyke relics

Man-made lowlands looks at two groups of dykes. Those with a water-defence function still protect us from flooding and

are therefore still 'operational'. For water management professionals these are the current primary and regional flood defences (see inset 'Flood protection today'). Dyke relics are dykes that have lost their flood-protection function, which is true of a sizeable portion of dykes and embankments in the Netherlands. We make this distinction because of the implications for managing dykes, for the spatial planning framework and for the kinds of interventions that can affect the cultural heritage aspects of dykes.

Guide for the reader

This book is intended for anyone who has to deal with dykes. The aim is to provide basic knowledge about their cultural heritage value and how to approach it. In these

guidelines you will find general information about the history of dykes, the different kinds of dykes, their cultural heritage value and spatial planning in relation to dykes, as well as tools for dealing with dykes.

Chapter 1 explains where, when and why dykes were built. It describes the different kinds of dyke and the building materials used. Chapter 2 outlines spatial policy on dykes and their cultural heritage value. In Chapter 3 you will find tools to help you compile an effective dyke inventory, especially for municipal land use plans and environmental impact assessment (EIA) projects. Chapter 4 provides tools for effective design with respect to dyke reinforcement, restoration and reconstruction.

	Flood-defence dykes	Dyke relics
Change occurs mainly through	reinforcement, shifting and excavation of dykes	agrarian land use, new housing developments, excavation, infrastructure building
Planning	EIA dyke reinforcement plan, land use plan	EIA, spatial development plan, land use plan
Monitoring	Rijkswaterstaat, province, regional water authorities	local authority, landowner

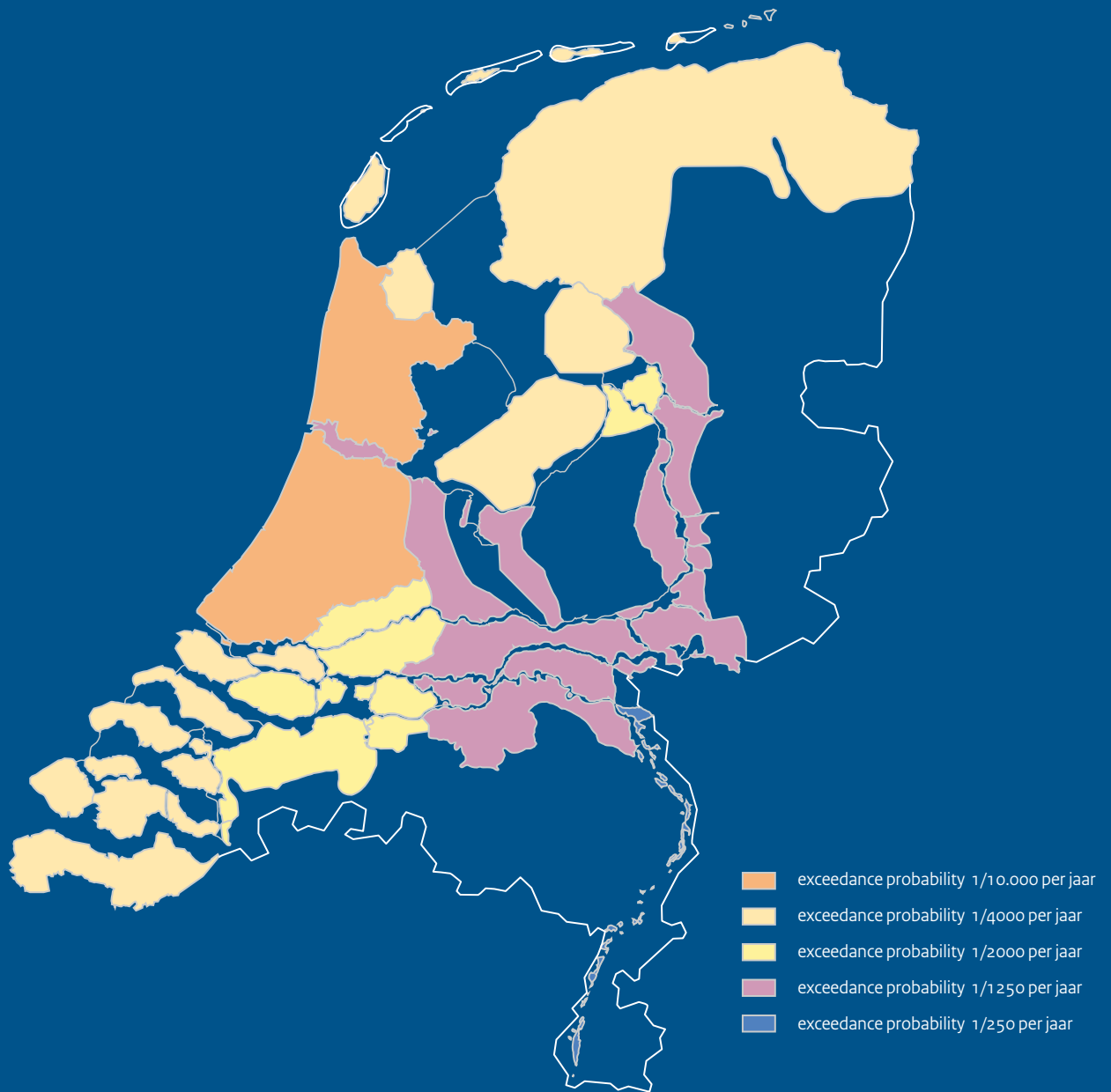
EIA = environmental impact assessment. Rijkswaterstaat = the executive arm of the Dutch Ministry of Infrastructure and the Environment.

Trees lining the dyke at Beets



Dyke reinforcement using heavy equipment.





Flood protection today

The Dutch system of flood defences is currently organised into 95 dyke rings. These are areas with a system of primary defences that offer flood protection, especially from external water. Each of these dyke rings is subject to a safety standard based on the probability – per year – of the highest water level being exceeded. The primary flood defences therefore have to be strong enough to meet this requirement. The Netherlands has almost 3600 km of primary flood defences, mainly in the form of dykes, embankments and dunes. The Dutch Water Act sets out what can be termed a primary flood defence. As well as primary defences there are regional ones, almost all of which are located inside the dyke rings. Regional defences, which are designated by the provinces, mainly offer protection from inland waters. They include polder dykes, compartment dykes, smaller dykes and embankments behind the primary sea walls. The water level outside these regional defences can generally be regulated, which is not the case with the primary defences. Regional water defences stretch over a total of no less than 14,000 km. Water authorities often use their own definitions for such defences. The Aa en Maas authority, for example, reserves the term regional flood defence for compartment dykes and for dykes along regional waterways; it has a further category for other water defences. In addition to primary defences, the Amstel, Gooi en Vecht water authority has secondary and tertiary defences that are of regional and local significance respectively.



The Waddendijk at Noordpolderzijl in Groningen.



Summer dyke near Eemnes with kolk lake.



The Spaarndammerdijk west of Amsterdam.



Boundary stone on the Spaarndammerdijk, originally marking the jurisdictional area of Amsterdam



The role of the Cultural Heritage Agency

There is a growing recognition that the landscape and elements such as historic dykes are of significance for society at large. The Cultural Heritage Agency has considerable in-house knowledge and expertise in this field, which it is keen to share with its partners. It also wishes to promote knowledge development in this area.

1 DYKES IN THE NETHERLANDS

Effective protection against water has always been a priority in our low-lying, water-logged country. It should therefore come as no surprise that so many dykes are centuries old. Once built, dykes had to be constantly repaired and improved. They are functional entities requiring continual work; change is the norm. A key feature of dykes is their recognisable history; every dyke has its own story to tell. This history is reflected in their winding course or the deep scour holes that bear witness to dyke breaches over the centuries.

Dykes come in all shapes and sizes. They range from low, narrow embankments along water courses, ponds, lakes, canals and polder storage basins to mighty river dykes and high, wide defences like the Afsluitdijk (in fact a dam) and the Hondsbossche Zeewering, a sea wall. Differences in function, shape, materials and type of construction mean that virtually no two dykes are the same and there is a wide regional variety in dyke ensembles. Dykes can be categorised according to the material from which they are built (peat dykes, seagrass dykes, pole dykes), the type of landscape or reclamation (sea dykes, river dykes, polder dykes) and their function (sand-drift dykes, enclosure dykes, defence dykes, compartment dykes).

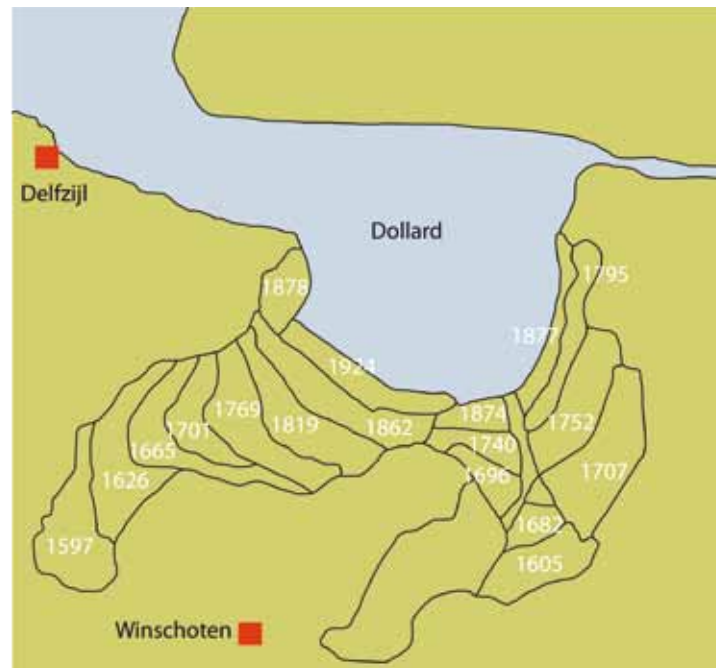
The origins of Dutch dykes

The first dykes were mainly built for defensive purposes. They were erected to protect the country's inhabitants from high tides or seepage from peatland that was not yet reclaimed. This concern for flood protection began in the tenth and eleventh centuries with low dykes made of stacked clay sods and continued into the twentieth century with the Delta Works (see inset 'A brief history of flood protection'). From about 1200, however, dykes also took on an offensive role as the focus shifted to land reclamation, chiefly to expand the area of agricultural land. One way this was done was to dyke in the land above the low-tide mark. Over the centuries, this led to a series of connecting dykes which can clearly be seen today, especially in the southwest and northern Netherlands.

In the sixteenth century people also began draining lakes, made possible through the use of drainage mills. The Achtermeer lake near Alkmaar was drained in 1532 and the Bergermeer and Egmondermeer lakes in the early 1560s. Larger areas of reclaimed land were surrounded by dykes

and ring canals. The first major polders of North Holland – Beemster, Purmer, Schermer and the Heerhugowaard – date from the seventeenth century. The first step in reclaiming this land was to construct a ring dyke and ring canal around the lake so that it could then be drained. From the mid-nineteenth century windmills were gradually replaced by steam pumping stations and in the twentieth century by diesel or electric pumping stations. This made it possible to drain even larger areas, such as the Haarlemmermeer in 1852 and the IJsselmeer polders in the twentieth century.

Land reclamation through dyke building. Successive dyking (showing year) in the Dollard region



Building and exporting knowledge

As early as the Middle Ages colonists from the Low Countries, with their specific expertise in water management, were attracted to other parts of Europe to help bring peatlands into cultivation. Wetlands reclamation and flood protection efforts were the clear impetus behind the development of dyke-building expertise, and later, behind efforts to underpin that expertise with scientific knowledge. Andries Vierlingh's *Tractaet van Dyckagie*, a dyke-building 'handbook' for a wide range of water management issues in the southwest Netherlands, dates to about 1578. By the eighteenth century hydraulic engineering had grown into a fully-fledged discipline and the Water Management Bureau (Bureau voor den Waterstaat) was established in 1798 (renamed Rijkswaterstaat in 1848).

Dutch dyke builders achieved international renown with the damming of the Zuiderzee (1932) and the Delta Works (1958-1997). Dyke building and related activities such as dredging and port construction became a major export product. But the development of expertise about flood defences did not stop with the Delta Works. The Maeslantkering floating pontoons that act as massive barrier doors in the Nieuwe Waterweg (1997) and the inflatable storm surge dam at Ramspol in the Ketelmeer (2002) are examples of revolutionary technological solutions.

Boundary stone on the Heidijk at Nieuwkuijk, marking the jurisdictional area of Heusden.



The cultural heritage value of dykes

Dykes and embankments create distinct patterns in the landscape. They do not stand in isolation but are always linked to other hydraulic engineering 'artworks' such as locks, bridges, mills and pumping stations that are erected on, within or adjacent to dykes. They lend dykes a patina of age, highlighting the fact that each dyke has its own unique history. Dykes that are part of the system of primary water defences almost invariably form distinctive lines that shape the landscape. However, many of the smaller inland dykes and embankments are also a prominent, readily identifiable feature of the landscape. In this respect, it hardly matters whether they are flood defences or relics. One difference, however, is that dyke relics tend to be interrupted because of a lack of maintenance, making them less easily identifiable. Many old dykes are obscured by the roads that run along the top of them, while dykes situated within the urban built environment, such as the Haarlemmerdijk in Amsterdam, are also harder to recognise as such, even if they retain their flood-defence function.

A switch in thinking

For a long time the focus was on the need to control water absolutely. This meant finding the most economical tech-

Dyke with trees at Nisse. Such dykes are mainly found in South Beveland, Tholen and Zeeuws-Vlaanderen.





Dykes never occur in isolation but are part of functional ensembles. This is an inundation sluice in the New Dutch Defence Line (Nieuwe Hollandse Waterlinie) in the Hoge Maasdijk at Hedikhuizen, North Brabant.



Hondsbossche sea wall.



Defence line dyke at Fort St. Joseph, Axel, Zeeuws-Vlaanderen.



The Diefdijk along the Culemborgsche Vliet at Leerdam.

nological solution and giving no thought to the environment or to cultural heritage values. It was not uncommon for 40 percent of buildings in a dyke village to be demolished to make way for a stronger dyke. The early 1970s saw growing opposition to these ‘engineers’ dykes’ and a gradual increase in emphasis on sophisticated designs and public participation. Consideration was given to interests other than flood protection – most notably the environment and cultural history.

In the latter half of the 1980s there was a slow but sure change in the belief that the ultimate solution to the problem of flood protection lay in constantly strengthening the dykes. Instead, people opted for a more diverse set of measures that included widening and deepening riverbeds and building flood channels to give the water more room. The establishment of ‘new’ nature areas also became increasingly common at this time.

Constant change

The fact that work on dykes is ongoing, as is happening today in response to global warming, is therefore nothing new. From the outset dykes had to be constantly reinforced so that they could continue to withstand the force of the water. For centuries the ground level in the western and northern Netherlands has been falling in relation to sea level. Along rivers too, the land behind the dykes is constantly sinking in relative terms. The function of many dykes has changed over time, with a later, higher dyke often taking over the main flood defence role. The old dyke would then become a ‘sleeper’ dyke (*slaperdijk* or *dromerdijk*), while the more recent dyke became the ‘watchman’. Many dykes had other functions besides that of water barrier and often several at once, the chief of which were habitation and traffic.

The ground plans of many towns and villages in the low-lying parts of the Netherlands feature one or more dykes as the oldest nucleus, often combined with a dam across a waterway. This is true of all places with ‘dam’ in their name, such as Amsterdam, Rotterdam, Edam and Schiedam. As for the traffic function, the through roads in low-lying parts of the country ran along the top of river and sea dykes until well into the twentieth century. In some places this function was so important that most people today are unaware that the road lies atop water defences. One example is the Schielandse Hoge Zeedijk between Rotterdam and Schiedam, where a four-lane highway now hides the old dyke from view, and the Voorstraat in Dordrecht, which is both a primary water defence and a main shopping street. For many dykes the defensive function also plays a key role.

Change is a reality for both flood-defence dykes and dyke relics. Once a dyke loses its water-defence function, the continual monitoring, reinforcement and upgrading for the purpose of flood protection also ceases. This does not mean that these dykes are no longer subject to change. Some have been excavated because they stood in the way or because the earth could be put to better use elsewhere. After the North Sea flood of 1953 material from inland dykes was used to quickly plug the gaping holes in the sea walls. There was also more gradual erosion as a result, for example, of over-grazing. Other dykes continued in use as causeways so that local inhabitants could get about with dry feet during wet periods and they were maintained for that purpose.



Stone dyke at Hasselt. This special dyke along the Zwarte Water is reinforced with a brick wall and is a national monument.



Muralt wall on the Schenkeldijk at Werkendam. Countless dykes in Zeeland were reinforced with these walls between 1906 and 1939. Most have since been removed.

Structure of the dyke body

The first dykes, from about the beginning of the first millennium, were built of clayey or sandy salt marsh sods that were dug on site. The core of the dyke was simply dumped in place, whereas the sods were usually carefully laid next to each other on the slope. Sometimes, as in Raversijde in West Flanders, the dyke core consisted of sand with a covering of peat on the slope. The core of later medieval dykes was also made of clay or sand, but with a clay overlay. From early on people looked for ways to strengthen the dykes. From the fifteenth century onwards, the sea dykes of North Holland were reinforced with compressed packs of dried seagrass stacked together. These rested on a solid layer of reed and were anchored with posts and beams to prevent them from being washed away. Another common method was to erect a continuous screen of poles on the seaward side to break the force of the waves. This rather expensive method was particularly suitable for 'schaar' dykes, which are dykes that directly border the sea, without a floodplain. Following a major shipworm infestation, revetments of natural stone had to be added to many pole dykes, which was even more expensive. In Zeeland the turf on the dykes was reinforced with straw or reed mats, or with brushwood structures. Brick was almost exclusively used in towns, in locks and at places where fortifications also served as flood defences. The Steendijk (stone dyke) at Hasselt is a fine example of a dyke reinforced with a brick wall. From the latter half of the nineteenth century outer revetments of natural stone were used on an increasing scale. The twentieth century saw the advent of new materials such as asphalt and concrete. In the years 1906-1939 low concrete Muralt walls were built on the crests of dykes in Zeeland. Developed by the engineer De Muralt, these walls proved unable to withstand the force of the sea during the 1953 flood. They subsequently fell into disuse but are preserved in several places as culture historical phenomena.



Anti-tank barrier on the Zuiderzeedijk at Muiden, erected in 1939/1940.



The Diefdijk, seen here at Everdingen, was partially constructed as a cross dyke in the 13th century. In the 19th and first half of the 20th century it formed part of the New Dutch Defence Line.

Defence line dykes

Dykes were built not only to prevent floods, but also to enable land to be strategically inundated. In the Netherlands the deliberate flooding of certain areas proved an effective way to keep enemy forces at bay. These dykes or embankments usually served to define an inundation area (defensive or line dyke). They formed part of a system that included feeder canals, locks and inundation basins.

A defence line is often a string of fortifications separated by inundation areas. The fortifications were located around towns and on higher ground that could not be flooded. A few feet of water was all that was needed to conceal ditches and other watercourses, creating treacherous obstacles for the approaching enemy under fire from the fortifications. Military defence lines such as the New Dutch Defence Line were built from the seventeenth to the twentieth centuries.

Fort Everdingen at the spot where the Diefdijk meets the Lekdijk.





High water on the IJssel River at Zalk.

A brief history of flood protection

The growth of the dyke system

The oldest known dykes date from about the beginning of the first millennium. These very early dykes – low earthworks composed of stacked clay sods – have been uncovered during archaeological excavations in Friesland and Zeeland. Because of their modest height they could scarcely have posed a serious obstacle to rising seawaters in winter. They were probably not erected for safety reasons, but rather to prevent frequent inundation by salt water so that the land could be used more intensively. At that time the dykes enclosed small fields and their modest size means that they were of local significance at best.

The first medieval dykes are believed to date from the tenth or eleventh century, but it was not until the twelfth century that dyke building really took off. This was a time when large tracts of cultivated land along the major rivers and expanding estuaries threatened to disappear. Dykes in the river region were built perpendicular to the main flow in order to convey excess water from upstream land back towards the river. At a

certain point these cross-dykes ceased to be effective and they were then linked together, creating a long uninterrupted flood barrier.

Something similar happened in coastal areas. Smaller dykes built by local village communities or individuals to combat local flooding were joined together to form larger dyke rings. One of the largest and best known is the Westfriese Omringdijk, more than 125 km in length. In the northern Netherlands monastic orders played a key role in dyking in the land. These were small monastic communities, not the large abbeys found elsewhere. Dykes and embankments were built in fen areas to prevent water from as yet unreclaimed peatland from flowing into the reclaimed land. This was necessary because peat would subside after reclamation, leaving the reclaimed land lower than the surrounding peatland.

Water authorities

As dyke systems expanded, building and maintaining them quickly became too much for individuals and for small village and monastic communities. As far back as the late Middle Ages numerous water authorities were set up to tackle this



The same spot at low water.

problem. They varied enormously in size, from a single polder with one or two farms to entire regions. At the beginning of last century the Netherlands still boasted more than 3000 water authorities, most of them encompassing a single polder. Then began a constant process of expansion and centralisation. At the time of writing (2014), the Netherlands still has 24 water authorities. The oldest authority still in its original form is the Hoogheemraadschap van Rijnland, which was founded in 1232.

Floods

Despite the building of extensive dyke systems and the establishment of water authorities vast tracts of land repeatedly fell victim to the waves during storm surges or other disasters (such as when drifting ice caused river water to back up). The likelihood of dyke breaches was increased by poor maintenance, often due to wars or uncertainty about who was responsible for maintaining the dykes. Along the rivers, downstream cross-dykes were even deliberately breached on occasions to allow flooded upstream polders to drain. This occurred at the expense of land further downstream, often leading to explosive conflicts. The many pot holes or kolk lakes

and bends in the dykes bear witness to countless breaches and repairs. Thus the history of Dutch dykes is one of a long succession of floods of varying magnitude. One of the best known is probably the St. Elizabeth's flood of 1421, which was responsible for creating the Biesbosch, a vast wetland area that is now a national park. The Biesbosch is an example of an inhabited area that was lost for a long period due to flooding. The All Saints Flood of 1 November 1570, the Zuiderzee flood of 1916 and the North Sea flood of 1953 are other well-known floods with disastrous consequences, but here most of the inundated land was eventually made habitable again once the dykes were repaired and upgraded.

Long periods without floods would lead to a reduced sense of urgency regarding dyke maintenance. Discussions about the usefulness, necessity and cost of such work have been going on for centuries, with dyking activity only increasing after a flood or acute threat. In about 1732, for example, when many dykes and other flood barriers threatened to fail through shipworm damage, disaster could only be averted by replacing the wood with materials such as stone that were much more expensive. This required an enormous investment, and in a short space of time. The enclosing of the Zuiderzee is another such example. The protracted decision-making on this issue



High water along the Rijnbandijk at Maurik, with the flood plains submerged. The low summer dyke can be seen on the right behind the trees.

gained momentum following the Zuiderzee flood of 1916 that inundated parts of North Holland and Utrecht. Newspapers published dramatic photos of the dyke bursts, flooded land and cows sheltering in an Edam church.

In 1953 a combination of a high spring tide and a severe storm caused a catastrophic flood which remains a terrifying spectre to this day. The floods caused about 1800 deaths and an enormous loss of land. From that time on neither expense nor effort was spared to protect the country from the water. The Delta Works were constructed to ensure that the southwest of the country would never again experience such a catastrophic storm surge. It was an ambitious project on an unprecedented scale, marvelled at both at home and abroad. It was not a definitive solution, however. Even as the plan was being implemented, the specifications for dykes and barriers were repeatedly modified as concerns other than safety became an issue.

More recently

More recent events include the near-breaches of dykes along the Waal River and the inundation of villages outside the dykes along the Meuse River following extremely high river wa-

ter levels in December 1993 and January 1995. The situation was especially critical in 1995 – at the village of Ochten, the dyke along the Waal only just managed to hold. Following this near disaster a start was soon made on improving the river dykes. There was immense pressure to simplify procedures and public participation was restricted. The work was completed in 2000. More recent still is the peat-dyke breach at Wilnis in the summer of 2003. Here the embankment collapsed because the peat had dried out, prompting an inventory of peat dykes at risk in this way. Many of these water defences were then kept wet by artificial means to prevent further flooding. Research into the stability of dykes was also given a renewed impetus. On 6 January 2012 high water in Groningen created a weak spot in the dyke at Woltersum and 800 people were evacuated as a precautionary measure. This shows that dykes can also collapse if the water is lower than the crest, as a result of softening following a long period of high water and underground seepage flow. Discussions are currently underway about raising safety standards and other measures as part of a new Delta programme.



The Slachtedijk, a former sea dyke in Friesland. This 42-km-long dyke is no longer used as a flood barrier and is now managed by It Frysk Gea, a private association that looks after nature and heritage in Friesland.



The role of the Cultural Heritage Agency

The central government wishes to ensure that heritage is taken into account when spatial interests are being considered and to lend support to provincial and local government in this matter. The Cultural Heritage Agency's role here is as an information provider and knowledge centre. There is no reason why paying attention to the cultural aspects of historical structures such as dykes should stand in the way of essential interventions. Rather, it can mean that the work is carried out with a sense of historical context and an attention to design quality.

The Knardijk in the province of Flevoland. It used to lie right on the water but now forms the boundary between Eastern and Western Flevoland.

2 DYKES AND SPATIAL POLICY

Dykes are seldom designated as protected monuments. Spatial plans involving dykes usually balance the interests of dykes against other non-cultural heritage interests. The different levels of government have differing roles, tasks and responsibilities when it comes to dyke management and protection and spatial developments affecting dykes and embankments. These stem from various laws and regulations and sometimes from local circumstances that have arisen historically.

Only a few dykes have been designated as protected monuments by central, provincial and local governments (see inset 'Monumental waterworks'). Dykes are generally included as part of cultural heritage in environmental impact assessments (EIAs), but this does not of itself provide them with protection. Any protection given to dykes occurs by way of provincial regulations and municipal land use plans. Since 1 January 2012 local authorities have been required to take cultural heritage values into consideration in their land use plans (article 3.1.6 Spatial Planning Decree).

The role of local authorities

Ongoing decentralisation means that local authorities are playing an increasingly key role in current spatial planning practice. They are also the key drivers when it comes to dealing with dykes and embankments as cultural heritage.

Heritage policy document

First of all, structures of historical significance such as dykes may be incorporated in municipal heritage policy. The heritage policy document is where a local authority sets out its plans to deal with the cultural heritage values within its boundaries and the tools it will deploy for that purpose. A key instrument here is the municipal map of cultural heritage values. A growing number of local authorities have such a map, which provides far more detail about dykes and embankments than can be found on national and provincial overviews. These maps are also better tailored to the specific issues facing each municipality.

Spatial development plan

The local council adopts one or more spatial development plans for the municipality as a whole in accordance with the Spatial Planning Act (WRO). This includes the proposed development of the area, general spatial guidelines and how the local authority plans to achieve its objectives.

The spatial development plan serves as a strategic planning tool, broadly outlining the organisation, scope and coordination of the various spatial functions. It also reveals the areas for which spatial functions are less appropriate. In the plan the local authority describes how it has involved landowners, local residents and community organisations in the preparation. These parties can provide useful support for spatial policy, as well as valuable knowledge.

Land use plan

Since 1 January 2012 the Spatial Planning Decree (BRO) has required local authorities to consider not only archaeological values when drawing up their land use plan but also urban planning, architectural, historical and historical-geographical values. These include dykes and embankments of cultural heritage significance. Local authorities can only take these values into account if they know about the cultural heritage within their boundaries. Where necessary, local authorities must conduct a further inventory and analysis of these values in preparation for their land use plan. Their own cultural heritage map can be used for this purpose.

A land use plan sets out the uses of the land and structures within a particular area in legal and planning terms. It provides explanatory notes, planning rules and some form of map. If there is a dyke or embankment of historical significance, it can be assigned a dual cultural heritage use. For example, the designation 'value – cultural heritage value' can be added to the principal use, which is generally water or traffic management or agricultural. A dyke or a plot of land featuring a historical dyke or embankment can also be specified more closely under the principal use. Thus within the principal use of 'nature or agricultural', the local authority can set out rules that take these elements into consideration. The principal use could then be 'agricultural with additional values'. Catch-all terms are sometimes used. For example, the predicate 'protected dyke' can refer to a combination of cultural heritage, landscape and/or scienti

Monumental waterworks

Dykes designated as protected monuments can be found at national, provincial and municipal levels. Most of the hydraulic elements and structures that are protected at a national level are built objects such as pumping stations, locks, stoplog sheds and lockkeeper's houses. Nationwide, they number more than 250. There are also a number of facilities on and in dykes that are protected, such as cuts, the four caissons used to close the dyke at Ouwerkerk following the disastrous storm of 1953, Mural walls to elevate dykes and a retaining wall for the purpose of dyke strengthening. The Steenendijk (stone dyke), an 800-metre-long wall on the outside of the dyke between Zwartsuis and Wijhe, is also a national monument, but not the earthen body of the dyke itself. In general, dykes as linear earthworks are only protected if they form part of a larger complex that is designated in its entirety as a national monument, such as the New Dutch Defence Line (since 2009) and the Grebbe Line (since 2011). In fact, apart from these defence line dykes, only the Leppedijk in Friesland is a national monument. For the rest, a single fragment of dyke has been listed as a national archaeological monument. This fragment is part of a protected site in Tjamsweer, in the municipality of Appingedam, with a very high archaeological value, but it is no longer visible on the surface. Five dykes have been designated as sites of very high archaeological value, 69 of high archaeological value and 79 of archaeological value, but they are not legally protected. Soil interventions are not permissible for sites in the first two categories. For the last category, further research is often needed to establish whether preservation in situ should be pursued or whether a different approach to these sites is possible. North Holland is the only province to have designated dykes as monuments (see the sections on archaeological research and provincial policy later in this chapter). Local authorities may also confer municipal monument status on dykes that have a culture historical value at the local level, but this has seldom happened. Thus parts of the Spaarndammerdijk and Inlaagse dyke in the municipality of Haarlemmerliede and Spaarnwoude are municipal monuments. The municipality has also granted this status to elements associated with the dykes, such as Rijnland distance markers and a quay wall, which is part of the Spaarndammerdijk.

Westfriese Omringdijk with the Burger kolk lakes. The dyke is a provincial monument.



fic values that are not further specified. Or the designation 'archaeology' may also include cultural heritage values that are located above ground. This does not usually pose a problem for the cultural heritage values themselves; at most, it can make communication more difficult.

The ensemble of dykes and embankments, waterways, dyke breaches and hydraulic structures such as culverts, locks, mills and pumping stations has a significant impact on the character of an area. The local authority can safeguard the spatial cohesion of these structural elements by giving them a dual designated use or site designation on the map. In the interests of preserving historic dyke ensembles the local authority can make an environmental permit mandatory for construction and other works that could disturb these values. Examples are the construction and filling-in of watercourses and the building or widening of roads. In this way the local authority can safeguard the spatial quality of dyke ensembles and where possible encourage or enforce improvements.

In principle, local authorities can protect the spatial character of a dyke or dyke landscape by means of a consolidating land use plan that sets out the existing spatial situation. It is often better, however, to have a flexible plan that offers protection while at the same time allowing scope for new developments, for example by permitting or prohibiting certain changes in designated use. Building a cycle or walking path on a dyke can boost its recreational function, on condition

that the new use does not detract disproportionately from the dyke's spatial quality.

The role of provinces

Each province handles dyke protection in its own way. The different provinces classify their policy areas differently and assign them different labels. Thus in policy terms historical dykes sometimes come under culture or cultural history, and sometimes under environment and landscape, space and housing, or similar areas. These policy spheres are included in a range of policy documents such as spatial development plans and provincial water plans. In some instances objectives relating to cultural heritage are also set out in a heritage or cultural policy document (e.g. *Nota Belvoir*, Gelderland; *Provinciale Cultuurnota*, Utrecht; *Nota Cultuurhistorie en Monumenten*, Zeeland). For the 'culture' and 'cultural history' policy areas, dyke policy can be classified under landscape, which is in principle also the category where archaeology belongs. In practice, however, historical dykes are not clearly linked to archaeology anywhere. There is a greater focus on dykes in the provincial heritage policies of Groningen and North Holland than in the other provinces. In Groningen dykes come under the 'nature and landscape' policy domain, where they form the key characteristic features targeted by preservation and, where necessary, restoration measures. 'Old dykes' and 'identifiable former dykes' are the policy focus, which therefore

Walkers on the Diefdijk at Sonsbrug.



Schenkelkade, a low peat dyke that functioned as a boundary in the Krimpenwaard near Haastrecht.





Walkers on the Lekdijk at Vreeswijk.



Boterpolder ring dyke and ring canal at Hazerswoude.

excludes much of the dyking history of the Dollard estuary since the dyke bodies of most of this series of successive dykes have been lost. The old dykes are mainly old ‘sleeper’ dykes, which are characteristic of the Eems delta, the Oldambt region and the Wadden Sea coast. To protect dykes and associated features, the province has set out rules in an environmental by-law stipulating which dyke components qualify for restoration. Financial support for this purpose is provided by the National Area Programme.

North Holland is the only province to have bestowed protected monument status on various dykes in accordance with provincial regulations regarding monuments. This status applies only to the Westfriese Omringdijk, the Noorder IJ and sea dykes, the Zuider IJ and sea dykes and the Wieringen Wierdijk (seagrass dyke). The province emphasises the importance of these dykes as structuring elements in the landscape. They are shown on the *Informatiekaart landschap en cultuurhistorie* (Landscape and cultural heritage information map), which can be viewed online. The significance of the Westfriese Omringdijk is also apparent from the fact that it has its own website (see Appendix 3).

In the absence of policy programmes like those in Groningen and North Holland, policy on historic dykes is less clear-cut in other provinces. There the importance of dykes is reflected more in the place they occupy in the province’s identity. Most provinces specify the key spatial qualities, either under ‘core qualities’ or other terms such as ‘identities’, ‘core characteristics’ and ‘distinctive landscape elements’. In Friesland, South Holland, Zeeland and Flevoland, dykes form a distinctive part of the province’s identity and this is clearly reflected in cultural heritage atlases and similar resources. The provinces of Gelderland, Utrecht and North Brabant all have geographical subareas whose landscapes, and often nomenclature, relate to rivers or to

a past or present coastline. Although dykes are not listed separately in the descriptions of these sublandscapes, they are seen as elements that define the nature and quality of the landscape together with other elements and structures such as rivers, forelands, natural levees and alluvial plains. They are components that make up the larger whole. The modest position of dykes is also reflected in the cultural heritage maps of these provinces, inasmuch as these exist. These maps do show dykes but not to the same extent as, for example, in Friesland or Zeeland.

The role of Rijkswaterstaat

Rijkswaterstaat, the executive arm of the Dutch Ministry of Infrastructure and the Environment, has undertaken responsibility for cultural heritage when developing new initiatives. To this end Rijkswaterstaat worked on its own dataset of relevant cultural heritage objects in 2006/2007. The result is three data layers for cultural heritage – archaeology, built heritage and historical geography – that can be combined with its other layers. Staff at Rijkswaterstaat can access this data via the portal of the Network Management Information System (NIS). While dykes are not part of the dataset, it does include a host of other objects associated with water management. *Erfgoed langs weg en water* (Heritage along roads and waterways), published in 2007, presented a selection of cultural heritage in the NIS. In that same year Rijkswaterstaat also published *Kunstwerken van Waterstaat* (Water management artworks) as a guide on how to approach cultural heritage objects relating to water management in the NIS. Neither of these publications contains guidelines for dealing with historical dykes. In 2010/2011 Rijkswaterstaat compiled a list of artworks under its jurisdiction that enjoyed the legally protected status of national, provincial or municipal monument. This list,



Dykes along the Beemster Uitwatering at Schardam.

incorporated as a separate data layer in the NIS, does not include dykes either.

Regional water authorities and cultural heritage

Until well into the twentieth century the regional water authorities bore primary responsibility for controlling the maintenance of hydraulic engineering works and for regulating water levels in the polders and storage basins under their jurisdiction. Their role has expanded enormously since then. As well as looking after flood defences, their task now includes responsibility for the quality and quantity of surface and groundwater, sewage treatment and sometimes road management. These tasks are becoming increasingly intertwined with other aspects of spatial planning, such as recreation and nature, as well as heritage. As a consequence, water authorities are playing a growing role in regional development and in the preparation of regional vision documents.

A sample survey carried out among 13 regional water authorities in the central and coastal Netherlands established the extent to which they view the dykes in their jurisdiction

as heritage and whether this is reflected in their policy and management responsibilities. Eight water authorities link aspects of recreation or the environment to their water-management role. Three authorities – those of Hollands Noorderkwartier, Rijnland and Groot Salland – explicitly referred to a relationship between the tasks of water authorities and cultural heritage. With few exceptions, it is only objects such as bridges and locks that are viewed as heritage. The dykes and embankments themselves (with the possible exception of the Westfriese Omringdijk) are not mentioned under heritage. The Rijnland water authority considers heritage management to be one of its tasks, while two other authorities referred to a relationship between water management issues and the history of their region.

Although not published by water authorities themselves, the 2004 book *Blauwe Tradities* (Blue traditions) by the Belvedere project bureau is aimed at people working in the water sector. It contains inspiring examples of a responsible approach to cultural heritage values in water tasking and can be downloaded free of charge (Appendix 2). Along the same lines is *Peilwaarden. Omgaan met erfgoed in actuele wateropgaven* (Reference levels. Dealing with heritage in current water tasking, 2010), a publication by the Dutch Association

of Water Authorities. Primarily targeting people working for water authorities, it goes a step further than *Blauwe Tradities* and focuses much more on day-to-day practice. It offers concrete suggestions that water managers can put into practice immediately. The online toolkit *Handreiking Archeologie, Cultuurhistorie & Aardkundige waarden voor Waterbeheerders* (Guidelines on archaeology, cultural history & geographical values for water managers) also specifically targets water managers and can be found at <http://handreikingarcheologie.sikb.nl/voorpagina.asp>.

Environmental impact assessment (EIA)

Environmental impact assessment (EIA) is a key tool for a responsible approach to the cultural heritage value of dykes. The primary objective of the EIA procedure is to ensure that the environment is given full consideration when it comes to preparing and adopting plans and decisions that could have an adverse environmental impact. The EIA procedure therefore supports decision-making and is applicable to both private and public initiators. 'Environment' is interpreted broadly to ensure that cultural history, landscape and nature are given due consideration in the EIA process. For this reason the Minister of Education, Culture and Science – in practice the Cultural Heritage Agency – has been designated one of the legally appointed advisors.

The EIA procedure is mandatory for the construction, expansion or modification of works designed to limit flooding, including primary water defences and river dykes. Earthmoving with respect to other types of flood defence is not directly subject to EIA but is often subsumed within other activities for which an EIA is required under the Environmental Impact Assessment (EIA) Decree. EIA is therefore an important procedure for both flood-defence dykes and dyke relics since an EIA requirement applies to all spatial plans that could have an adverse impact on the environment. The EIA Decree does, however, pay particular and explicit attention to the reinforcing of existing flood-defence dykes and the construction of new ones.

The EIA procedure has been modified over time so that it now also covers framework plans such as spatial development plans. The option of a simplified or a full EIA procedure was introduced in June 2010. The full procedure applies to plans or decisions for which the central government is both the initiator and competent authority. Significantly, it also applies to approvals of dyke reinforcement plans under the Dutch Water Act. In the full EIA procedure, there must be public notification of the initial memorandum (*startnotitie*) as well as mandatory review advice from the Netherlands Commission for Environmental Assessment (NCEA). The simplified procedure may be followed if it is clear from the outset that an environmental permit is required, but that

Dijkje Elstgeestpolder near Voorhout, South Holland.



Slachtedijk in Friesland.





River dykes along the Lek River at Jaarsveld.

no appropriate assessment needs to take place under the 1998 Nature Conservation Act.

The EIA procedure usually involves an environmental impact assessment report. The Dutch Environmental Management Act stipulates the content of the report, which relates primarily to the proposed activity and possible alternatives, the decisions to be taken, the environmental impact of the proposed activity and alternatives, and a comparison of the environmental impact of the proposed activity and its alternatives. EIA is tailored to a specific situation. In principle, cultural heritage is only included in the procedure if it may be affected by the plan or project.

Several players are involved in dyke improvements for which an EIA is mandatory. The competent authority is usually the province. The NCEA advises on whether a further cultural heritage investigation is needed. It is frequently the water authority that commissions the EIA. Cultural heritage research carried out with respect to dyke improvements may take the form of both archaeological and historical-geographical and/or building history research. The catch-all term *landscape* is also commonly used, and it is not always clear whether this refers to the impact of dyke improvements on historical geographical or visual aspects of landscape.

Archaeological research

Archaeological research has been an integral part of spatial planning since the introduction of the Archaeological Heritage Management Act (WAMZ) in 2007. Under the Act responsibility for heritage rests largely with local authorities, which are required to consider archaeological values in their decision-making. The WAMZ also feeds through into land use plans and the associated permit system (Spatial Planning Decree, Spatial Planning Act). Conditions relating to archaeological research may be attached to the environmental permit. The WAMZ is also evident in the EIA process as anyone making permit applications may be required to submit an archaeological research report containing a valuation. As well as local authorities, other licensing bodies such as provincial and water authorities – for earth removal permits and under the Water Act respectively – are able to impose conditions regarding archaeology.

If a plan entails soil interventions for which permits or land use plans impose conditions relating to archaeological features, it is the initiator's responsibility to conduct the inventory and valuation study. The responsible level of government (usually the local authority) then decides whether the archaeology is 'worth preserving', based on the research report containing selection recommendations and

Open-day crowds during an excavation on the Zuiderdijk at Venhuizen.



The oldest phase of the dyke, built up of clay sods.



any additional advice and valuations by other parties. This occurs in accordance with the authority's own policy, which may include the valuation and an assessment of public support. If the archaeology is considered worth preserving, the plan may be modified so that the archaeology is saved. Or, as often happens, the archaeological remains may be excavated. If the archaeological remains are not considered worthy of preservation, or if they do not fit within the policy, a decision is taken that no follow-up study is needed. Sometimes a decision is made to have archaeologists supervise the earthmoving work but this can only happen in specific situations.

Archaeological research during reinforcement of the Zuiderdijk, part of the Westfriese Omringdijk





The role of the Cultural Heritage Agency

The central government, provinces, local authorities and water authorities all have a role to play in preserving the culture historical values of dykes. A proper assessment of these values calls for culture historical research prior to the planning and decision-making process. The Cultural Heritage Agency can provide information to people and organisations wishing to research cultural heritage. The Agency has made several guidelines available online (appendix 2):

- Handreiking erfgoed en ruimte (01-02-2011) (Heritage and spatial guidelines)
- Handreiking Cultuurhistorie in m.e.r. en MKBA (Guidelines for cultural heritage in EIA and social cost-benefit analysis) (June 2008)
- Cultuurhistorisch onderzoek in de vormgeving van de ruimtelijke ordening (Culture historical research in spatial planning design) (3-01-2013).

Waterlandse Zeedijk at Uitdam in North Holland. The island of Marken can be seen in the distance.

3 FOUNDED ON KNOWLEDGE AND RESEARCH

Detailed knowledge underpins any initiative relating to dykes, whether this be inventorying dykes and embankments of cultural heritage relevance for a local authority's land use plan or conducting a valuation as part of the EIA procedure for dyke reinforcement. The first step is to inventory what is already known about the dykes and embankments within the municipality or planning area. This will reveal which kinds of study might still be needed.

Knowledge is essential for an effective approach to the cultural heritage value of dykes. This includes knowledge of the dyke's path, function, age, history, conservation and relationship to other landscape elements. An initial picture can be gained by examining existing overviews at the supraregional level (Appendix 1). Regional studies and supplementary inventories can then be used to focus at the level of a land use plan or project.

Compiling an inventory for a land use plan

The information accompanying a land use plan should include a description of how an area's cultural heritage values have been taken into account. This is only possible if the local authority has had these values inventoried and analysed in advance. For the sake of efficiency, it makes sense to compile at the same time a cultural heritage values map for the entire municipality so that any structures encountered can be placed in a municipal perspective. The Cultural Heritage Agency's booklet *Cultuurhistorisch onderzoek in de vormgeving van de ruimtelijke ordening* (Cultural heritage research in spatial planning design, Appendix 2) contains guidelines and recommendations for cultural heritage research that will enable local authorities, as required by the *Spatial Planning Decree*, to give consideration to any cultural heritage values that are present. It sets out what form this research should take.

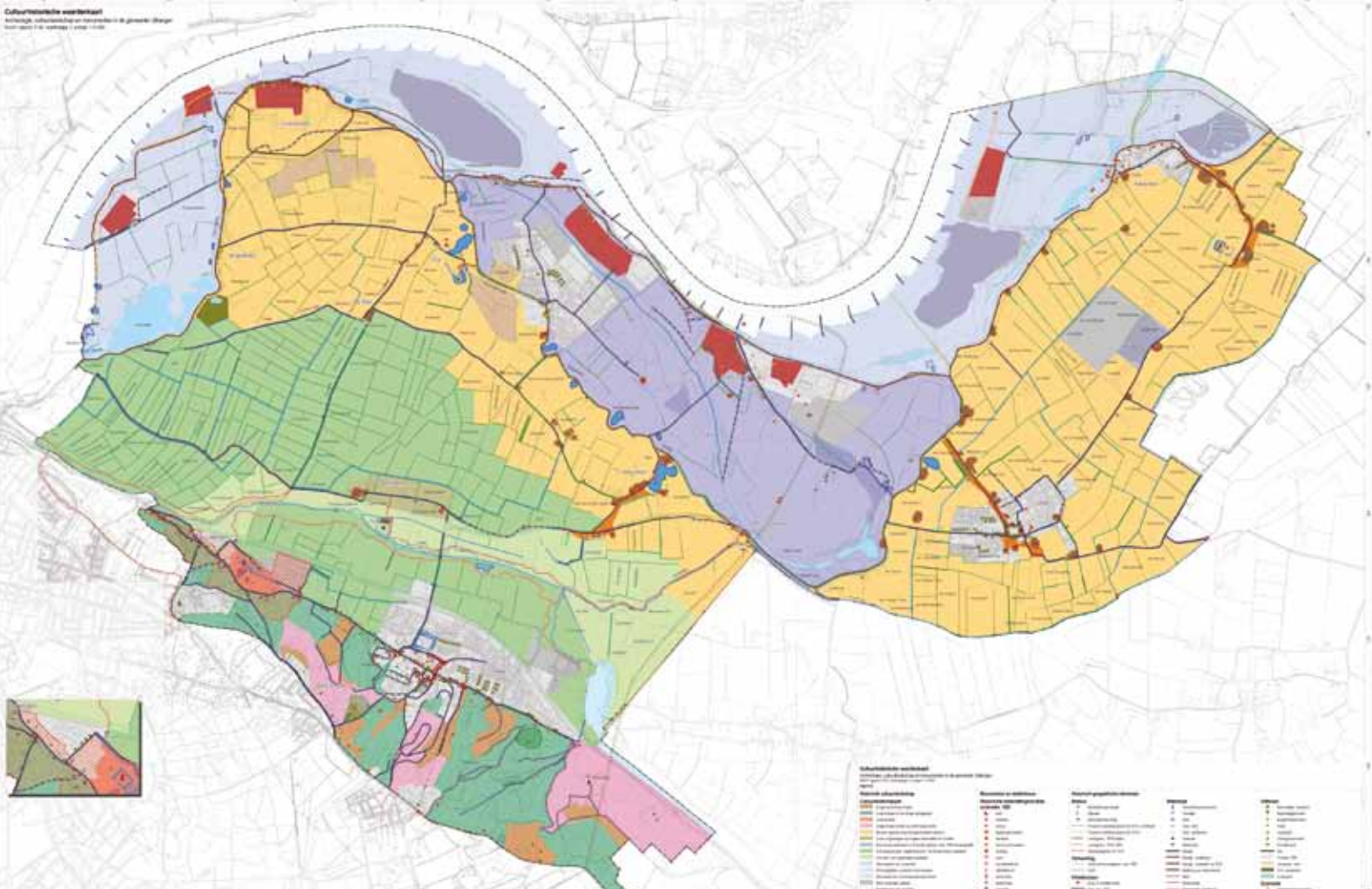
Inventorying and describing

If the overviews available at national, provincial or municipal level (Appendix 1) do not provide enough information, additional research may be useful. Ideally, a supplementary inventory should not be confined to the dykes themselves but should also look at elements and structures relating to the dykes and embankments and at their place and significance in the landscape and its development. .

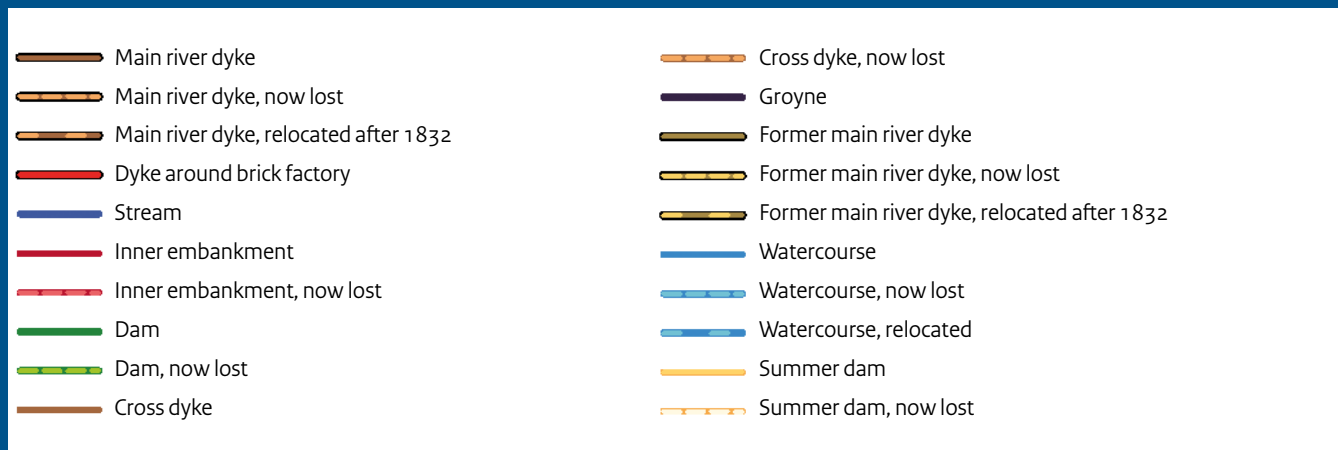
An inventory and a valuation?

Following an inventory of cultural heritage phenomena it is fairly common practice to assess their quality on the basis of valuation criteria such as rarity and recognisability. But is this always necessary? A valuation is in fact only required for proposed developments affecting heritage, such as an EIA prior to dyke reinforcement. Conditions, principles and development options can then be drawn up on the basis of the valuation. Nor is it always useful on the basis of a valuation to make absolute distinctions between heritage that is valuable/less valuable or worth preserving/less worth preserving. Valuable heritage does not need to be excluded from development – in fact, this can be quite inappropriate – and heritage that is of little value may even be enhanced through development. Heritage may often benefit from development that will ensure its preservation. Where a valuation is required, however, there needs to be transparency regarding the procedure and valuation criteria. When it comes to historical geography, there is almost no discussion of what valuation criteria should be used. It is therefore customary to proceed on the basis of the rarity, integrity, distinctiveness, coherence and age of the elements to be valued. Key qualities, and the valuation criteria used to measure them, are:

- perceived quality: visibility/recognisability and memorability
- physical quality: integrity, authenticity, level of conservation
- intrinsic quality: rarity, information value, legibility, coherence and representativeness.



Culture historical values map for the municipality of Ubbergen, with dykes listed in detail in the legend. The map also shows dykes that have since disappeared.



Culture historical values map for the municipality of Ubbergen

Structures of culture historical significance such as dykes can first of all be incorporated into municipal heritage policy. A key instrument here is the municipal map of culture historical values. A good example is the map for the municipality of Ubbergen, which has a comprehensive legend containing a wide variety of dyke types as well as dykes that have since disappeared.



Dykes along the Schipbeek at Holten.



Polders. On the left is the Beemster, drained in 1612, and above right the Schermer, drained in 1635. Both have a ring dyke and a ring canal. Between the two polders is a strip of older peat meadow where the village of Schermerhorn is located.

Inventorying: how far should you go?

A good inventory of dykes and embankments is one that clearly sets out the current function of each dyke. Is it a flood-defence dyke or a dyke relic? Which landscape elements are closely associated with it (e.g. vegetation, ditches)? The inventory should also outline what historical role the dyke played in local water management, what its location is and whether it is still recognisable as a dyke. Dykes that have not been preserved also need to be documented. To ensure that dykes are considered from the very start of the design process, the inventory needs to be as complete as possible, which means including dykes that have since disappeared. This may then prompt a decision to reconstruct a particular dyke for recreational or cultural heritage reasons.

Focus on management

Dykes managed by regional water authorities are regularly monitored and where necessary repaired. This mainly involves dykes and embankments with a flood-defence function. Responsibility for managing dyke relics usually rests with the landowner. Some dyke relics, such as those still used as catchment boundaries, continue to be managed by water authorities. Dyke relics are at greater risk of erosion and damage because their ability to withstand floods is no longer regularly monitored. Dykes that have lost their flood-defence function are less likely to be preserved. For municipalities in particular, it can be helpful to ascertain in consultation with water authorities which dykes and embankments are being managed and which are not in order to ensure ongoing compliance with flood protection standards for regional water defences.

Inventorying and valuing dykes for EIA

When compiling an inventory as part of the environmental impact assessment procedure, it is almost invariably useful to also carry out a valuation. A sound valuation of the baseline situation is essential for identifying the impact of dyke reinforcement or other spatial intervention on cultural heritage. A 2004 study has shown that a baseline measure of this kind is often missing from valuations conducted as part of an EIA procedure. Another concern is that a valuation should look not only at the quality of the dyke itself but also at the quality of associated elements and at the integrity of the whole.

Various guidelines and booklets have appeared on inventorying and valuing for the purposes of EIA. *The Handreiking cultuurhistorie in m.e.r. en MKBA* (Guidelines for cultural heritage in EIA and social cost-benefit analysis, Appendix 2) can be used for both flood-defence dykes and dyke relics. These guidelines explain in detail how cultural heritage can be allocated a proper place in EIA procedures involving an integrated impact assessment and valuation method for cultural heritage. Although not addressing dykes specifically, the compact factsheet *Cultuurhistorie in m.e.r.* (Cultural heritage in EIA, Appendix 2), published in 2010, does briefly outline the issues that should underpin a cultural heritage assessment within EIA. It points out the importance of first establishing what precisely will happen. In the case of dyke reinforcement, this may involve fairly limited interventions. The next step is to identify which cultural heritage values are involved in the dyke reinforcement or other spatial intervention. Does the project or plan have implications for



Zuiderzeedijk at the West Battery fort in Muiden.



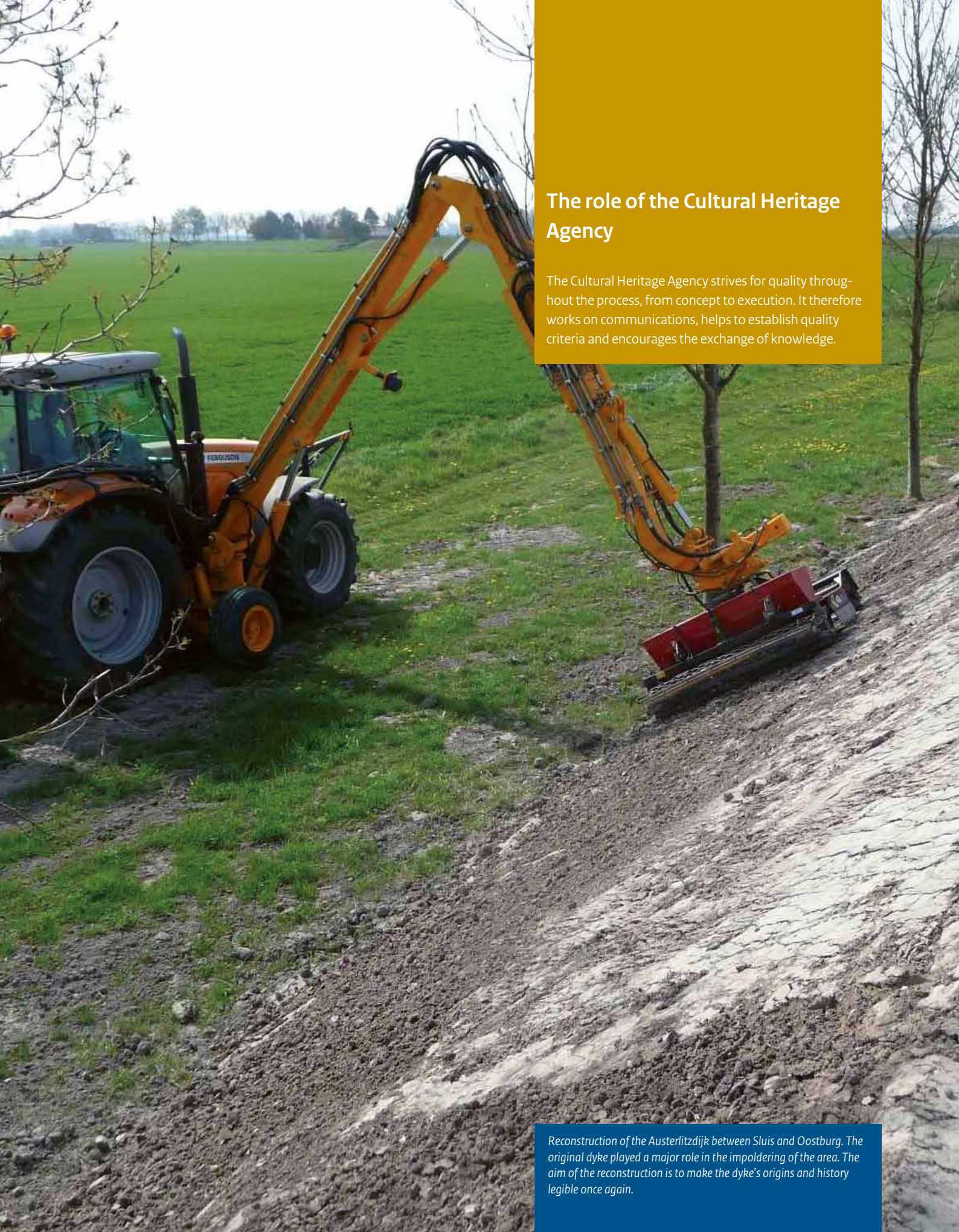
Above and right: the Schenkeldijk at Werkendam.

the soil archive, built monuments or cultural landscape values? It is important to know in advance whether the project outcome has already been established in detail or whether modifications are possible. The more room for manoeuvre, the less detailed the study for the EIA needs to be as the design can still be adapted in line with information that becomes available later.

Added value of archaeological research

If archaeological research is carried out on a dyke in relation to dyke reinforcement or another project, this does not of course have to be done independently of the historical-geographical inventory and valuation. Because written information about a dyke's history is often scarce, questions about such matters as dating and construction can only be answered by archaeological research. Methods commonly used by archaeologists, such as optically stimulated luminescence (OSL) and studies of plant remains obtained from soil samples, can yield information about the structure and phasing of a dyke and the earlier landscape at that site. A study of profiles in a dyke's cross section can also provide major added value because it generally reveals the remains of the oldest form of dyking as well as construction details for the rest of the dyke. Soil samples of the original surface can then also be taken, yielding information about landscape and land use from the earliest dyke phase and the period preceding it.





The role of the Cultural Heritage Agency

The Cultural Heritage Agency strives for quality throughout the process, from concept to execution. It therefore works on communications, helps to establish quality criteria and encourages the exchange of knowledge.

Reconstruction of the Austerlitzdijk between Sluis and Oostburg. The original dyke played a major role in the impoldering of the area. The aim of the reconstruction is to make the dyke's origins and history legible once again.

4 TOOLS FOR DYKE RESTORATION AND DESIGN

Given the key role played by dykes in the Dutch landscape it may be a good idea to restore or even reconstruct historical dykes. Any developments occurring at or around dykes also need to be carefully designed so that due respect is paid to cultural heritage. This chapter offers some useful guidelines in this regard.

Dyke restoration and reconstruction

One special kind of development is the restoration or reconstruction of historical dykes, in other words restoring damaged dykes or rebuilding dykes that have been levelled at same time in the past. Reconstruction is a sensitive issue in heritage management. A good deal of restraint is exercised, especially where built heritage is concerned. The biggest objections are that reconstruction may introduce falsifications and erase features showing a building's development.

However, there are several reasons why it could make sense to restore all or parts of dykes that have disappeared altogether. The reconstructed pole dyke at Nijkerk and seagrass dyke on the former island of Wieringen have an educational function as they show what the dykes used to look like. But also for recreational projects, nature development initiatives or projects designed to create more room for water storage, there can be reasons for restoring a lost dyke or making it more recognisable. Generally, the underlying aim is to make the dykes visible once again as defining structural elements in the landscape. The restoration of various line dykes that make up the States-Spanish Lines in Zeeuws-Vlaanderen has clearly shown up the relationships between the entire system of forts and lines. The restoration of line dykes in North Holland has also made them more identifiable. This has been achieved not only by repairing or reconstructing the earthworks, as happened at the Fort aan den Ham, but also by restoring the authentic vegetation, as with the line dykes at Fort Krommeniedijk. Both these forts are part of the Defence Line of Amsterdam (Stelling van Amsterdam). Several sections of lost inner dyke have also been reconstructed in western Zeeuws-Vlaanderen, such as the Austerlitz dyke between Sluis and Oostburg.

Partly damaged dykes with no flood-defence function are well suited to restoration. Small potholes and subsidence in the body of the dyke can be filled in, dyke ditches that were filled in can be excavated and rows of willows that have

disappeared from the foot of a dyke can be replanted. Restoration need not replicate the original situation exactly. Restoring the old profile may be undesirable for a variety of reasons and the visual value of a dyke may be enhanced by having a slightly lower crest height and/or a gentler slope. Examples here are the Reitdiep dyke at Oldehove and Garnwerd in the province of Groningen.

Towards a good dyke design

A good design is achieved by working through the right steps, and with the right design team. We will briefly discuss several key aspects of dyke design.

The design process

The process of coming up with a good design begins with a proper analysis. In addition to cultural heritage, this will address other aspects such as the natural environment, urban development and flood protection. The dyke is considered in its setting: it is part of a larger whole, a landscape pattern in which it has a certain significance. The present-day dyke is placed in a long-term perspective by answering the following questions: what changes has the dyke undergone in the past, how has this led to its current form, what will happen in the near future?

For larger projects such as reinforcing primary flood defences it is best to draw up a spatial quality framework. This is a separate document setting out the core qualities of the dyke and how they will be preserved or strengthened. It serves as a guide throughout the design process. By placing the framework and the purpose of the development alongside one another, you can reach a well-founded decision on a solution that takes all aspects into consideration. Once the solution is decided on, the design can be worked out in detail.

Lingewaard dyke zone

The report entitled *Inspiratieboek. Dijk als as van ontwikkeling* (Sourcebook. Dykes as axes for development) is a practical example of an effective approach to the culture historical value of dykes. A sourcebook to inspire nationwide renewal, it describes dykes as landscape zones and axes of historical and future economic development. It charts water tasking ('Room for the River'), ecology (National Ecological Network/EHS) and economics (including tourism, greenhouse horticulture and housing) and seeks to integrate them in a way that will offer promising solutions. The report presents ideas for spatial renewal, based on an area's own identity and geared towards achieving spatial quality and developing a new economy. This approach includes a provisional inventory and analysis of culture historical values to ascertain the impact of the dyke in question on its surroundings and on people's lives. Thematic inventory maps form part of this process.

The report highlights the metamorphosis of the Lingewaard landscape following the advent of the dyke. It looks at structuring elements in two periods – the natural patterns of fossil river courses from the period before the dyking and the patterns of flood defence and water discharge after that time. The report can be downloaded from the municipality's website at www.lingewaard.nl.

Dyke at Huissen, municipality of Lingewaard.



The design team

The secret behind a good design is having the right design team. You need an integrated team, one in which a spatial designer works together with a technical designer and if necessary a cultural historian, ecologist, water manager or other expert. The team's composition should reflect the nature of the project. If the environment is central to the project or if the dyke has important natural values, environmental expertise must be well-represented in the team. A pitfall with projects involving dykes is that technological know-how tends to predominate and cultural heritage and landscape are not given enough attention. With an integrated team this pitfall can be avoided. Another danger is coming up with solutions that are unworkable through lack of money and manpower, which makes them unsustainable in the long term. This problem can be avoided if the people who are ultimately responsible for managing the area are involved in the design process from the outset.

A design that respects cultural heritage

There are many aspects that should be considered when devising a dyke design that does justice to cultural heritage. Here are just two of them.

Continuity

The continuity of dykes in this country is coming under increasing pressure through their sheer length and the fragmentary nature of their ownership and management. Modifications are often made to a small section of a dyke's course which is actually part of a larger entity, thereby disturbing the unity of the dyke. Preserving a dyke's continuity along a greater length makes the history more legible and enhances the quality of the landscape.

Character

A dyke's character is determined by its most salient spatial features (e.g. a sharply winding dyke with a steep slope) and how the dyke has evolved over time. In a design you always have to ask to what extent cultural heritage values should be preserved and how much scope there is for development. Also, is there a technological challenge, how significant is the site's cultural heritage, what is the dyke's function? This broad context allows proper consideration to be given to arguments for preserving or developing the dyke so that the right decision is made regarding development.

Restoration of a cut in the old dyke between the Nieuw-Westenrijk and Van Wyckhuise polders in Hoek (Zeeuws-Vlaanderen). Supervised by a contractor, volunteers from the Stichting Landschapsbeheer Zeeland restore the paving of the cut.



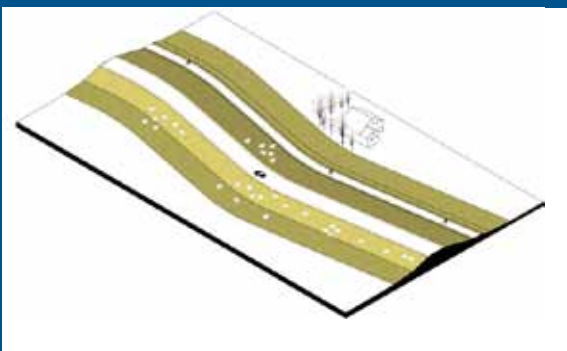
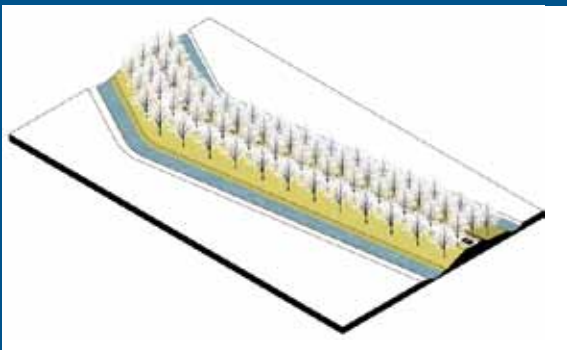
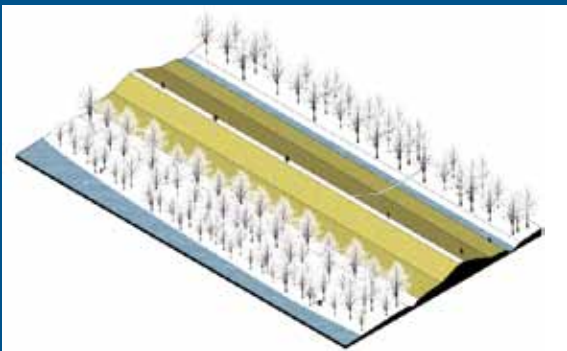
Dyke reconstruction in Zeeuws-Vlaanderen



IJsselmonde Dyke Atlas

The IJsselmonde Dyke Atlas is the result of design research into the spatial possibilities of dykes on the island of IJsselmonde. This study looks at new forms for old dykes. First, it maps out the existing network of dykes and investigates how the current water regime and dykes can be used to accommodate future water tasking. It then investigates how the remaining dykes can enhance the recreational and ecological network on IJsselmonde. Finally, it explores the value of the dykes as a living environment. The study can be found at www.eilandijsselmonde.nl.

Different types of dykes.



Current dykes at IJsselmonde.





Reconstruction of a section of a pole dyke at Bunschoten.



The Hondsbossche sea wall.

APPENDIX 1: EXISTING OVERVIEWS OF DYKES

Overviews are indispensable for establishing the cultural heritage value of a dyke or a dyke section or component. Oddly, there is no clear, comprehensive overview that shows all Dutch dykes and embankments, explains who manages them and describes their cultural heritage value. The Netherlands boasts many thousands of kilometres of dykes but there is still a lot we don't know about them. For example, we don't know how old some dykes are or how recognisable they are in the landscape. It is therefore no easy task to compile useful, high-quality overviews of dykes, including details about their history, function, changes in function and current condition. Nevertheless, some helpful maps have since come available, each with a selection of dykes based on their own criteria.

The overviews vary considerably because of the purpose for which the maps were compiled, the sources used and the date of compilation. Some relate to individual dykes that may or may not be part of a particular system. Others relate to larger areas, with some maps showing dyke systems while others do not (e.g. north Groningen). In other words, even when combined these maps still do not show a complete picture of historically relevant dykes and embankments in the Netherlands.

National overviews

Published in 1977, the *Cultuurwaardenkaart van Nederland* (Cultural heritage map of the Netherlands) (1:250,000), is a national overview showing dykes of cultural heritage significance. The map is part of the Bolwerkgroep inventory, a first attempt to map out all important cultural heritage elements and structures in the Netherlands. The Bolwerk map is far from complete, however, and has never been enshrined in policy. Another overview appeared in 2001 as part of project 33 in the nature policy plan of the Ministry of Agriculture, Nature and Food Quality. The report *Ontgonnen Verleden* (Reclaimed past, Baas et al., 2001) contains 76 dykes of national significance. It is a top-down selection based on function; in other words, it is not an overview of all major dykes.

A large number of dykes and embankments which are significant from a cultural heritage point of view can be found in *Cultgis*. Although based on the *Topografische Kaart Nederland* (Topographical Map of the Netherlands, 1:10,000), *Cultgis* provides information at various levels. Firstly, it presents a historical geography profile at national level (landscape types and sublandscapes). The second level comprises more specific regional descriptions organised by province and includes historical-geographical areas that are regarded as being of national significance. At the lowest level we find specific elements and patterns, including dykes and embankments. It is a selection of characteristic objects and not a complete and comprehensive resource. Because *Cultgis* has been compiled from various datasets, such as provincial cultural heritage maps, it is underpinned by different selection criteria. The result is that some parts of the country are remarkably empty. *Cultgis* also contains relatively many individual segments of dykes and it is not clear to what extent they form part of spatially coherent systems. Nor is it possible to make out whether the dykes are still visible in the present-day landscape.

Another overview featuring dykes of cultural heritage significance is the *Archeologische Monumenten Kaart* (Archaeological Monuments Map, AMK), which can be downloaded from www.cultureelerfgoed.nl. It shows dykes that are designated as sites of archaeological significance, which means it is a selection rather than a comprehensive resource. And unless you consult the accompanying descriptions, it is impossible to know to what extent the dykes are still recognisable as such.

Two other national overviews relate to polder maps rather than dykes. *The monograph Polders! Gedicht Nederland* (Geuze and Feddes, 2005) is a comprehensive study of many aspects of polders, including ones unrelated to water management. It takes a typological and chronological approach to land conservation and reclamation. A range of sources, such as provincial water management histories, were used to compile the book, which reflects the situation in about the year 2000. With the exception of polders adjacent to higher land, most polders are entirely enclosed by dykes, which means that the maps in this atlas provide an indirect indication of where dykes are located. However, it does not show whether these dykes are still identifiable as such in the landscape.

The *Polderatlas van Nederland* (Polder atlas of the Netherlands, Steenbergen and Reh, 2009) is the most recent and most ambitious study of Dutch polders. Its primary concern is polders, but given that polder boundaries – according to the atlas – in most cases consist of dykes, it also shows dykes (or ‘hydraulic engineering design features’). The objects listed in the legend include polder dykes, fixed water-level area dykes, storage basin dykes, outer dykes, dykes outside the outer dyke (e.g. summer dykes) and functionless dykes. The atlas mainly shows the situation in about 1850. For the period thereafter, it features only the most important land reclamation works and does not include any changes to polder boundaries. Anyone using the map should therefore bear in mind that it does not reflect the current situation. The dykes are shown on 35 map sheets, on a scale of 1:100,000, which is suitable for the purpose of regional and local analyses. The atlas clearly sets out the procedure used and the sources of information. Because the maps show the period from 1850 to 1900 rather than the present situation, the level of visibility of the dykes cannot be read from them.

A new dyke atlas for the Netherlands, with substantial input from the Cultural Heritage Agency, is scheduled for late 2014. It will contain more detail than the dyke and polder atlases published earlier and will also appear in English.

Provincial overviews

Each province has its own cultural heritage map showing the most important objects and structures. The different provinces use different selection criteria to compile their maps. They also adopt different policy with respect to old dykes and embankments. Most maps are available on the internet. The provincial values maps have been in existence for some years and some have already been updated and/or upgraded. The province of Overijssel (2012/2013) is currently working on a fully revised map that includes dykes as important structural elements.

Municipal overviews

For a growing number of local authorities there are overviews available showing the cultural heritage values within their territory. The number of such maps at municipal level is expected to rise still further now that local authorities are obliged (since 1 January 2012) to specify how they have taken cultural heritage into consideration in their land use plans. As with provincial values maps, there is no fixed standard for the municipal maps. This has led to a wide variation in how dykes and embankments are mapped, as well as in the objects listed in the legend. Sometimes only the dykes have been taken from the provincial map, but there are also good examples where information has been included from overviews at a supra-municipal level, accompanied by a legend with a strong emphasis on dykes. A good example of a dyke overview at municipal level is the archaeological predictive model and cultural heritage map of the municipality of Ubbergen, updated in 2010 (Appendix 2). This provides a separate legend for water management, with no fewer than 14 kinds of dykes, including dykes that have since disappeared. The cultural heritage map of the municipality

of Woerden does not classify dykes to the same extent in its legend, but it does show dykes that are missing from the national and provincial overviews.

Regional studies

In addition to overviews at national, provincial and municipal level, there are many monographs available containing regional overviews. Examples are the online dyke atlas of the island of IJsselmonde, which looks at design aspects, and two reports published by the Stichting Dorp, Stad & Land – *Cultuurhistorie aan de Oosterscheldedijken* (Cultural heritage of the Oosterscheldt dykes, 2008) and *Cultuurhistorie Zeeweringen Westerschelde* (Cultural heritage of the Westerscheldt sea defences, 2011), containing inventories and valuations of historical elements on and near dykes. More information about earlier dyking technology and the history of specific dykes can be found in academic publications such as dissertations and numerous articles. See Appendix 2 for a small selection from the available literature.

APPENDIX 2: FURTHER READING

Bijker, W. E. 2007.

American and Dutch Coastal Engineering: Differences in Risk Conception and Differences in Technological Culture.
Social Studies of Science 37/1 (February 2007) 143-151.

Cultural Heritage Agency.

Archeologische Monumenten Kaart (AMK)

www.cultureelerfgoed.nl.

Cultural Heritage Agency 2013.

Cultuurhistorisch onderzoek in de vormgeving van de ruimtelijke ordening. Aanwijzingen en aanbevelingen.

www.cultureelerfgoed.nl

Cultural Heritage Agency

Handreiking erfgoed en ruimte.

www.cultureelerfgoed.nl > handreiking erfgoedenruimte

Cultural heritage map municipality of Ubbergen.

www.ubbergen.nl > internet > monumenten-en-archeologie

Dijkzone Lingewaard. De rivierdijk als structuurdrager.

www.cultureelerfgoed.nl > handreiking erfgoedenruimte > praktijkvoorbeelden > dijkzone-lingewaard

Geuze, A.H. & F.M. Feddes 2005.

Polders! Gedicht Nederland.

NAI, Rotterdam.

Kraker, A.M.J. de 2011.

Sustainable coastal management, past, present and future or how to deal with the tides.

Water History vol. 3, no. 2, June 2011, 145-164.

Kraker, A.M.J. de 2006.

Flood events in the southwestern Netherlands and coastal Belgium, 1400–1953

Hydrological Sciences–Journal–des Sciences Hydrologiques, 51(5), 913-929.

Metz, T. M. van den Heuvel 2012

Sweet & Salt. Water and the Dutch.

NAI publishers, Rotterdam

The Netherlands Commission for Environmental Assessment (NCEA) 2010.

Cultuurhistorie in m.e.r.

Factsheet no. 17.

www.commissiemer.nl

Projectbureau Belvedere 2010.

Peilwarden. Omgaan met erfgoed in actuele wateropgaven.

Matrijs, Utrecht.

Projectbureau Belvedere 2004.
Blauwe Tradities. Inspiratieboek water en cultuurhistorie.
Projectbureau Belvedere, Utrecht. www.belvedere.nu

Rijkswaterstaat 2011.
Water Management in the Netherlands.
www.rijkswaterstaat.nl/en

Rijkswaterstaat 2007.
Kunstwerken van Waterstaat. Naar een Cultuurhistorische Inventarisatie en Waardering van Waterstaatsobjecten.
www.scribd.com/

Rijkswaterstaat 2007.
Langs weg en water. Overzicht van historisch-bouwkundige, historisch-geografische en archeologische waarden binnen en langs de beheergrenzen van Rijkswaterstaat.
www.rijksverheid.nl

Ruijgrok, E.C.M. & D.J.F. Bel 2008.
Handreiking cultuurhistorie in m.e.r. en MRBA.
Rijksdienst voor het Cultureel Erfgoed & Projectbureau Belvedere, Amersfoort. Via www.cultureelerfgoed.nl

Technische Adviescommissie voor de Waterkeringen (TAW) 1994.
Handreiking Inventarisatie en waardering LNC-aspecten.
TAW, Delft.

Ven, G.P. van de (ed.) 2004.
Man-made Lowlands, History of Water management and land reclamation in The Netherlands.
Matrijs, Utrecht, 4th edition.

Vereniging voor Waterstaatsgeschiedenis
Tijdschrift voor waterschapsgeschiedenis.
Verloren, Hilversum.
With the exception of the most recent issues, available via www.jydn.nl/pages/WG/oo.html

APPENDIX 3: USEFUL LINKS

Netherlands Commission for Environmental Assessment (NCEA)

The NCEA website contains information on dykes featuring in plans for which an EIA has been or will be compiled.

www.commissiener.nl

Dyke atlas of the island of IJsselmonde

Design study of the spatial possibilities of the dykes on the island of IJsselmonde.

www.eilandijsselmonde.nl/

Een dijk van een landschap

Website with stories about dykes.

mtilstr1.wix.com >

IJ dykes route

Experience historical dykes by means of a 40-km long walking and cycling route.

www.ijdijkenroute.nl

Provincial support centres

The addresses of provincial support centres can be found on www.monumenten.nl.

Provincial maps of cultural heritage values

Friesland

www.fryslan.nl/chk

Gelderland

ags.prvgld.nl > GLD.Atlas

Groningen

www.provinciegroningen.nl > loket > bibliotheek > publicaties > meer-informatie > _publicatie > cultuurhistorische-waardenkaart/

CD-ROM with three maps (2004). Can be ordered free of charge.

Limburg

www.limburg.nl > Beleid > Kunst_en_Cultuur > Cultureel_erfgoed > Cultuur_Historische_Waardenkaart_Limburg

North Brabant

<http://brabant.esrinl.com> > chw

North Holland

<http://maps.noord-holland.nl> > extern > gisviewers

Overijssel

<http://gisopenbaar.overijssel.nl> > website > cultuurhistorie

Utrecht

www.provincie-utrecht.nl > loke > kaarten > geo > cultuurhistorie

Zeeland

<http://zldags.zeeland.nl> > geoweb > geowebinternet

South Holland

The dykes are organised along historical landscape lines.

<http://geo.zuid-holland.nl> > geo-loket

Cultural Heritage Agency

The Cultural Heritage Agency is the national knowledge institute for moveable, archaeological, built and green heritage. It is part of the Ministry of Education, Culture and Science.
www.cultureelerfgoed.nl/en

Dutch Association of Water Authorities

The umbrella body of regional water authorities.
www.waterschappen.nl

Water heritage

Website containing general information about water-related heritage other than dykes.
www.watererfgoed.nl

Pole dyke at Bunschoten

Website of Vallei en Veluwe water authority containing information about the reconstructed pole dyke at Bunschoten.
<http://www.palendijk.nl>

Westfriese Omringdijk

www.omringdijk.nl

COLOPHON

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Siebe Swart: p. 26, 36

Stichting Archeologie West-Friesland: 34R, 35

Stichting Vrienden Zwartenhoek: 45L

DLA + rural and urban Architects: p. 44

LOLA Landscape Architects: p. 46

Robert Breed: p. 32

Bert van As: p. 11, 64

Waterschap Hollandse Delta: p. 19 (B/W photo)

Dienst Landelijk Gebied Joera de Moree: p. 42, 45R

Gemeente Ubbergen, RAAP Archeologisch Adviesbureau: p. 38

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