

## DUTCH LOWLANDS

The Dutch delta is a reclamation landscape. It has undergone several transformations since the Middle Ages to become an inhabitable, beautiful and unique cultural landscape. Many factors that determine the spatial quality of the future urban landscape are directly connected with the formal properties of the polder landscape of the Dutch lowlands.

The form of a landscape is no accidental or random phenomenon, but the result of a transformational process that can also be called a formal process when seen in terms of form. Knowledge and understanding of the basic forms are instrumental in the design of the new landscape and presented in this unique publication on the Dutch Lowlands.



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# DUTCH LOWLANDS

Morphogenesis of a Cultural Landscape

Saskia de Wit

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Morphogenesis of a Cultural Landscape

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*graphic design:* OPVIS

*production:* Ton van Lierop, Nico Buitendijk, SUN

*publisher:* Martien de Vletter, SUN

Landscape complexes of the Dutch lowlands is part of the research program of the department Landscape architecture of the faculty of architecture at the Delft University of Technology, lead by Professor Dr. Ir. C.M. Steenbergen and Dr. Ir. W. Reh. This research was made possible in cooperation with the Nieuwland Erfgoedcentrum in Lelystad.



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ISBN: 978 90 8506 7351



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# Differentiation and Cohesion in the Landscape

*Wide the sky and steely grey,  
Above the wondrous lakes and fens;  
Greenhouses, trees, mills, spires, penned  
By ditches silver-grey.*

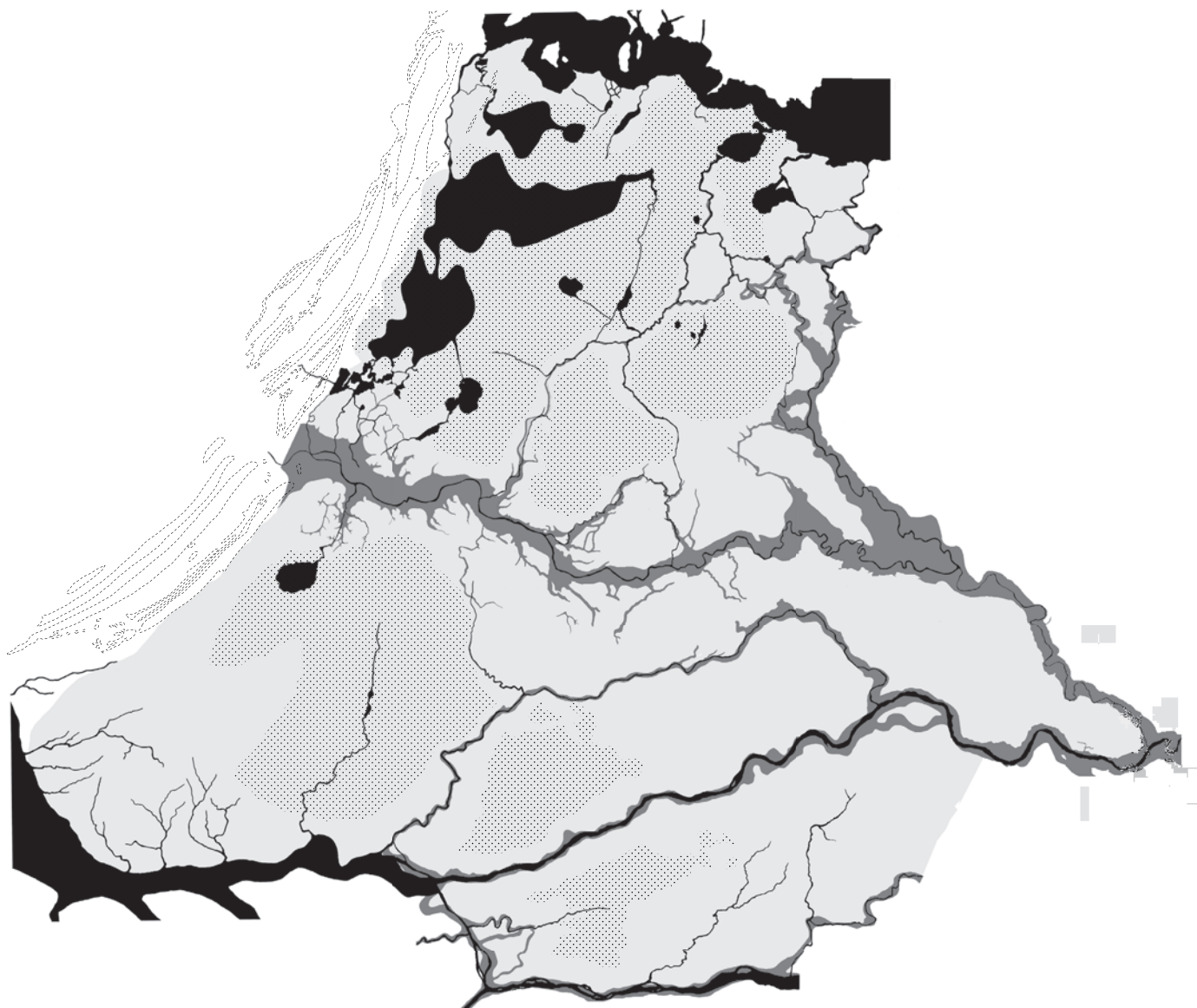
H. Marsman, *Holland*, 1931.

## THE FORM OF THE CULTURAL LANDSCAPE AS THE BASIS FOR THE DESIGN OF THE DELTA METROPOLIS

The Dutch delta is a reclamation landscape. It has undergone several transformations since the Middle Ages to become an inhabitable, beautiful and unique cultural landscape. A peat reclamation landscape was created from the natural landscape. This was followed by a lake-bed polder landscape, then a land consolidation landscape. The fifth stage, the urbanised delta, began a couple of decades ago. Many factors that determine the spatial quality of

the future urban landscape, such as infrastructural claims, a drastic reform of water management, and the anchoring of nature in the urban network, are directly connected with the formal properties of the polder landscape of the Dutch lowlands. Knowledge and understanding of the basic forms are instrumental in the design of the new landscape.

The form of a landscape is no accidental or random phenomenon, but the result of a transformational process that can also be called a formal process when seen in terms of form. All morphogenetic, technical, functional, cultural and architectural aspects are expressed in the form; the form of the



The Form of the Natural Landscape as the Product of Sea, Rivers and Peat

landscape incorporates all other aspects and is the expression of their organisation. The explanation of the form of the landscape is the description of the logic of this organisation and of the transformation, the development of a new form from the existing one.

Seen from this perspective, the landscape can be viewed as an organisation of interrelated spatial phenomena. Knowledge of the form of the landscape grows in importance as the programme becomes more general or the programmatic changes become more uncertain. It is then an instrument to interpret the process and to be able to scrutinise possible combinations in the light of the form.

The form of the landscape can be broken down into different layers, which are expressed in a landscape architecture design in four formal ways: the basic form, the spatial form, the visual structure, and the programmatic form. The form of the landscape is based on the basic form, the rationalisation of the topography, in which the interaction between reclamation and natural landscape is expressed. The spatial, visual and programmatic layers (agrarian and infrastructural, but above all hydraulic) are closely connected with this and play an implicit role,

but the emphasis in the present inquiry is on the basic form, in this case the form of reclamation.

## SCALES

Distinguishing the different scales is instrumental for a systematic analysis of the morphogenesis and formal diversity of the Dutch polder landscape. When the form of the ground plan is taken as the starting point, the smallest components of the lowlands are the reclamation units or parcels. These form different patterns depending on differences in the natural subsoil, administrative relations, economic and political conditions, and the stage of technological progress.

On the regional scale complexes can be distinguished with a geographical and morphogenetic coherence. Each of these landscape complexes is defined by a unique configuration of its landscape components and the different types of reclamation. All the landscape complexes of the central Dutch delta consist of a constellation of drained lakes embedded in older peat reclamation areas. However, regional differences can be detected: for instance, the Waarden of South Holland form a continuous





The Form of the Reclamation Landscape as a Man-made Transformation of the Natural Landscape

carpet of peat reclamation polders, while the peat reclamations in the Haarlemmermeer complex have been left on the margins as relics of the past. The landscape complexes indicate a geographical cohesion as they are the product of the reclamations as a spatial arrangement.

The demarcation of the landscape complexes is determined on the basis of the natural subsoils related to the history of reclamation. We can take the example of the peat streams the Amstel and the Rotte: although similar in nature, each plays an entirely different role within its landscape complex. The Amstel forms a border, while the Rotte is the heart of a complex. Both peat streams originated in the middle of a peat cushion, but the Amstel was later artificially extended to the IJ and has thereby become a boundary. The Rotte is the central drainage channel of the peat reclamation polders around it.

The interaction between form of reclamation and natural landscape can best be seen in the various patterns of reclamation. These are smaller, not always strictly demarcated configurations within a landscape complex with a common morphological basis. Like the landscape complexes, they are determined on the basis of the natural subsoil related to

the history of reclamation, but they can be distinguished from one another above all on the basis of the characteristics of their pattern. They show the stages and orientation of the reclamations of the whole complex as an expression of the temporal sequence. The analysis of these patterns of reclamation is primarily concerned with the genesis and process of the landscape, the sequence of the reclamations, and the emergence of the complicated pattern of the landscape complexes. Spatial demarcation is less relevant here than a temporal periodisation as part of an ongoing process.

## GENESIS AND DEVELOPMENT

The lowlands are the triangular delta wedged between the ice-pushed ridges of the Veluwe, the Utrechtse Heuvelrug, Nijmegen, and the sandy soils of Salland and Brabant. It is the product of sea, rivers and peat. The surface is composed of sediment from the rivers which continually branch as they seek a route to the sea. The triangular form of the delta is connected with this forking of the rivers. Behind the coast a belt of dunes was formed by the system of currents in the North Sea and the mass of material that it transported. As the sea continued



The Form of the Urbanised Delta, an Ongoing Transformation of the Reclamation Landscape



to rise, a freshwater lagoon was created behind the dunes, which developed to become an extensive peat bog.

In the Dutch lowlands the sea, rivers and peat have determined the form of the landscape in continuously shifting constellations; each of these influences predominated almost everywhere for a shorter or longer period until human intervention stopped the process at a certain point.

The form of the landscape is determined by the reclamations. In what was originally a relatively homogeneous peat bog, the different types of reclamation led to the emergence of different landscape patterns. The characteristics of the natural landscape such as the composition of the peat – which determines its usefulness as fuel –, the proximity of the sea or rivers, or the thickness of the peat cushion, found expression in different types of reclamation: drained, or poldered, or drained, stripped of peat and then poldered. Some of these landscapes were reclaimed again in the twentieth century in the land consolidation polders. The peat reclamation, peat extraction, lake-bed and land consolidation polders as well as the sporadic living peat bogs are the components which, in different combinations, confer its unique character on each landscape.

The first chapter deals with the Grote Waard. This waard complex no longer exists, but in the Middle Ages it was a coherent polder complex until a combination of human intervention and natural forces destroyed it. The history of this landscape is complex and not all of the details can be traced. All the same, a reconstruction has been attempted to provide deeper insight into the relation between the geogenesis – the natural history of its emergence – and its cultural technical adaptation.

The former Grote Waard can be understood in two ways in the total landscape of the delta. In the first place it is a unique landscape in that the present landscape has been formed by natural forces without the geometry of the cultural landscape being projected on top of it. It could be said that the layer of the cultural landscape actually lies underneath rather than on top of the natural landscape. In that sense this landscape offers insight into the first stage of the development of the surrounding cultural landscapes of Holland and into the natural factors that have determined its geometrical composition. In the second place, its tumultuous history, which results in clearly distinguishable stages in the history of its reclamation, provides a clear picture of the development in the Dutch reclamations. It thus provides a framework for the analysis of the current



In the central part of the Dutch Lowlands, between Amsterdam, Rotterdam and Utrecht, the transformation of the polder landscape into an urban landscape is already at an advanced stage. Knowledge of the polder landscape is urgently required in order to direct this process.







landscape complexes in which different forms of reclamation lie like layers on top of one another and are interwoven.

## LANDSCAPE COMPLEXES OF THE DELTA

The following chapters deal in detail with the landscape complexes of the central part of the delta: the Waarden of South Holland, the Rhine-IJssel complex, the Rhine-Vecht-Drecht complex, Central Holland, and the Haarlemmermeer complex. Here, in the heart of the western agglomeration known as the Randstad, between Amsterdam, Rotterdam and Utrecht, the transformation of the polder landscape into an urban landscape is already at an advanced stage. Knowledge of the polder landscape is urgently required in order to direct this process. These chapters are concerned with unravelling the cultural landscape as a mosaic of different reclamations in the light of the background of their geomorphological cohesion.

The complexes are described more or less in order of complexity. The first, the Waarden of South Holland, did not undergo any major transformations after the

first transformation of the peat reclamations. In the case of the last, Central Holland and the Haarlemmermeer complex, the pattern of the first transformation has largely disappeared as the result of poldering, so that the connection between the present topography and the original natural landscape is of a more layered and indirect kind.

The landscape complexes are described on the basis of two factors: the geogenesis resulting in the basic natural form; and its cultural technical adaptation resulting in a unique configuration of different forms of reclamation. Use has transformed the basic natural form, determined by wind and water, into an efficient and geometrical cultural landscape. The tension between the basic natural form and the geometrical pattern is constantly present.

The relation between the basic natural form and the cultural technical adaptation brings to light the specific spatial characteristics of the different landscape complexes. There are three forces at work in shaping the natural landscape of the lowlands in the Netherlands: sea, rivers, and the stagnant water in between – the peat bog. The relations between these three factors are constantly changing. Each chapter describes the natural landscape on the basis of these three formative forces. To understand the eventual

form of reclamation, it is important to know by whom, when and why the different reclamations were carried out, in other words, the historical and administrative background. This provides the background information for the diffusion of the different forms of reclamation within the complex. To obtain insight into the interaction between the different factors, the analysis zooms in on the patterns of reclamation, which reveal how basic natural forms, the history of reclamation, and the configuration of the different forms of parcellation have influenced one another and led to the topography that we see today.



# Historical Cohesion and Breakdown. An Example: the Grote Waard

*So after nothing had been done about dikes or sluices for years, at a time of general exhaustion, indifference, administrative stagnation and embitterment – that was when, on the night after St Elizabeth's Day (17/18 November) 1421 a tremendous storm took place which caused houses in Tiel to collapse, inflicted serious damage on the North Sea coast, and caused several breaches of the dikes in Flanders, Zeeland and Holland – but in particular caused a large breach at the most vulnerable point of the Grote Waard dike (at Broek en Wioldrecht on the Wijkeveen). It must indeed have been a major catastrophe.*

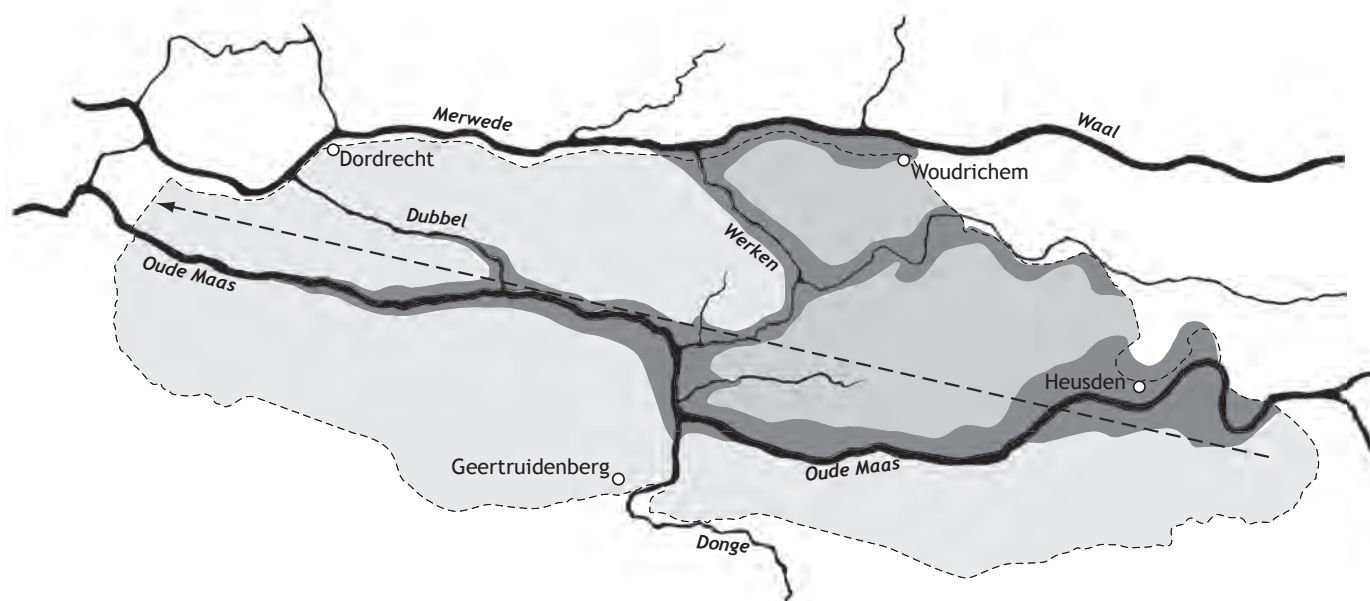
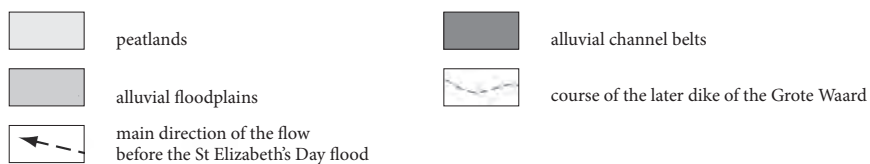
S.J. Fockema Andreae, *De Grote of Zuidhollandse Waard*, 1950.

## DEMARCATIION OF THE AREA

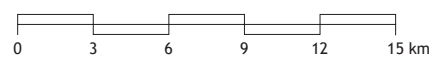
In the Middle Ages the Grote Waard was a coherent landscape complex on the border of the provinces of Brabant, Zeeland and Holland until it was swallowed up by the sea during the St Elizabeth's Day flood of 1421. The region was drastically changed as a result. Before the flood it was an area of 40,000 hectares that was bounded on three sides by water: by the Nieuwe Maas in the East, by the Merwede in the North, and by the Dubbel and several of the Zeeland tidal inlets in the West. To the South was a large peat landscape that extended to the sandy soil of Brabant. The southern boundary ran through this peat landscape.<sup>1</sup> It was an artificial unit cre-

ated by the concentration of a number of existing *waarden* (polders that are entirely enclosed by rivers) and a strip of peat landscape wedged between the Maas and the Pleistocene sand of the Brabantse Wal.

After the flood the (organisational) cohesion was destroyed for ever. The western part formed the core of the dike system of the Hoeksche Waard and the western boundary is now formed by the Dordtse Kil. Most of the dike through the Brabant peat soil has disappeared, the Langstraat and Lage Veenzijde now merge into the sandy soil of Brabant without any clearly visible boundary. The remaining



## The Natural Landscape



area can be broken down into several zones each with a character of its own.

## THE NATURAL LANDSCAPE

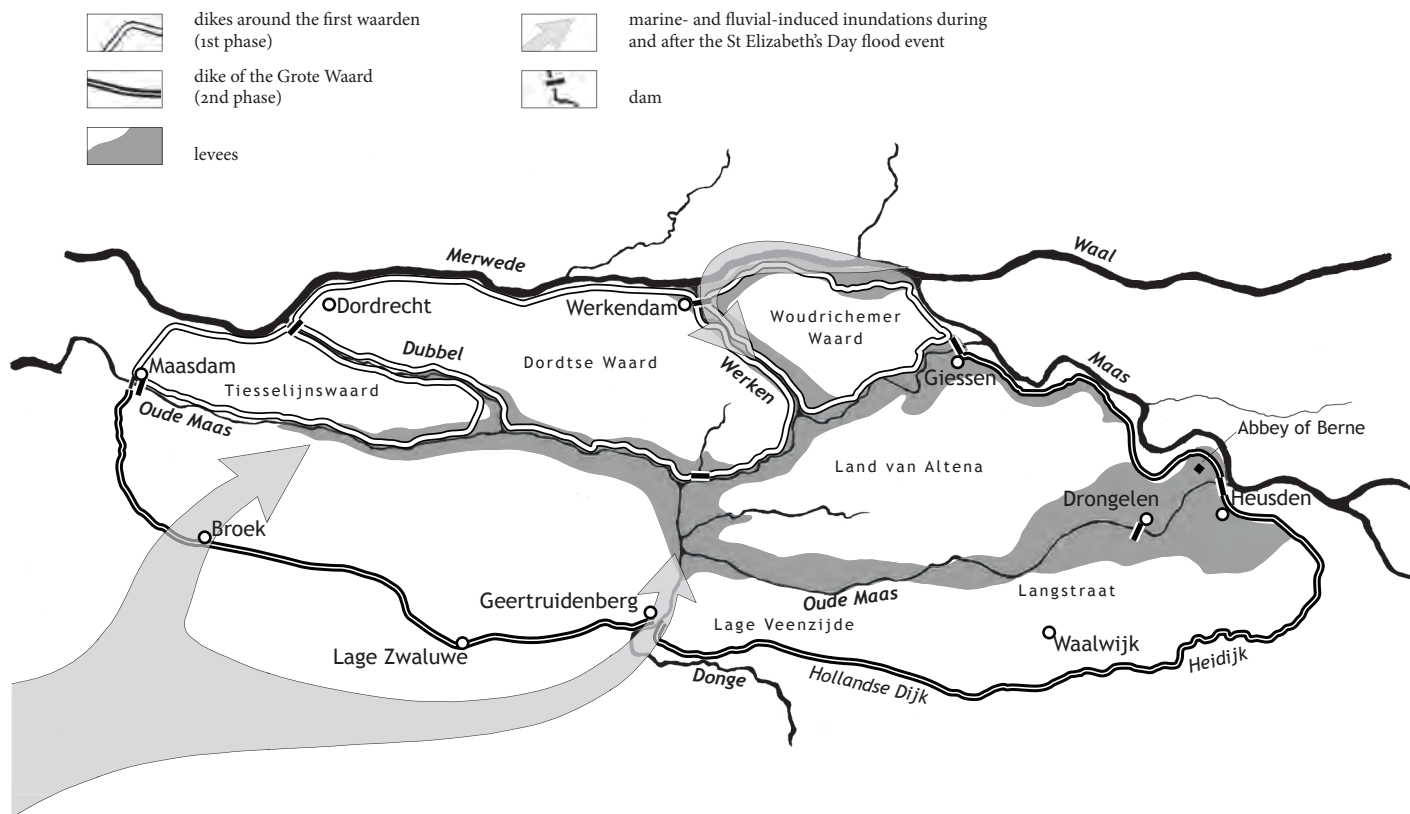
In its lower reaches, the riverine system of the Netherlands is influenced by the tides. Here the rivers are bounded by relatively high dikes and form part of the surrounding peat and sea-clay landscape. The upper reaches are virtually free of tidal influence; here the rivers have large flood meadows with wide and tall levees.<sup>2</sup> A further distinction can be drawn in the lower reaches between the area with marine deposits, and further eastward a perimarine area that is influenced by the tides but does not have any marine deposits. In the lee between the sea and the rivers the conditions were favourable for long-term peat growth. The Grote Waard contains all three types; it is a hinge between the maritime and the riverine systems.

**PEAT** The sea level began to rise under the influence of the warmer climate after the Ice Age. The corresponding rise in the level of the groundwater drowned the Pleistocene sand and the process of peat formation began. A freshwater, marshy envi-

ronment arose in which each layer of dead plants sank down on top of the others. The lack of oxygen caused the material to only partly decompose, resulting in a layer of peat. During periods when the water level was high, a thin layer of clay was deposited, resulting in alternating layers of clay and peat. Beside the levees of the Maas a narrow strip of nutrient-rich peat arose, which rapidly merged into a fairly thick layer of nutrient-poor peat. The process came to an end towards the start of the first millennium.

**RIVERS** The rising sea level caused the river beds to rise as increasing layers of sediment were deposited. The area became a part of the delta.<sup>3</sup> The sedimentation of the river courses was limited at first, but later levees, ridges and basins were formed, especially in the East. The levees and alluvial ridges were formed because coarse material was deposited close to the riverbed during high water periods. The finer material was deposited further away in the basins. In this way the ground immediately beside the riverbed and the bed itself were raised the most. In the course of time the bed grew so high that the river breached its own levees and sought a new course. The former course left its trace in the landscape as an alluvial ridge: the sedimented riverbed with its flanking levees.<sup>4</sup>





First Reclamation: Colonisation



## FIRST RECLAMATION: COLONISATION

The occupation of the original natural landscape took place in a number of stages. Because every new wave of reclamation caused a drop in the ground level in relation to the water level, new interventions were required each time to ensure the proper functioning of the drainage system. However, these new interventions were unable to prevent the system from growing increasingly vulnerable.

**WAVES OF RECLAMATION** The earliest wave of reclamation in the riverine area was on the levees, which were gradually brought under cultivation from East to West by local agrarian communities. A new wave of more systematic reclamation in the opposite direction commenced around 1000. Ditches were dug at a short distance from one another to channel the water into the rivers. At first arable farming was practised, but drainage and oxidation caused the peat to compact so quickly that it was only suitable as meadow and hay land. When this happened, new patches of marsh further inland were reclaimed and building followed.

A low weir protected the fields from the water of the higher peat marsh, while the sides were protected from descending water flows by transverse weirs. The result was a number of small units serviced by a river dike, a peat dike and two transverse weirs. Drainage proceeded naturally, which was no problem when the peat was still high, but became one when the substratum of basin clay came to the surface. By the twelfth century the ground level had sunk to such an extent that the farmers had to collaborate on diking the polders. These dikes were maintained per shire.<sup>5</sup>

**URBAN DEVELOPMENTS** In the twelfth century Count Dirk VII of Holland appropriated an island on the Merwede, the Poortzijde, and founded the city of Dordrecht there. By the end of the century he had managed to obtain possession of the toll at Geertvliet and the district around Dordrecht, enabling him to develop a comprehensive system of tolls in the region beneath the rivers. He proclaimed Geertruidenberg, which was also one of his possessions, a city in 1213. This became the most important gateway from the South to the Grote Waard and the whole of Holland. In the meantime the Count of Brabant had proclaimed Waalwijk a city, while the abbey of Berne and the city of Heusden became important hubs in the Land of Altena.

The area between these urban centres was a mixture of diked peat districts, diked holms and riverbank accretions, and individual dikes resulting from successive changes of course.<sup>6</sup>

**DAMS AND DIKES** Between the eleventh and the thirteenth centuries the main body of the Maas moved eastwards to combine with the Merwede at Woudrichem. Now it became possible to dam the former main course and the tributary the Dubbel (around 1282, at Maasdam and Dubbeldam). Dams had been constructed prior to this in the Werken stream and the Eem. The water courses slowly silted up and became narrower. Sluices were built in the dams to regulate the water level in the polders.<sup>7</sup>

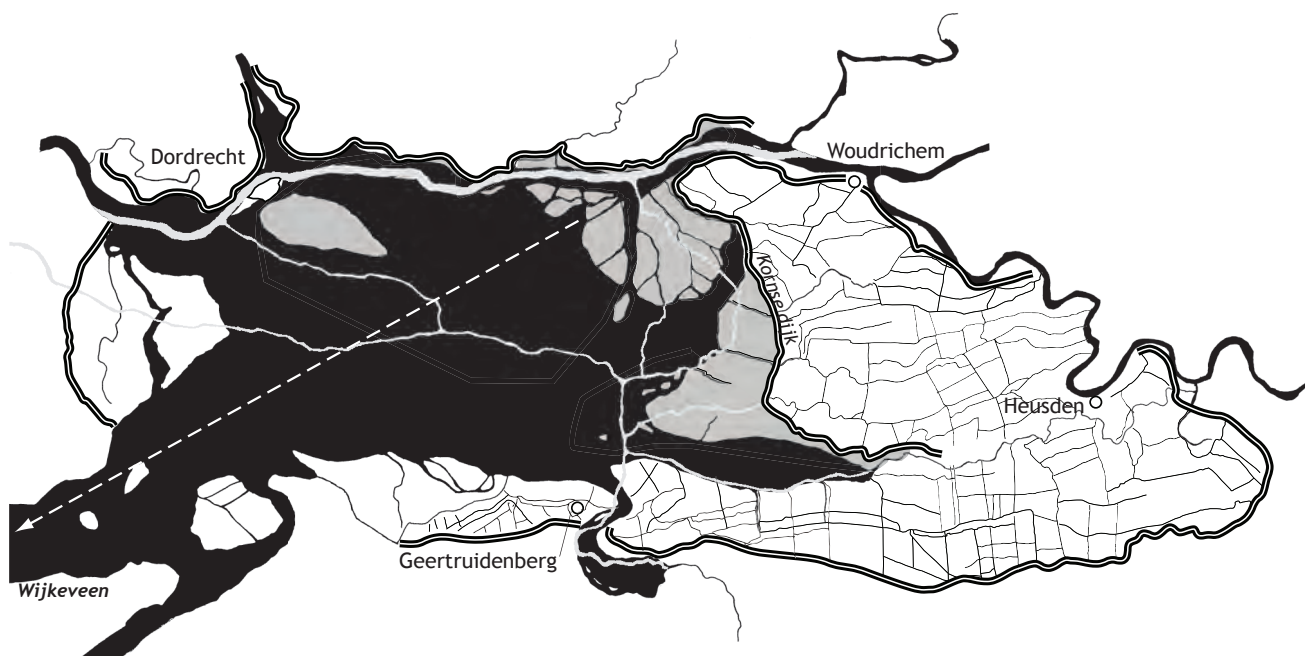
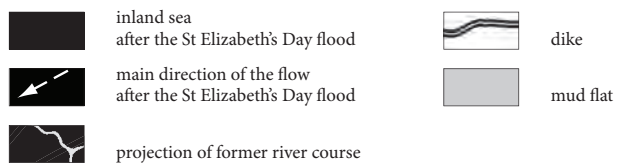
A major obstacle to the creation of the Grote Waard had now been removed; what had initially been a major border river became a central drainage channel of what was to become the Grote Waard (Oude Maas). The new course (Maas) was to become the eastern boundary. A number of smaller works completed the unification of the Grote Waard. A dike was created from the Puttense-Strijense polder through the wilderness to Geertruidenberg. Langstraat, an area that was reclaimed at a relatively late date with elongated parcellation, was given a rear barrier, the Heidijk, to the South of the vil-

lages to protect it from descending flows from the heath lands; this left a wide strip of peat marsh as no-man's land which could function as a reserve boezem (a reservoir with a separate level, to collect the water until it could be discharged). The Werken stream was dammed as part of a dike some eight kilometres long to join the Dordtse Waard and the Woudrichemerwaard. Altena and Heusden were joined by a stretch of dike beside the Maas.<sup>8</sup> The damming of the Maas near Heusden in the East and at Maasdam in the West (1273), plus the damming of the Donge at Geertruidenberg, marked the birth of the Grote Waard.<sup>9</sup>

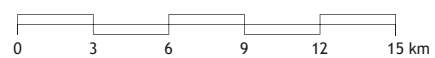
The coherent diking of the Grote Waard was intended not only to improve flood protection and drainage but also to obtain control of the traffic system and to ensure the monopoly of Dordrecht as a riverine port. The closure of the Oude Maas, for instance, was important in this respect because it enabled a link that passed behind Dordrecht. With the agrarian market monopoly in Geertruidenberg, which had better connections by land, Count Dirk (with the abbey of Berne as an ally) had full control of trade.<sup>10</sup>

**THE WATER BOARD (WATERSCHAP)** The water boards traditionally exerted a strong influence on

the creation, demarcation and infrastructure of the South Holland landscape. That is particularly true of the Grote Waard, one of the first large *waarden* in South Holland. The first dams were made possible because in the thirteenth century the shires of Dordtse Waard had joined to form a water board. Several decades later the other shires of the Grote Waard also joined, so that one large water authority was formed. This water board ensured that the shires (which remained largely autonomous in other respects) maintained the dikes, it took measures against shires that failed to meet their obligations, and was itself in control of the dams and a number of sluices. The management was in the hands of a dike-reeve, appointed by the Count of Holland, who was assisted by seven higher polder representatives designated by Dordrecht and Geertruidenberg and the intervening area.<sup>11</sup>



Destruction



## DESTRUCTION

Around 1400 the problems in the fight against the water increased. The ground level was compacting more and more, so that the level in the rivers rose and sea water penetrated further and further inland through the tidal gullies. The water board turned out to be too divided to manage the dike and the polder consistently. As a result of the permanent political unrest (including the protracted civil war between two aristocratic factions known as the Hooks and the Codfish),<sup>12</sup> the requisite dike reinforcements failed to materialise. Moreover, opinions were sharply divided on the practical aspects of polder management: on the degree to which peat cutting and salt extraction could be allowed; and on the opposed interests of drainage and protection against water from outside the polder. Breaches of the dikes became increasingly common after 1375.<sup>13</sup>

**PEAT CUTTING** Peat cutting went on for a long time in the peat landscape in the southern part of the Grote Waard. The Langstraat area in particular provided fuel for Dordrecht and the surrounding districts. Peat was also exported, exclusively via Dordrecht, which of course levied a toll on it. The consequence was an acceleration in the falling of the ground level. Worse still was salt extraction, in

which the salty peat beneath the layer of clay was dug up.<sup>14</sup> This was done on both sides of the dike, so that the dikes were undermined without being repaired. These activities were the main cause of the inundation at Broek in 1374. From that moment on there was a situation of permanent crisis in the Grote Waard. The restrictions were tightened up but were never properly complied with. Salt extraction was often the only source of revenue to pay for the repairs to the dike that had been breached because of that very same salt extraction.<sup>15</sup>

**SLICES** Besides, drainage grew increasingly difficult because of the ongoing compaction and the rise in the level of the water outside the dike system. For a long time the entire Grote Waard was drained at Maasdam. At the end of the fourteenth century the drainage was gradually moved to Broek, where a drainage facility had been discovered by chance. The shires of Putten and Strijen had been given permission to drain their land via the common boezem and via Maasdam, but when the channel was dug for this, the water flowed in the opposite direction and drainage through the sluice at Broek proved to be much more effective than at Maasdam. There was a fairly high floodplain in front of Maasdam, while the peat land in front of Broek had been thoroughly extracted so that the differ-



ence between high and low tide was much greater. Since the polder mill had not yet been invented, this seemed to offer the ideal solution to the problem of inadequate drainage. However, those powerful sluice flows led to a deepening and widening of the water outside the dike system, the Wijkeveen, which formed a growing threat to the dike and sluices. This too led to conflicts between the administration that wanted to close the sluices or to protect them with a new outer dike and the villages concerned. In this period of warfare and administrative stagnation, the dikes and sluices were entirely neglected.<sup>16</sup>

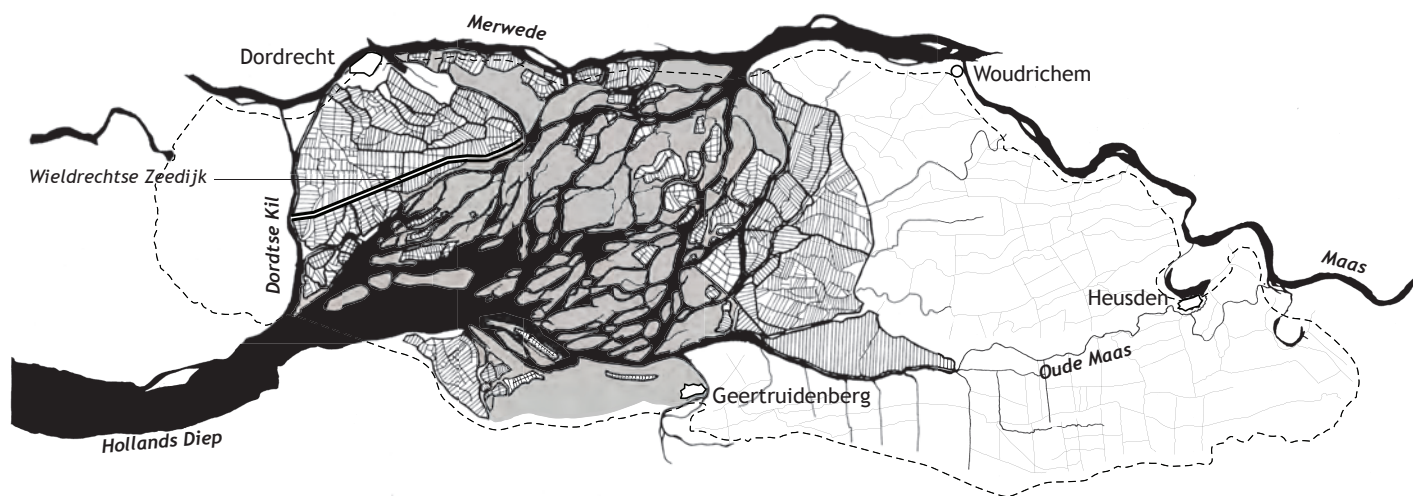
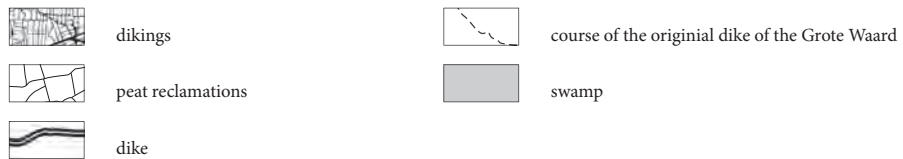
**FLOODS** The breach of the dike at Broek in 1374 was followed by four more floods, with that of St Elizabeth's Day as the climax. When a tremendous storm arose on the night after St Elizabeth's Day (the night of 17 to 18 November 1421), the dike gave way at various points. High rivers led to another breach on the Merwededijk a month later. Great efforts managed to repair the breach at Broek, but when the dike gave way again in 1422, the ongoing civil war prevented the formation of a united emergency board. The efforts on both sides were not enough to prevent the land inside the Grote Waard from becoming more and more ruined and uninhabitable as a result of the prolonged inundation.<sup>17</sup>

**INLAND SEA** The St Elizabeth's Day flood left behind a large inland sea with isolated islands, including Dordrecht, where the water reached the city walls. The water made its way to the sea from the breach in the Merwededijk straight across the Grote Waard and through the breach at Broek. During the flooding large pieces of peat were torn loose and swept downstream at ebb. The water deposited a thick layer of clay in their place. Deep gullies were formed and the Maas and Merwede rivers moved southwards to flow into the sea via the Hollands Diep (the former Wijkeveen) and the Haringvliet.<sup>18</sup>

The inundation did not affect the whole of the Grote Waard. Many dikes within the dike ring had remained intact, although they were redundant by now. One of them, the Kornsche dike, which runs from North to South from Werkendam to Dussen, held up against the water, which had already spent some of its force because here the weak peat marsh had in the meantime been replaced by strong river clay. The area to the East of this still has the same basic shape as when it was first divided into parcels, a relic of the Grote Waard.



De Biesbosch



## Second Reclamation: Recovery



## SECOND RECLAMATION: RECOVERY

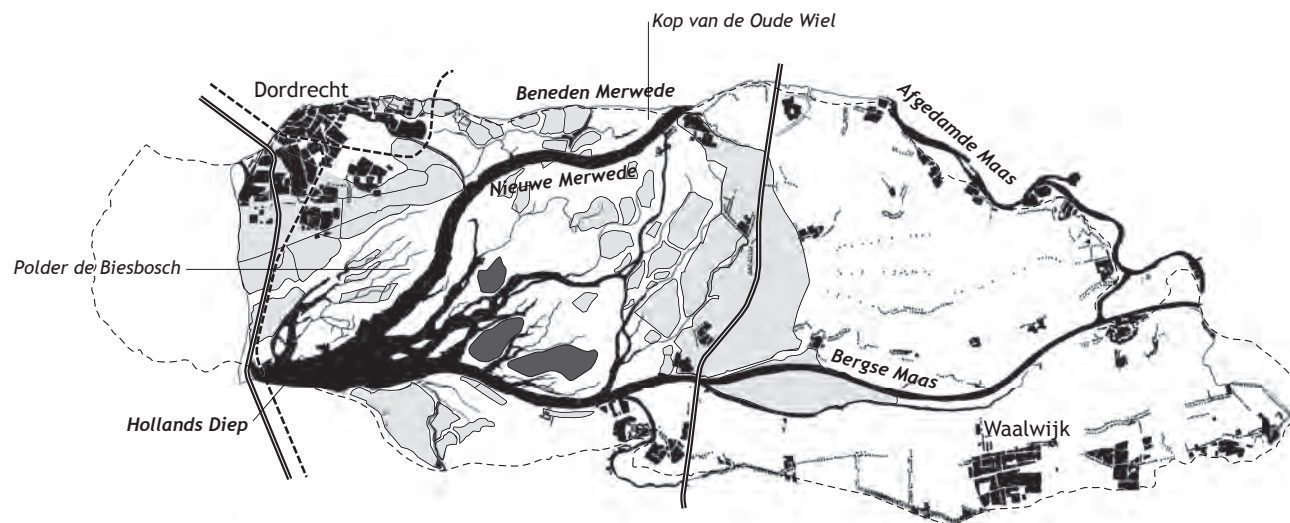
It was some time after the St Elizabeth's Day flood before polder activities were resumed with the construction of weirs, although there was still regular flooding when the tide was high. By the end of the civil war, the land had already been so eroded that restoration was impossible at that moment. Reconstruction did get under way at other spots in Holland where there had been incursions, dikes had been broken open and land destroyed, but the administration in the (former) Grote Waard was too weak for that. Only minor repairs in the border areas were carried out.<sup>19</sup>

For instance, at Strijen the Grote Waardsdijk was used as a basis for the diking of the land outside the dike – what is now Oudeland van Strijen – to compensate for the land inside the dike that had been lost. New diking was carried out on the western side of Langstraat, where the Donge had become a broad tidal passage. The Land van Heusden built a barrier in the Oude Maas on its own territory. But no local repair efforts were made in former Dordtse Waard and Tiesselijnswaard, though they must have been quite feasible here with the help of the old Merwededijk, Maasdijk and Dubbeldijk. Perhaps

the local residents were biding their time in the hope of a general restoration from Dordrecht.<sup>20</sup>

**HOLMS AND RIVERBANK ACCRETIONS** After the inundation an inland delta was formed and islands and riverbank accretions immediately appeared under the influence of the rivers that flowed into the inland sea. Because of the extensive mass of water, the rate of flow was slow at some points, enabling the material that the rivers carried with them to sink. Large masses of sand were borne by the flow, which formed tall flat sandbanks on which a thin layer of heavy clay was deposited.<sup>21</sup> Elliptical holms were formed between the river gullies, tall and sandy in the North-East, flat clayey banks towards the West. South of Dordrecht riverbank accretions grew up next to the existing land in peel-shaped strips. Once these had been diked, new ones were formed further and further toward the South.

Rushes and reed mace grew on the sandbanks, leading to the retention of even more silt deposit. Reeds for matting were grown on the lower banks, while the higher ones were converted into osier beds. So the flood area had already been brought under cultivation before the diking, and that part of the Biesbosch that had not been poldered was still a source of income from reeds, rushes and osiers for



Third Reclamation: Occupation



the locals for a long time to come. In fact it was not until after the Second World War that the drop in demand put an end to the osier and reed industry. The osier beds and floodplains were transformed into a dense forest, intersected by channels. The closure of the Volkerak and the Haringvliet around 1970 reduced the tidal difference from more than one and a half metres to twenty centimetres.<sup>22</sup>

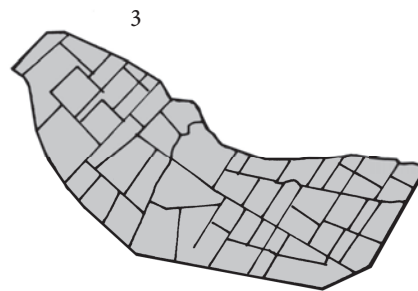
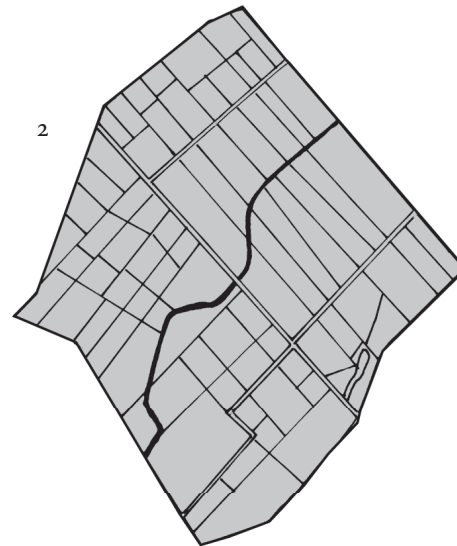
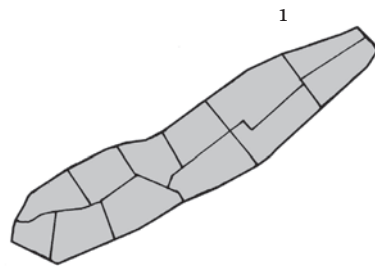
**DIKING** The first diking operations took place on the eastern side of the inundated area, where extensive mud flats had formed. This zone was diked in large tracts between 1465 and 1646. It was not until well over a century after the flood that poldering got under way again in the Dordrecht area, starting with the riverbank accretions directly to the South of Dordrecht. The shape and direction of the parcels are irregular because the area was reclaimed starting from the dikes and working inwards. The last of these accretion polders to be diked was the Wioldrecht polder (1659). Polders were not diked south of the Wioldrechtse Zeedijk until more than a century later.<sup>23</sup>

### THIRD RECLAMATION: OCCUPATION

When the adverse effects of the flood had eventually been counteracted and the new land forms had been stabilised, a final series of drastic interventions took place.

**DRAINAGE** The ongoing silting up in the Biesbosch and the formation of sandbanks with vegetation gradually came to interfere with the drainage of the water from the Maas. This led to considerable flooding in the polders, but the city of Dordrecht prevented the digging of a drainage channel for a further century because it would weaken its position as a port.<sup>24</sup> Work on the Nieuwe Merwede commenced in 1850 by widening and deepening the existing river gullies. This meant an enormous increase of scale in the finely meshed system of gullies. The forking of the Nieuwe Merwede and the Beneden Merwede was chosen at a point where the Merwede had deposited high sandbanks which were banked up to form river dunes, the Kop van de Oude Wiel.<sup>25</sup> In 1883 the Bergsche Maas was dug to relieve the area to the East of the Grote Waard, which regularly flooded during heavy rainfall. Thus the eleventh-century situation, in which the Oude Maas had ensured rapid drainage, was finally restored.<sup>26</sup>





## Polder Types

1. holm polder: oval form
2. mud flat polder: shoal-shaped form
3. accretion polder: peel-shaped form

**NEW DIKING** After the completion of the Merwed-edijk, the formation of riverbank accretions and holms speeded up in the area between the Merwed-edijk and the Wioldrechtse Zeedijk because there was hardly any current. The river arms became narrow creeks, mere rudiments of their original form.

This area, Polder de Biesbosch, was poldered in 1926 in a project to generate employment. The existing creeks were incorporated in the polder system, unlike the older polders situated between the creeks. Polder de Biesbosch has a very open landscape. The dikes are high, as are the roads planted with ash and poplar. Since the polder was not created until late, the ground level is relatively high; sand and clay had much more time to subside than in the surrounding polders. Drainage was carried out by opening the drainage sluices at ebb. The tidal difference has now virtually disappeared; moreover, the agricultural activity requires a lower groundwater level in the polder, so that there is now a pumping station in use.<sup>27</sup>

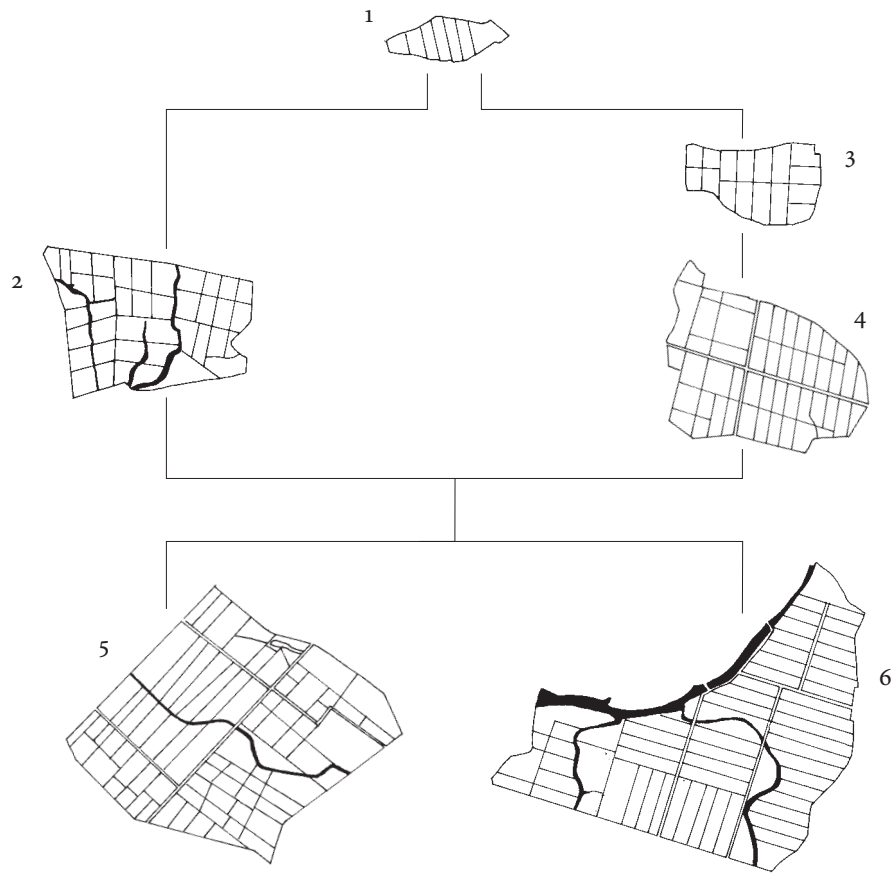
## POLDER TYPES

The old land is a continuous carpet of peat lands drained by a system of ditches with a general drainage direction that follows the main direction of the rivers. In the new land, on the other hand, poldering took place in clearly demarcated units. Three basic forms can be distinguished: the holm polder, the accretion polder, and the mud flat polder.

The basic type is the holm polder which originates as an island between river gullies. The oval form reflects the direction of the current.

Accretion polders are the product of the deposit of sediment on the riverbank. The peel-shaped form reflects the flow of water past the riverbank: the inner curve is the contraform to the bank, the outer curve is the side of the river gully.

In the regained land, however, the water was so shallow that there was hardly any current; the inundated tracts of land were covered with a layer of sludge and diked once they became dry. These mud flat polders have a much larger surface area than the previous two types, and are shaped like shoals. Mud flat polders can also be found on the western



## Parcellation Types

1. discharge towards the edges (polder Ruwen Hennip)
2. fractal geometry (polder Maltha)
3. drainage system with central channel (polder Grote Turfzak)
4. rational parcellation (polder Vogelenzang)
5. hybrid system (Karnemelkspolder)
6. rational pattern projected on top of fractal pattern (polder De Zalm)

border of the accretion area where hardly any land has been swept away.

The three types differ not only in shape but also in size. The largest, the mud flat polders, have an area of from six to twelve km<sup>2</sup>, while holm polders are usually smaller than a single km<sup>2</sup>, and accretion polders are from two to three km<sup>2</sup>.

## PARCELLATION TYPES

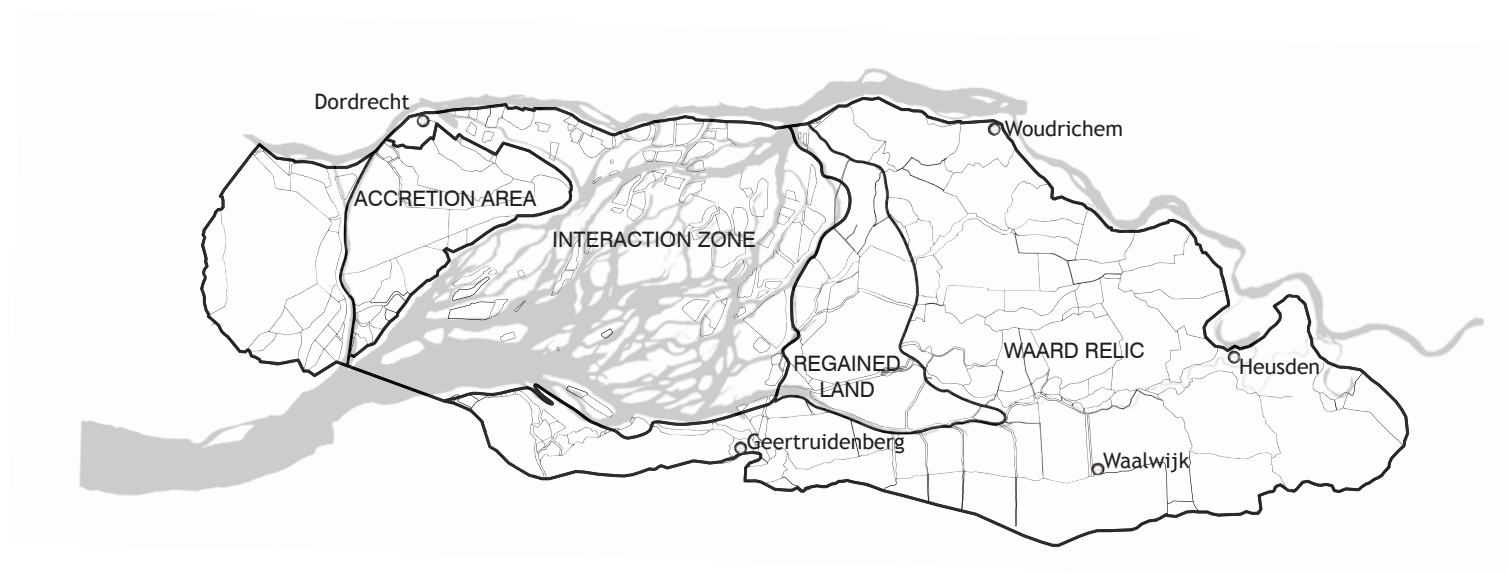
The fine-meshed creek pattern is the foundation of the drainage and parcelling system of the polders. The geometry at the level of the parcel is a reflection of the narrow creeks, which in turn reflect the larger pattern of the river gullies. This geometry could be called fractal to distinguish these river reclamation polders from the orthogonal geometry that is to be found in the rational lake-bed polders in the peat landscape.

The drainage structure is determined each time by the fractal geometry of the natural creek pattern. The pattern of the parcels is either derived from this creek pattern, or is projected on top of the creek

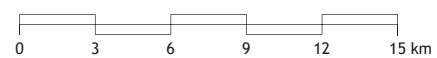
pattern as an autonomous layer, though the creeks still constitute the main drainage system.

Patterns of parcellation can be distinguished in terms of a series displaying an increasing degree of rationalisation. The smallest polders drain into creeks at the edges. Larger polders are intersected by a creek or a network of creeks, which function as the main drainage system after poldering. A central ditch is introduced if there is no creek and if the distance from the edges is too much. When the polders have rational parcelling, this is always based on the access structure and not on the main drainage system. A fully rational parcelling, as in the Vogelenzang polder, is exceptional. Hybrid forms can be found in which a gradual transition from the fractal to the rational system can be detected, or in which the rational parcelling is projected on top of the natural main drainage structure as an autonomous layer.





Landscape Types in the Grote Waard



## LANDSCAPE TYPES IN THE GROTE WAARD

The original Grote Waard has fragmented into four zones, each with its own characteristics. Because the western part of the Grote Waard consisted of peat soil before the flood, this part was eroded by the flooding and replaced by a layer of clay. The parcelling is based on the natural form of the islands that were diked. In the eastern part the sturdy river clay prevented this from being affected. This part is thus old land, with the pattern of parcelling dating from the time of the Grote Waard. From West to East the landscape grows increasingly opener and larger in scale, and the visible influence of the river increases too.

The two major breaches during and after the flood took place on the north-eastern and on the south-western sides. This resulted in a strong current from Southwest to Northeast (sea) and from Northeast to Southwest (river), while the central zone (the Biesbosch) was eroded more heavily than the zones on either side of it.

The result was a variety of areas: the intact old land – the relic of the *waard*; the new land with a heavily eroded central zone, the interaction zone; and on

either side of it the accretion area and the regained land. Each of these areas was cultivated in a different way, so that the different cultural landscapes have received a form of expression of their own. They form the basic elements of a condensed version of the landscape series that is characteristic of the delta landscape.

In the meantime the clear distinction between the four areas has become blurred. Particularly in the West of the original Grote Waard the landscape pattern has been profoundly changed. In the accretion area the original pattern has been largely erased by the urban development of Dordrecht, though it is still sporadically visible at some dikes and roads. With the construction of the Nieuwe Merwede, the fine-meshed fluvial system in the interaction zone has merged in a single current, which is separated from the marine system through which it passes by two dikes. The marine system was reduced even more by the further diking and by the reduction of the effects of the tides as a result of the construction of the Haringvliet sluices in 1970.

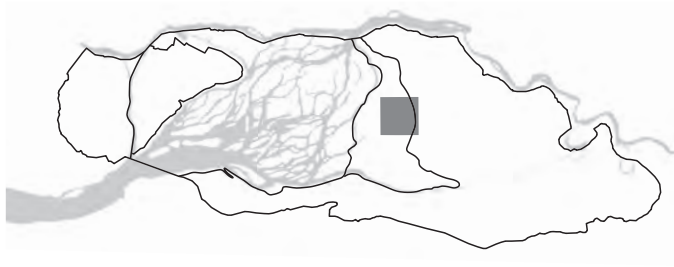


## Waard Relic

The developmental stages after the St Elizabeth's Day flood: the 12th century parcellation, with its roads as reclamation axes parallel to the river, is still intact (1840); unchanged parcellation (1889); scaling up by land consolidation, a land consolidation road following the direction of the parcellation and a new access road intersecting the parcellation (1986).

## WAARD RELIC

The area to the East of the Kornsche dike, the Land van Heusden en Altena, has remained virtually intact. This area with river clay ridges and gullies still has a typical *waard* pattern, with peat reclamations on both sides of the main rivers, scattered small villages, and ribbon development. The main orientation is East-West. The eastern part (Langstraat) of the peat landscape South of the Oude Maas has also remained intact. Here a regular pattern of cultivation at right angles to the river can be seen (in the easternmost part this is less clearly visible because of the broad levee between the peat zone and the river). West of the Donge is a sea clay area with many dikes, creeks and open polders.



## Regained Land

The developmental stages after the St Elizabeth's Day flood:  
extensive mud flats intersected by creeks (1639); the mud flats are reclaimed in shoal-shaped units with creeks as boundaries (1840); scaling up by land consolidation and a motorway following the main direction of the parcellation (1986).

## REGAINED LAND

West of the Kornsche dike large adjoining patches of land have been diked in the form of an arabesque folded around the Land van Altena. The old land has not been eroded, but it was covered by water during flooding, so that an extensive mud flat landscape arose, intersected by creeks. A similar creek landscape also arose in the triangle South of the Amer. When the water level was high, even more clay was deposited over the subsoil. When these mud flats were diked, this was actually 'patching up' the relics of the original situation; the old main structures of the *waarden* could still be discerned, but raised and distorted by the influence of the water. The new polders are situated between the creeks; the creek structure bounded by tall vegetation determines the appearance and contrasts with the rational parcelling of the polders. The typical polder here is the mud flat polder.



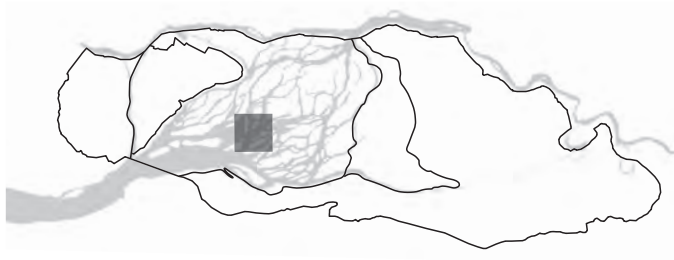


## Accretion Area

The developmental stages after the St Elizabeth's Day flood: the first accretions (Nieuw Land: new land) are diked (1639); the parcellation of the accretion polders, intersected by the railway to Breda (1840); the extensions of Dordrecht are rolled out like a carpet of autonomous parcellations on top of the agrarian parcellation pattern (1986).

## ACCRETION AREA

South of Dordrecht the flow of the current against the island city formed peel-shaped accretions that were diked and incorporated into polders one by one. The dike rings literally follow the natural accretion patterns, with parcelling at right angles to the longitudinal axis. The first of these accretion polders was the Oud-Dubbeldam polder in 1603, the last was Polder de Biesbosch in 1926. The polders are open, with large parcels and few farms, and are encircled by high dikes, often accentuated by the planting of poplars..



## Interaction Zone

The developmental stages after the St Elizabeth's Day flood:  
inland sea with elongated holms that have not yet found their  
ultimate position (1639); diked holms (1840); polders are dug out  
to form storage reservoirs for drinking water (1986).

## INTERACTION ZONE

The area consists of elongated accretions with a fine-meshed network of river gullies in between. It is a small-scale zone of water, reed lands and marsh lands. The holms have been diked and reclaimed as isolated agricultural islands surrounded by wide streams. The pattern of gullies and dikes has a Northeast-Southwest orientation, sometimes accentuated by the planting of the dikes. Until around 1850 the pattern of gullies and rivers could be seen as two hands with interlocking fingers; the currents of several wide streams fan out from the riverside to form a fine-meshed system of creeks separated by shoals; in the direction of the sea the currents follow the same pattern and combine to form wider watercourses. In the southern part water is predominant, and the sporadic small polders can only be reached by boat. They are surrounded by low weirs and are flooded when the water is high. Besides the open water in the network of creeks and gullies, a large part of the area consists of marshy (wood)land, reed land and floodplains. Land and water interlock in the north-eastern part; a capricious pattern of fairly wide watercourses flanked by vegetation winds its way between the open polders.

## JOURNEY THROUGH TIME

Originating as a poldered peat area between the Maas and the Merwede with an overarching drainage system controlled from above, the Grote Waard was a precursor of *waarden* such as the Alblasserwaard and the Krimpenerwaard. The influence of the sea is indirectly present in those *waarden*, but in the Grote Waard the sea had a direct influence, in fact to such an extent that virtually the whole of the area was eventually swallowed up by it. This was followed by a second reclamation, this time to reclaim the area not from the rivers but from the sea. The Grote Waard had been a chain of originally smaller *waarden* or polders; it now became a chain of diked polders.

The Grote Waard was originally a riverine landscape, such as the Alblasserwaard and the Land van Heusden en Altena in the eastern part of the Grote Waard still are today. The area was situated along the line where the river clay landscape merged into the peat landscape which has disappeared by now. It was a stable landscape that could be protected against the periodic high river water by means of simple, small-scale interventions. However, reclamation and peat cutting caused the ground level to sink drastically, and salt extraction outside

the dikes led to the disappearance of the foreland of the dikes, so that the natural resistance of the area decreased and the dike was left as a fragile boundary between the 'island' and the pressure of water from outside it. The drop in the ground level also enabled the influence of the sea to extend right up to the dike, while the pressure of the river was still present. In the end there were three factors that led to the disappearance of the Grote Waard. First, the soil; only in a peat area could human intervention cause the ground level to sink so quickly. Second, the location near the estuaries of several large rivers without the protection of sand ridges. Third, primarily social factors: the lack of administrative continuity, the differences on fundamental issues, the war, the disappearance of central functionaries, the destruction of the archive, and the unwillingness of the residents to meet certain obligations. In fact, the Grote Waard was too large for the organisational and technical capacity of the time.

Since the St Elizabeth's Day flood, the Grote Waard has ceased to be a *waard*. The flood brought both the sea and the rivers within the dike, where they combined to form an inland delta. Holms and river-bank accretions were formed, and these were used as the basis for the new reclamation of the area. Unlike the first diking, the drop in ground level meant

that the sea and the rivers could no longer be kept out of the area, and the resulting interaction zone between the sea and the river was condensed in the central area. The form of the interaction zone, a fine-meshed creek system, replaced the typical form of the *waard* system. With the further regulation in the nineteenth and twentieth centuries, however, sea and river were separated again, so that the interaction between the different layers is barely visible any more. The area is intersected by the Nieuwe Merwede; while in the past the main direction of flow (the Oude Maas) was Southeast-Northwest, it is now Northeast-Southwest.

The Grote Waard has a place in the series of reclamation landscapes in Holland between the peel-shaped tracts of reclaimed land formed by the sea on the South Holland islands and the linear reclamations of the *waarden*. The peel-shaped accretions on the western side and the parcelling in strips on the eastern side represent the extremes of the series, with the regained land intersected by creeks between the Biesbosch and the Land van Altena as an intermediate form.

Moreover, thanks to its tumultuous history, as a result of which the reclamation took place in clearly distinguishable stages, the Grote Waard offers a

unique glimpse of the history of reclamation in the Netherlands. The relic of the *waard* shows the first stage of reclamation. The interaction zone shows the stage of destruction, a stage that in North Holland, for example, also preceded the formation of the lake-bed polder landscape. The exceptional situation is found here that the stratum of reclamation landscape lies beneath the natural landscape instead of above it. In the regained land we can see the new reclamation, still with faint traces of the old one. Finally, the accretion area presents a new landscape of lake-bed polders.

## NOTES

1. Stol (1981), p. 129.
2. Bosch Slabbers (1999) p. 2.
3. Berendsen (2005).
4. Van Groningen (1995) pp. 19-20; Van Groningen (1992) p. 3.
5. Oerlemans (1992) p. 151; Stol (1981) pp. 134-136.
6. Fockema Andreae (1950) pp. 2-9; Hendriks (1988) p. 41.
7. Oerlemans (1992) p. 152; Stol (1981) p. 137.
8. Fockema Andreae (1950) pp. 9-12.
9. Van de Ven (1996) p. 107.
10. Fockema Andreae (1950) p. 12.
11. Bosch Slabbers (1999) p. 17; Stol (1981) pp. 136-140.
12. The civil war between the Hooks and the Codfish was the background to these conflicts. The Codfish had been in control of Dordrecht since 1407, but the prominent figures in Grote Waard and the water board were Hooks. A civil war broke out, in which Dordrecht, under Codfish control, rebelled against the Hook Countess Lady Jacoba. After her vigorous reaction, Dordrecht occupied Geertruidenberg. This almost spelled the ruin of Geertruidenberg, and although Dordrecht had strengthened its position, this only increased the pro-Hook feelings of the authorities in the Grote Waard.
13. Fockema Andreae (1950) pp. 27-37; Oerlemans (1992) p. 152.
14. It was of special importance to Dordrecht for the trade in salt and herrings, which was a reason not to impose restrictions on salt extraction, even long after it had become clear that it posed a threat to the dikes. On the one hand, bans were imposed on salt extraction within four miles of the dike, on the other hand the same nobles who imposed those restrictions granted concessions to operations within that margin. Fockema Andreae (1950) pp. 37-40.
15. Fockema Andreae (1950) pp. 33-37; Stol (1981) pp. 141-142.
16. Fockema Andreae (1950) pp. 26-27; Stol (1981) p. 143.
17. Fockema Andreae (1950) pp. 40-44.
18. Oerlemans (1992) p. 152.
19. Fockema Andreae (1950) pp. 46-48.
20. Fockema Andreae (1950) pp. 44-46.
21. Zonneveld (1960) p. 1.
22. Bosch Slabbers (1999) pp. 18-21.
23. Oerlemans (1992) p. 153.
24. Oerlemans (1992) p. 54.
25. Bosch Slabbers (1999) p. 20.
26. Damoiseaux and Vos (1987) p. 23; Morzer Bruijns and Ben-  
them (1979) p. 128.
27. Oerlemans (1992) pp. 24 and 54.





# The *Waarden* of South Holland

*Well, that is why the early polder administrators said: if we do not want to get flooded and to see the land grow acid every year, we must dike an inner drainage reservoir.*

*We get a few mills to pump the water into this inner drainage reservoir and another mill, which is in a higher position and has a bigger radius of action, pumps the water from this boezem into the IJssel.*

H. de Man, *Het wassende water*, 1937.

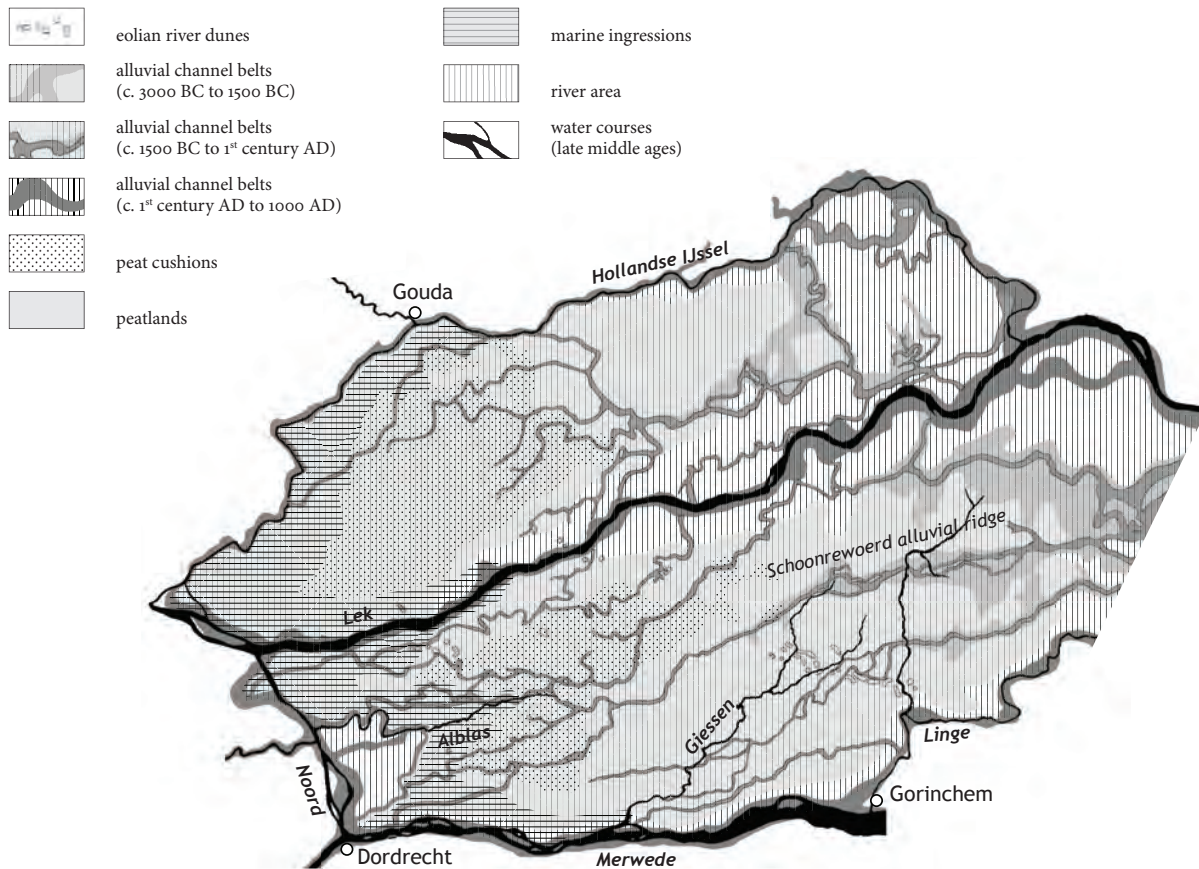
## DEMARCATIION OF THE AREA

*Waarden* are polders that are entirely enclosed by rivers. Because the rivers in the delta do not only fork but also join up again, the result is elongated islands. The different reclamations grew to fill the elongated form determined by the rivers, which was then fixed by a ring dike.

The rivers and *waarden* between them form a belt stretching from East to West between the Utrechtse Heuvelrug (Utrecht Hill Ridge) and the sandy soils of Brabant to the sea. This belt of rivers intersects the peat zone which extends from North to South

along the coast of Holland and the high sandy soils of the Gooi, the Utrechtse Heuvelrug and Brabant.

At the point where peat land and rivers meet lie the Krimpenerwaard and the Lopikerwaard (bounded by the Hollandse IJssel and the Lek), and the Alblasserwaard and Vijfheerenlanden (bounded by the Lek, Merwede and Linge). The Diefdijk marks the eastern border of the peat land. These *waarden* are very similar to one another because of the more or less comparable structure of the ground and practically similar method of reclamation and land use.



## The Natural Landscape



## THE NATURAL LANDSCAPE

Although the big rivers are hidden from the view of the *waarden* by high dikes, it is clear from a glance at the map that they are the main factors influencing the natural shape of the land of the *waarden*, but that is not the whole of the story, because the course of those rivers is determined by the subsoil and refined and influenced by the sea and the growth of peat.

This older subsoil of sand and gravel was left behind after the last Ice Age, some 11,500 years ago. In the area of the *waarden* this subsoil slopes fairly evenly westwards, from around seven metres below NAP (Normal Amsterdam Level) at the eastern border, the Diefdijk, to around fifteen metres below NAP in the West at the confluence of the Noord, Lek and Hollandse IJssel. The present ground surface slopes from about one and a half metres above NAP in the East to about one and a half metres below NAP in the West, a difference of level that is primarily due to the river deposits in the East. At the end of the last Ice Age there was hardly any vegetation in the area where the big rivers flowed. During the dry winter months fierce storms whipped up the sand in the beds – which were kilometres wide – of the original Rhine and Maas rivers to form elongated

river dunes (*donken*). Some of these dunes were so high that peat never formed on them afterwards. They still rise three or four metres above their surroundings.<sup>1</sup> Others were covered by a layer of peat or were eroded by a river that had altered its course.<sup>2</sup>

**RIVERS** After the last Ice Age the Rhine and the Maas branched to form a wide network of gullies that forked and then joined up again. Levees and alluvial ridges emerged on the riversides because when the water was high, coarse material was deposited close to the riverbed. The fine material was deposited in the lee at a considerable distance from the river: the basin areas. Sometimes the riverbed grew so high that the river breached its own levees and sought a new course. The former course left its mark in the landscape in the form of an alluvial ridge: the sedimented riverbed flanked by levees.<sup>3</sup>

As a result of the braking effect of the influx of sea water and the decreasing fall, the rivers closer to the estuary developed lower and narrower deposits on their banks than those on the eastern side of the area, corresponding to clay banks and steeper levees respectively.<sup>4</sup>

**PEAT** That the influence of the rivers increasingly declined as they flowed westward can be seen from the depth of the peat layer: in the western part of the *waarden* the peat layer has become eight to ten metres deep, while further to the East it becomes less deep. The Krimpenerwaard and the Alblasserwaard consist largely of peat, covered with clayey sedimentation deposited by the rivers. The Vijfheer- enlanden and the Lopikerwaard form a transitional zone between the peat meadow landscape of the South Holland *waarden* and the river landscape of Gelderland.

**SEA** Around the beginning of the first millennium the peat land became covered by a layer of clay as a result of the increased number of inundations from the sea. This put an end to the process of peat formation. When the sea level was high, the water carrying sediment was driven back through the river beds, over the river banks, into the peat streams and from there over the land. This accounts for the deposits of sea clay to be found particularly in the West of the Krimpenerwaard and the Alblasserwaard along the banks of the Hollandse IJssel, the Lek and the Merwede, but also beside the Alblas. The layer of clay beside the rivers was sometimes more than a metre thick, thinning out towards the middle of the *waarden*. No clay was deposited in

the centre of the Alblasserwaard or the Krimpenerwaard.

**THE FORM OF THE NATURAL LANDSCAPE** The basic form of the *waarden* is determined by the rivers. The almost parallel courses of the Hollandse IJssel, Lek and Merwede have been responsible for the elongated form of the islands that were formed between the rivers as they forked and joined up again. The alluvial ridges in the basins also have an East-West orientation. Moreover, as the ground level slopes evenly from East to West, the currents had the same direction not only in the rivers but also over land when the *waarden* were flooded in winter. This interaction between the rivers, alluvial ridges and ground level explains why the later drainage pattern could be so regular, parallel to the rivers and flowing out at the lowest, westernmost point.



With the exception of the easternmost part, the entire area is covered with the thick layer of peat that is characteristic of the Dutch lowlands. The Vijfheer- enlanden and the Lopikerwaard form the transition to the area of the upper rivers, with the corresponding broad and sandy alluvial ridges and levees.

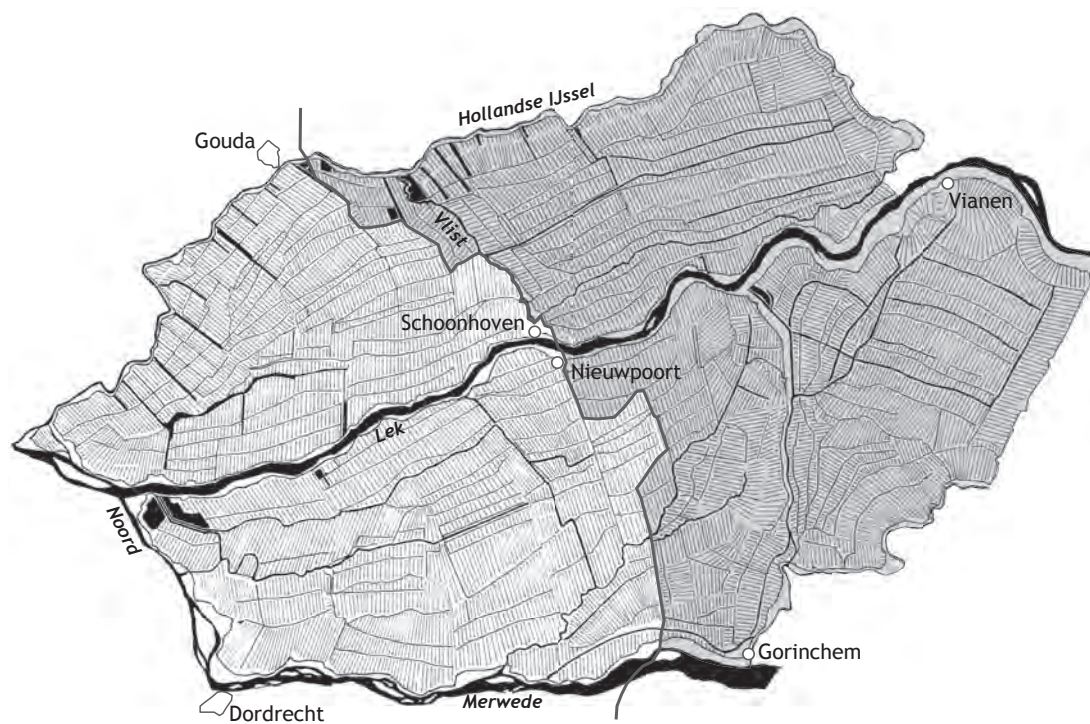
The main structure of the Alblasserwaard clearly reveals the interaction between peat, sea and river.

The middle part of the *waard* is peat, which continued to grow without interruption until reclamation put an end to it, without the intervention of either sea or river. Three of the many original watercourses can still be seen in the landscape (see drawing on p. 70). The Schoonrewoerd alluvial ridge had already silted up before the Roman era and is in fact the westernmost spur of the riverine area. The Giessen still has a drainage function. The Alblas, which still carries water too, was the gateway to the area for the sea; a layer of sea clay has been deposited around it. The Alblas and the Schoonrewoerd ridges form part of the same alluvial ridge that is the central axis of the polder. This was later formalised in the Graafstroom which links the two of them and has become the basis of the drainage system.

Visible elements of the natural landscape are in the first place the river dunes (*donken*), the basis for the oldest inhabitation around 5000 BC. In the early Middle Ages they were also the locations for convents (such as the Brandwijk Donk) and castles (Schoonenburg Hill).<sup>5</sup> Peat streams such as the Alblas and the Giessen are visible in the landscape as channels of the drainage system.



-  reclamations under the authority of the Bishop of Utrecht
-  reclamations under the authority of the Count of Holland



Administrative Relations Around 1100

## RECLAMATION HISTORY

The transformation from riverine islands to *waarden* took place in a number of clearly distinguishable, albeit sometimes overlapping stages. The first was the conversion of the levees into higher arable complexes, enclosed by the wild marshes of the interior and the unpredictable rivers. In the second stage the swamps were reclaimed, either individually by extending the parcels until they collided with another parcel, or based on an organised system of agreements (known as *copes*). The third stage was the construction of dikes to protect the reclaimed land from the water that came from the rivers or from reclaimed land higher up. Finally the dikes were connected to form a ring of dikes, whereby the reclaimed land was transformed into a *waard*.

**ADMINISTRATIVE RELATIONS** The *waarden* were administered by a number of local nobles, such as the five lords of Vijfheerenlanden (literally ‘lands of the five lords’): Vianen, Hagestein, Ter Leede, Everdingen and Arkel. The lords of the Lopikerwaard and the Vijfheerenlanden fell under the authority of the Bishop of Utrecht, those of the Alblasserwaard and the Krimpenerwaard under the Count of Holland. It is evident that a much more systematic parcelling based on an organised system of agree-

ments and with regular dimensions was applied in the *waarden* that fell under the authority of the bishop than in those accountable to the count.

**THE LEVEES** The higher parts of the levees and alluvial ridges were already occupied since the Roman era. By the end of the Carolingian period there were fairly large arable complexes, though they were limited to the highest areas, which were the only ones where the land was parcelled. The parcelling of the levees consisted of wide, short and usually irregular blocks. The differences in soil quality and drainage, connected with the zoning from levee to basin, led to parcelling in stages from high to low. The land was already in use before it was parcelled. The slopes were common hay and grazing land, while the more intractable land in the basins was only grazed in the summer. The arable plots on the levees could drain directly into the river or the basin without the need for hydraulic interventions.

**THE BASINS** Peat streams were used for access to the peat swamps, the same streams that served after reclamation to carry the excess water to the big rivers. Channels were dug more or less parallel to the big rivers and buildings were erected beside them. The basins were drained by means of a system of

channels and parallel ditches that were dug at right angles to them. However, the quality of the grassland in the basins remained poor because of the heavy soil. A large number of the reclamations were elongated parcellations extending from the reclamation axes, so that each time the land had compacted too much to support agriculture, the parcel was lengthened by making the ditches longer. The original part became hayfield, the new, higher part arable land. If the parcels became too long, the house was moved to the other end.

In some parts, particularly in the Lopikerwaard and the Vijfheerenlanden, reclamations with a fixed length based on agreements (*copes*) were applied from 1150.

**LAND USE** The reclamation of the *waarden* was begun to obtain arable land. There was a system of mixed agriculture, which concentrated mainly on self-sufficiency. Two-thirds of the grassland were used to make hay, and one-third as meadow. The livestock were kept in the first place for their manure which, when mixed with silt from the ditches, was used to fertilise and raise the fields where flax, barley and buckwheat were grown: nicknamed 'agriculture with the cow'. These fields were enriched as a result, while the hayfields at the back of the parcels

became impoverished. This system of dredging the ditches and covering the land was only to be found in the central part of the *waard*, because the sandy river clay closer to the rivers already had a good structure for arable farming. Since the river clay was more permeable than the peat in the central part, the ditches in the latter were also closer together than in the outlying parts. The constant drop in the ground level made arable farming increasingly difficult. In the end there was no alternative but to switch to grassland.

This system based on self-sufficiency was transformed in the sixteenth century. There was a sharp rise in international shipping, which increased the demand for rope for shipbuilding (on the Lek, the Merwede and the Noord). As a result, many mixed enterprises of livestock farming and hemp growing were created, especially in the Alblasserwaard and the Krimpenerwaard. The crop was grown in small raised fields close to the farmhouse, surrounded by wide ditches in which the hemp was left to rot to loosen the fibres. Dense rows of pollard willows protected the plants against the wind. After a heyday in the seventeenth century, when Dutch shipping underwent an enormous expansion, hemp cultivation died out in the nineteenth century. The earlier hemp fields can still be seen in a few places: small

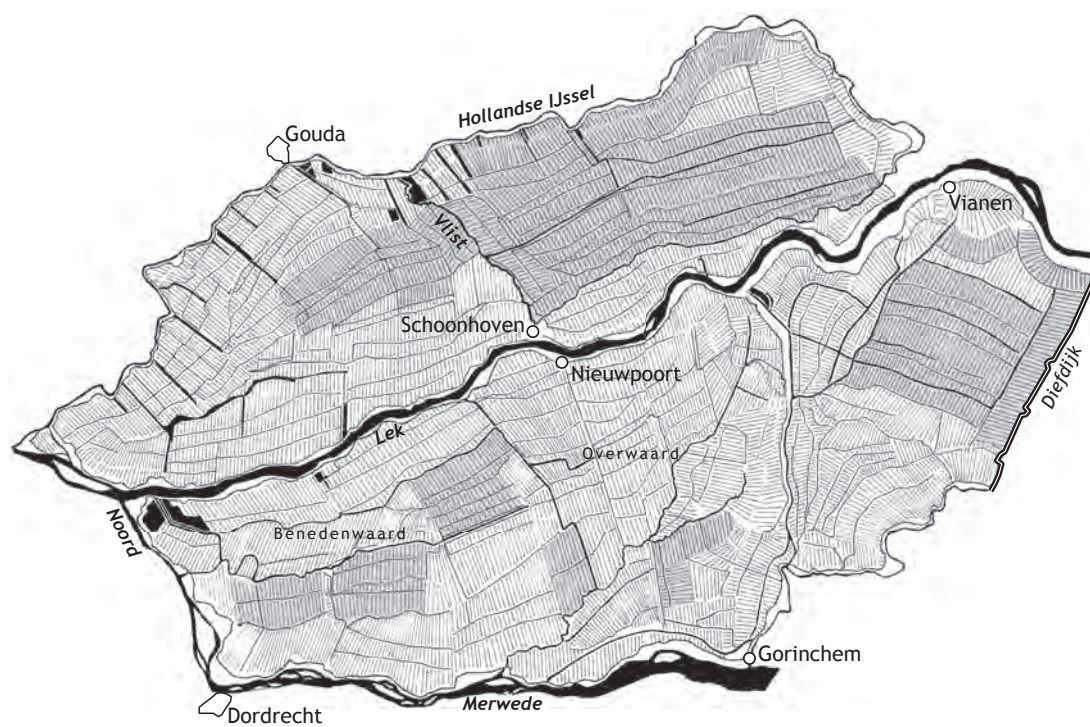
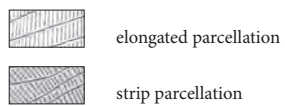
fields on a high situation close to the farmhouses, with wide ditches and pollard willows around them. The intensive manuring has often turned the soil a deep black.

Large parts of the *waarden* were cultivated with reed and osier beds, because that was all that grew on the wet soil. The osier beds yielded hoops, baskets, fencing and fascines for the dikes. This cultivation disappeared in the twentieth century as a result of the improved control of the groundwater level, which enabled soil that was unsuitable for agriculture to be converted into grassland.<sup>6</sup>

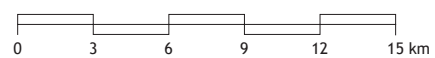
A typical form of land use was the deployment of decoys (*eendenkooien*, from which the word 'decoy' is derived): ponds with four tentacle-like channels, hidden in the osier beds, in which ducks were caught and kept. They were usually situated well inland where there was seepage and little fertile land. Today the few remaining decoys are striking features surrounded by tall vegetation.<sup>7</sup> Such larger features of the landscape as decoys, osier beds, orchards and poplar woods are commonest in the eastern *waarden*.

Until the middle of the twentieth century the central area of the *waarden* was densely covered

with reeds, osiers and undergrowth; today it is a wide open space with long lines that determine the shape: ribbon reclamation with buildings and vegetation, and to a lesser extent roads with pollard willows. The big built up areas are always situated at the edges of the *waarden* and accentuate the boundary between polder and river. Woods are the only large spatial features: in the Alblasserwaard and Krimpenerwaard they are open modern recreational woods, in the Vijfheerenlanden they take the form of a hedgerow (*coulisse*) landscape in which rows of trees stand like the wings in a stage set. Decoys and the planted farmyards of land consolidation farms feature as smaller detached objects in the landscape.



Reclamations



## DEVELOPMENT OF THE POLDER SYSTEM

**PARCEL** The first reclamations started out from the banks of the rivers and peat streams. The as yet unreclaimed peat inland functioned as a border territory. Ditches perpendicular to the river provided drainage. Only later were they interrupted by a continuous river dike. Each parcel regulated its own drainage, and the water flowed directly into the river or peat stream. A parcel was enclosed by the water that formed the basis for the reclamation, the boundary ditch, and a rear weir to hold back the water that descended from the uncultivated peat. Each parcel was thus a polder of its own.

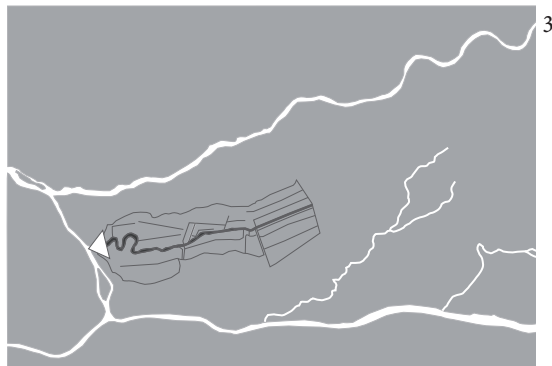
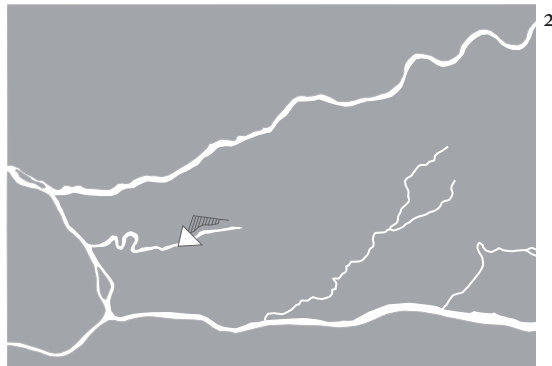
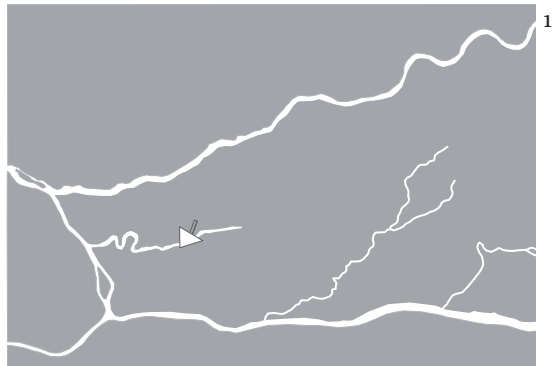
As a result of the drainage and the subsequent oxidation and compaction of the peat, over the centuries the ground level subsided several metres (by about two metres in the peat areas of Holland and Utrecht), while the river water rose. It proved impossible to simply drain into the river any longer, and raising the land with manure and mud from the ditches was no longer sufficient.

**PARCEL CLUSTER** To improve the drainage system, joint channels were dug parallel to the basis of the reclamation to a point further to the West where

the levels at ebb were lower. On the *cope* parcels, this was systematised in a modular system of parcels and channels. A front channel was dug close to the basis of the reclamation, a rear channel was dug at the other end of the cluster of parcels, and if the parcels were deep a central channel might be dug too. The end of the parcel cluster was marked by a dike. Instead of a front channel, a weir was sometimes constructed which also functioned as a barrier against seepage, with a channel on each side. The drainage unit was increased to the cluster of parcels linked by channels, which sometimes covered a large distance before discharging into the river.

**AGGREGATE PARCEL CLUSTER** The parcel clusters that discharged directly into the river continued to function as autonomous drainage units for a long time, but the clusters situated more inland engaged in joint drainage into the same peat stream. When simple drainage no longer proved to be possible, sluices were placed at the points where the channels flowed into the rivers so that discharge could take place when the rivers were low. Sluices were also placed in the estuary of the peat stream. As a result, all of the clusters of parcels around a peat stream were combined to form an aggregate drainage unit.





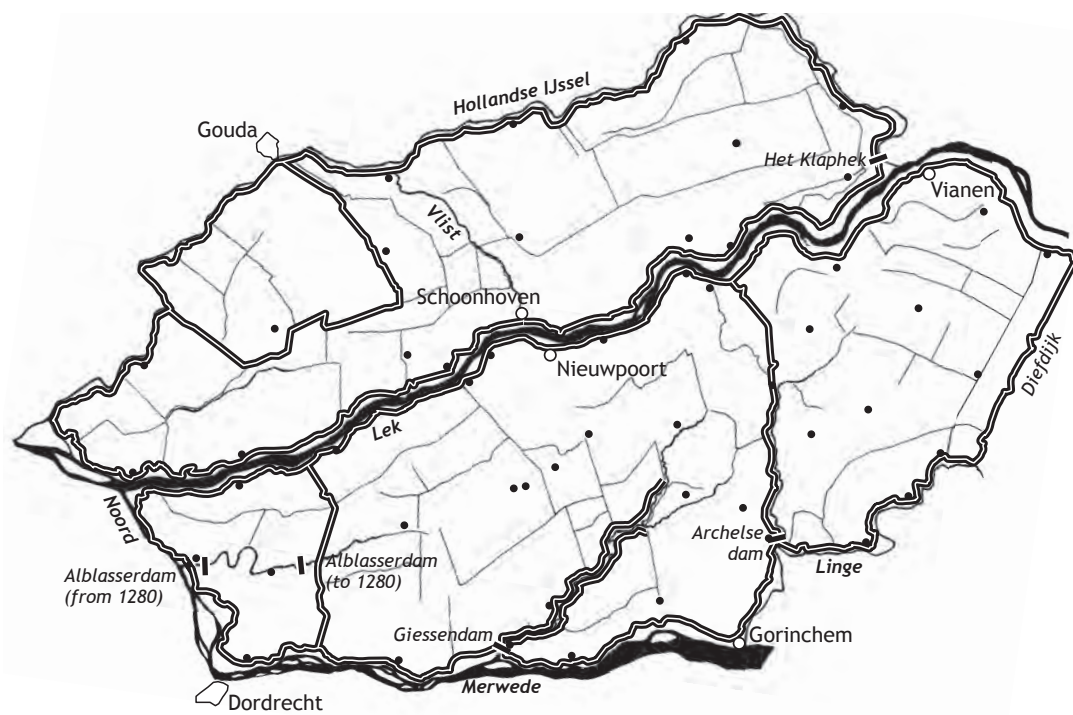
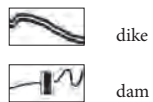
Development of the Polder System (The Alblasserwaard)

- 
1. parcel with autonomous discharge directly into the river (peat stream the Alblas)
  2. parcel cluster with joint front and rear channel
  3. aggregate parcel cluster with the dammed peat stream functioning as *boezem*; discharge into the river is via a sluice in the dam (1264)
  4. polder with an artificial *boezem*; the point of discharge is moved (Benedenwaard; 1369)
  5. polder with a double *boezem*; the water can be stored in the high *boezem* (1738)
  6. joining of several polders (20<sup>th</sup> century)

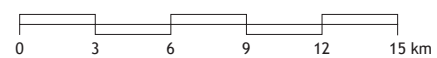
The next step was to make *boezems*: reservoirs and channels with a separate level, to collect the water until it could be discharged. The different channels met in a *boezem* in order to discharge into the river at the westernmost point, making use of a high *boezem* if necessary.

**WAARD** With the closure of the dike rings in the thirteenth century, the drainage system was centralised too and the different polders with their own *boezems* worked in close collaboration within the framework of the joint dike ring. Thus the two largest polders of the Alblasserwaard – the Overwaard and the Benedenwaard – were jointly drained at the Kinderdijk, and at the end of the nineteenth century the groundwater level was standardised. The different polders within the *waarden* were recognisable by their different water levels. Nowadays each *waard* is a single polder and the water level has been rendered uniform.<sup>8</sup>

Besides the moving of the points of discharge and the creation of high *boezems*, the possibility of improved drainage was provided in the fifteenth century with the invention of the windmill.<sup>9</sup> This made it possible to pump the water up from the *boezem* to the level of the river. A mill with a water-wheel could raise water by one metre; a course of



Diking



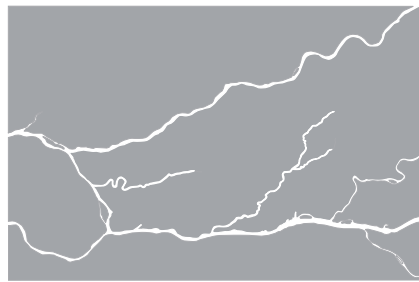
mills (*molengang*) was deployed to cover the few metres between the *boezem* and the river. The water was first pumped into the low *boezem* and subsequently into the higher one before being discharged at low tide.<sup>10</sup>

As a result of the drop in ground level, the development of the *waarden* underwent an increase of scale and a reversal: from small, river-orientated hydraulic units to the *waard* as a unit orientated towards a central main axis in the middle and with its back turned to the river. Water was drained from the central axis to the lowest polder in the West. This main axis was originally the rear where the elongated parcels extending from the riverbanks collided with one another.

## DIKING

Reclamation was accompanied by two kinds of interventions: the digging of watercourses to drain the excess water, and the construction of dikes to keep the water out.<sup>11</sup> That was not primarily the open water of the river, but above all precipitation, seepage and groundwater from the adjacent (and higher) land. The river dikes were not originally connected, but the closing of the gaps between them led to a single dike ring in place of what had been an open, fine-meshed network of transverse weirs, rear weirs and river dikes. The dikes that did not form a part of the dike ring lost their function, the others combined and took on a new significance: not only defence from the water outside the dike ring, but also the definition of the hydraulic unit.

**TRANSVERSE WEIR** In the initial stage there was not yet a need to protect the reclamation from the outside water. The land was called ‘floating’ land. The first hydraulic interventions were the transverse weirs, barriers constructed at right angles to the river to keep out the water from the neighbouring settlements upstream. This also enabled a more intensive use of the flanks of the alluvial ridges and the conversion of the grassland there to agricultural



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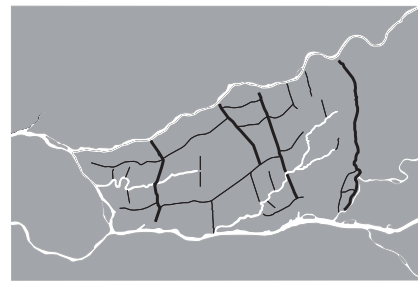


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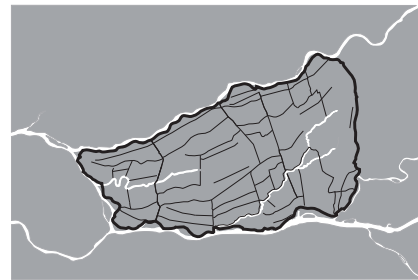
5



6



7



1. initial phase
2. transverse weirs
3. rear weirs
4. seepage weirs
5. transverse weirs, 2<sup>nd</sup> phase
6. first dike ring (1277)
7. ultimate dike ring (1857)

From Transverse Weir to Dike Ring (The Alblasserwaard)

land. These transverse weirs were constructed while the parcellation was already in place, as can be seen from their angular course. The water boards had to conduct strict monitoring to prevent the inhabitants of the upstream villages from piercing the transverse weirs.

**REAR WEIR** The next step was the construction of the rear weirs, which ran parallel to the river. They offered protection against the overspill from the more highly situated hinterland.

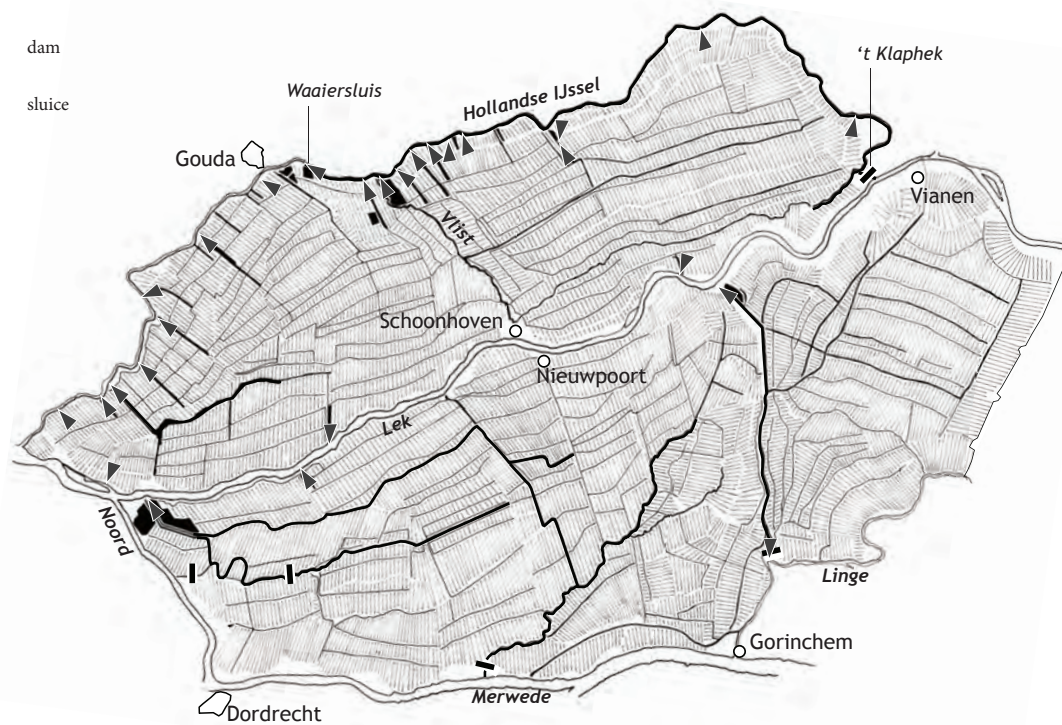
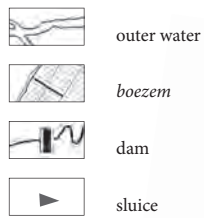
**RIVER DIKE** In the meantime, as the ground level dropped, the river water was pushed upwards, assisted by the diking of the river in the East. At the beginning of the Middle Ages, the basins were flooded in the spring by the flow of water that arrived via the Rhine and the Hollandse IJssel when the snow on the Alps began to melt. The first river dikes were created around 1100.<sup>12</sup> But the river water could still flow unimpeded into the basins at points where the local river dikes were not connected.

**TRANSVERSE WEIR** As a result of the sloping surface of the land, the water flowed from the higher polders in the East to the lower ones in the West. To prevent this, transverse weirs – comparable to the

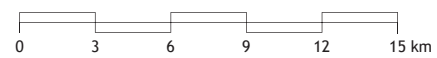
older transverse weirs on the alluvial ridges – were created in the basins on the border of a reclamation. These transverse weirs were between fifty and eighty centimetres high and were planted with willows, alders or poplars to provide timber for agricultural purposes. One of the most important inland dikes in the Netherlands is still the Diefdijk, which protects the Vijfheerenlanden and the Alblasserwaard from the water from Gelderland if a river dike is breached there.<sup>13</sup>

**DIKE RING** In 1277 a number of lords in the Alblasserwaard, at the instigation of Count Floris, joined forces and jointly financed a dike ring around the *waard*, within which the drainage could be systematically regulated. The Vijfheerenlanden followed their example in 1284. These dike rings were in fact no more than the connecting of the river dikes and transverse weirs already in place.

**SEEPAGE WEIR** A type of dike that also played a role in the hydraulic management is the seepage weir or seepage dike. As a result of the difference in pressure between the high river water and the lower-lying land behind the dike, the water was pressed under the dike and rose in the ditches behind the dike. To prevent this seepage from penetrating further inland, narrow, continuous strips of land were



Drainage





raised with a seepage ditch behind them to drain the water. The water level in the strip between the original dike and the seepage weir was thus usually not the same as that of the land behind the seepage weir. Seepage weirs were also constructed around wheels and *boezems*. Weirs known as seepage weirs may also be found in the middle of the polder in order to maintain different water levels in the polder, for example for hemp cultivation. In contrast to, for example, rear weirs, seepage weirs are projected over an existing parcellation.<sup>14</sup>

## DRAINAGE

Together with the diking, all the separate interventions to keep the water out of the basins were combined to form a single hydraulic system. The drainage of the *waarden* is carried out in four stages, each with its characteristic size, form and materials.

**DITCH** The ditch is the smallest component of the system. Small differences give expression to their place in the *waard*. For instance, the ditches in the middle of the Krimpenerwaard are wider than those on the edges because farmers dredged the ditches to reinforce and raise the land. Clay depos-

its have made the ground beside the river firmer. The ditches in the middle of the *waard* are also closer together than those on the edges because the ground is wetter here.<sup>15</sup>

**CHANNEL** The channels were dug parallel to the main drainage to receive the water from the ditches. There is usually a system of channels: a front channel, a rear channel, and sometimes also a central channel. Typical are the (concrete) bridges over the channels, flanked by one or two trees (ash, elder or willow) which stand out as a striking group of trees in the empty polder.

**BOEZEM** The most important link in the system is the *boezem*. This functions as a drainage channel, but also as a storage reservoir for the water until it can be pumped into the water outside the dike system.

**RIVER** The river, the water outside the dike system, is clearly separated from the *waard* by a high dike. The river dikes are so high that the water cannot be seen from the *waard*. It is the different, often industrial buildings that make the river visible.

In the reclamation history of the *waarden*, the enlargement of the unit was accompanied by a



reversal of the drainage flow. The drainage from a parcel to the front side, directly into the peat stream, was replaced by drainage to the rear, from where the water was successively drained into the lowest-lying polder in the West. As a result of the fact that the level both of the ground and of the rivers (and the alluvial ridges with their East-West orientation) slopes down towards the West, a structure of long (drainage) lines parallel to the river was created.

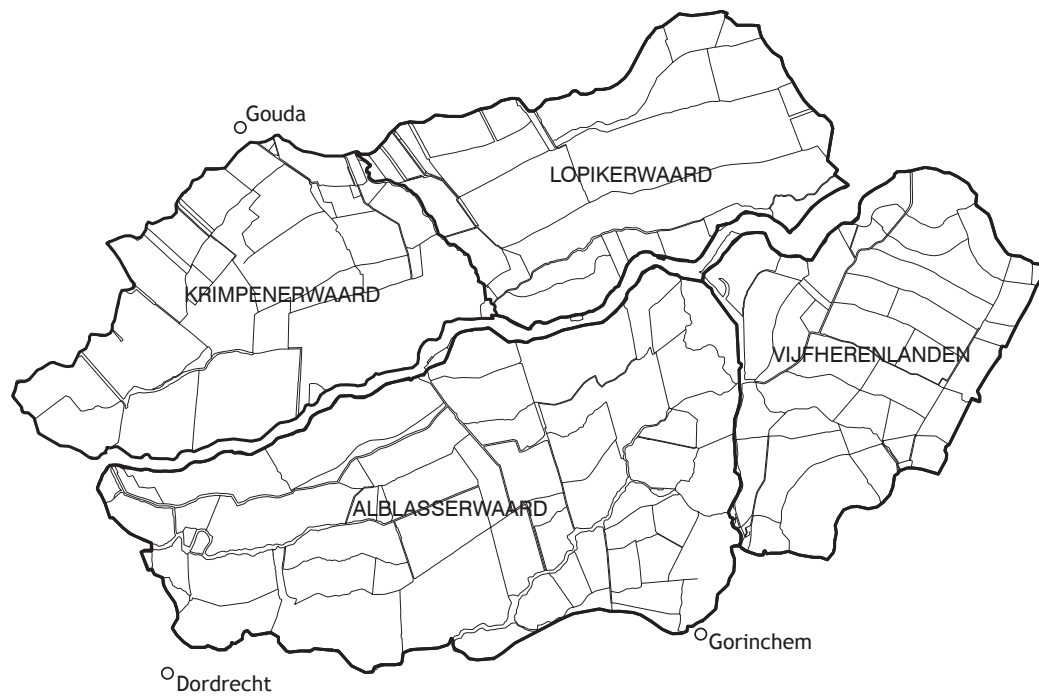
## TWO TYPES OF *BOEZEM*

There are two types of *boezem* to be found in the *waarden*: the *vliet* and the double *boezem*.

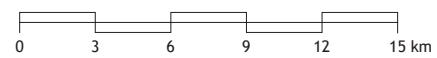
**VLIET** The *vliet* is a wide watercourse that serves to collect, store and discharge the surplus polder water. In the northern part of the Lopikerwaard and Krimpenerwaard they are arranged in a series at right angles to the river.

**DOUBLE *BOEZEM*** The double *boezem* is a later development. It is a more advanced system which was made necessary because it grew increasingly difficult to control the drainage. The system consists of a low and a high *boezem*. The low *boezem*, like

the *vliet*, is a wide watercourse that functions as a drainage channel and as a reservoir. Where the water outside the dike system cannot be controlled, it has to be drained at the westernmost point possible. This low *boezem* was therefore created parallel to the river, or at right angles to the river at the western end of the *waard*. The high *boezem* was added later. This is a meadow surrounded by weirs that functions as an extra reservoir when the river is high. In the summer the river levels were low enough and the high *boezems* were used as hay and grazing land. The high *boezems* are on average one and a half metres higher than the low ones. If the low *boezems* were full, the water was sluiced to the high *boezem*; as soon as the water could be discharged into the river, it was sluiced back from the higher to the lower *boezem*. Later on the system was improved by building high dikes around the high *boezem*, by introducing courses of mills that pumped the water from the low to the high *boezem*, and drainage sluices to discharge directly from the high *boezem* into the water outside the dike system.<sup>16</sup> This serial system is like the course of mills in the lake-bed polders. Because of its position in the parcellation, the form of the high *boezem* is the expression of the encounter between the natural form of the river and the grid of the parcellation.



Patterns of Reclamation



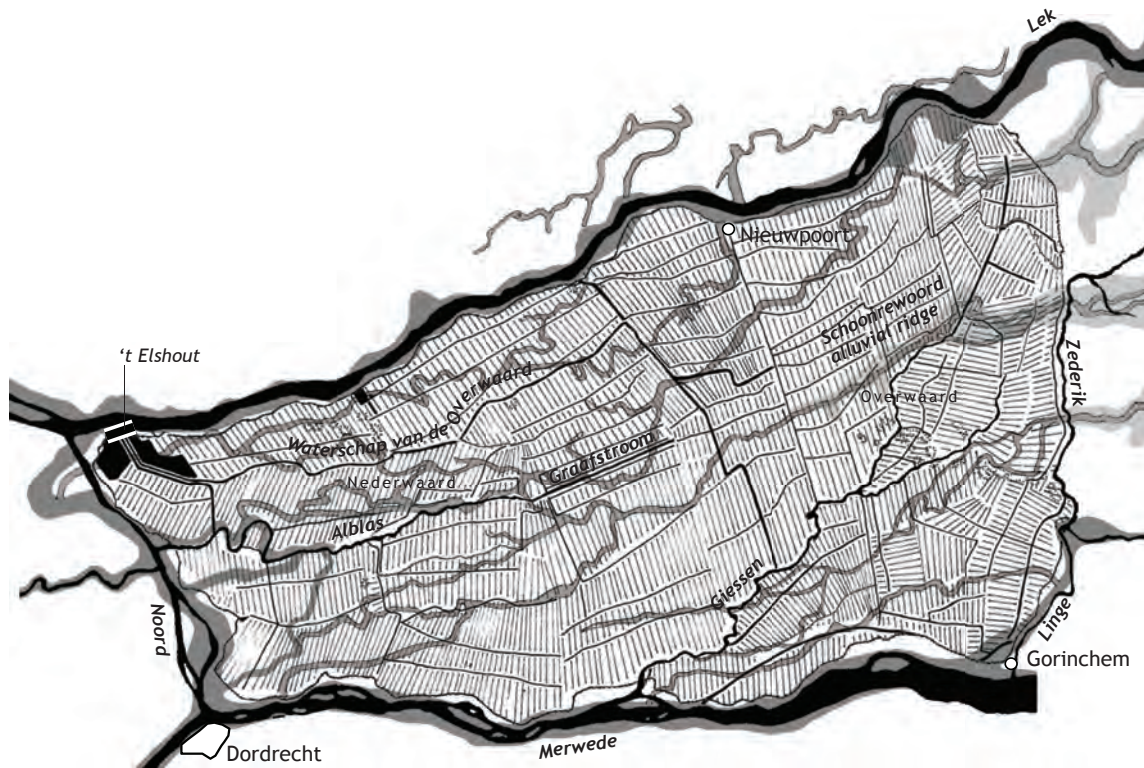
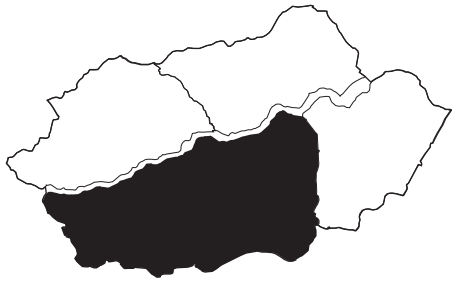
The fact that the simpler system of the *vliet* is often to be found in the northern *waarden* and the double *boezem* system in the southern ones is probably connected with the damming of the Hollandse IJssel. This made it possible to control the water level in the IJssel so that it no longer behaved like a river outside the dike system, but could take over the role of the high *boezem*.

## PATTERNS OF RECLAMATION

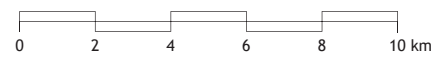
The *waard* area as a whole demonstrates a large measure of coherence, without sharp transitions and without large contrasts in forms of parcellation. All the same, the boundaries between the different units are clear and incontestable. The different units were created before the reclamation by the rivers that forked and then joined up again. The riverine islands formed in this way were confirmed and fixed in the course of the reclamation history by diking and the drainage system.

The development from a parcel cluster with a transverse weir to a *waard* with *boezems* and a ring dike took place in a similar way in all the *waarden*, but this yielded four different *waarden* depending on the differences in the natural basic form and on the administrative relations.





Alblasterwaard



## ALBLASSERWAARD

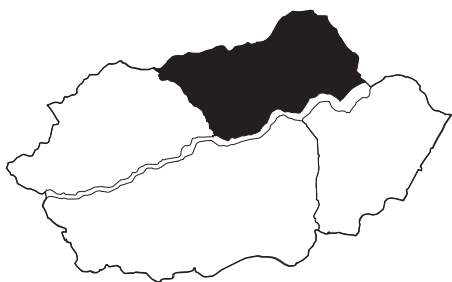
The Count of Holland issued the virgin land of the Alblasserwaard for reclamation to five lords: Brederode, Duyvenoorde, Teilingen, Lek and Ter Leede, nobles who already lived on land that had been brought under cultivation in the surroundings, such as the sandy soil behind the dunes. The first reclamations started out from the peat streams the Alblas and the Giessen.<sup>17</sup> The polder authority of the Alblasserwaard was founded on 31 March 1277. A central dike body was appointed, in which the autonomous authority of the lords was transferred to a dike board consisting of a dike-reeve and thirteen dike representatives. Initially there were still a few areas that fell outside the dike ring and had their own barriers against the water, but within a few decades they joined the dike community as well.

The Alblasserwaard consisted originally of a number of water boards: a few smaller ones, such as the Land van Arkel, that remained as an independent hydraulic unit until 1857, as well as the Streefkerk, Nieuw-Lekkerland and Papendrecht polders; and the two large polders Nederwaard and Overwaard. The Nederwaard discharged into the Alblas, the Overwaard into the Giessen. The Giessen was already dammed before 1231. The Alblas

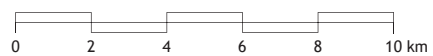
discharged via a sluice into the Noord and was extended in 1264 by the digging of a watercourse: the Graafstroom. In the fourteenth century a 17-kilometer canal was dug to drain the Overwaard: the Waterschap van de Overwaard. Not long afterwards the Nederwaard dug a new drainage channel from the Alblas to the same point of discharge at the confluence of the Lek and the Noord where the ebb levels were the lowest. Both *waarden* then proceeded to purchase land on either side of these *boezems* for use as a high *boezem*.

The Alblas/Graafstroom system runs over the Schoonrewoerd alluvial ridge and is determinant for the pattern of occupation, which consists of long lines running from East to West with the Lek and Merwede as the two outermost and the Alblas/Graafstroom as the central axis. A dense ribbon development arose on either side of the central axis. The farms often stand facing the water, which indicates that in the past the watercourses were more important means of transport than the roads. Not far from the ribbon development runs a front channel and in the middle of the polder a rear channel. The end is marked by a rear weir or dike. The Giessen cuts diagonally through this pattern and demarcates an area with irregular parcellation that deviates from the regular strip land parcellation.





Lopikerwaard



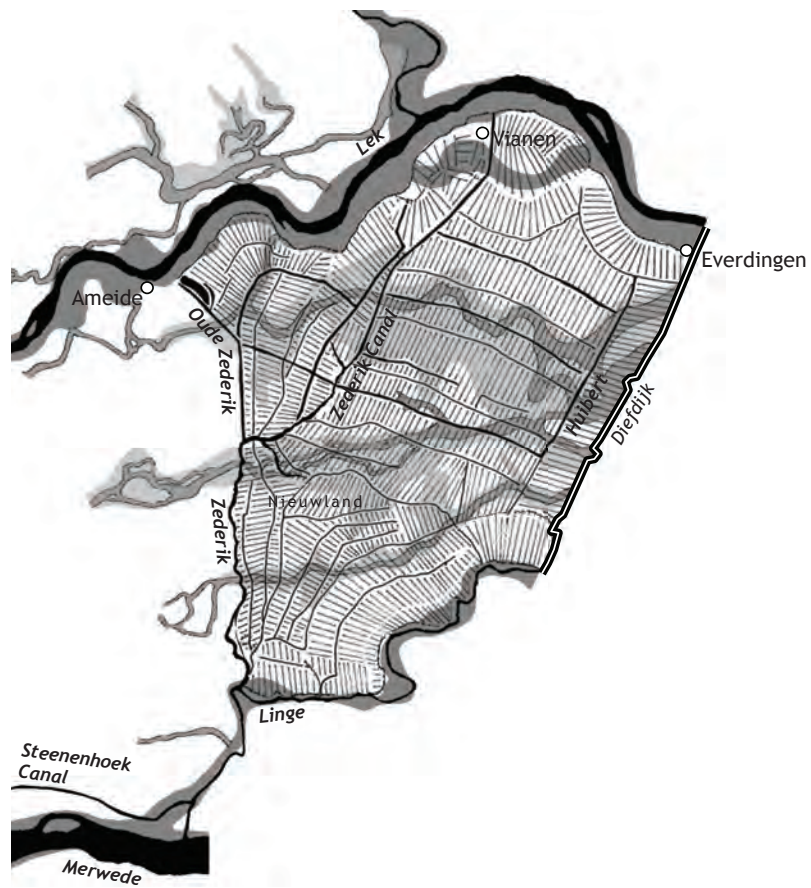
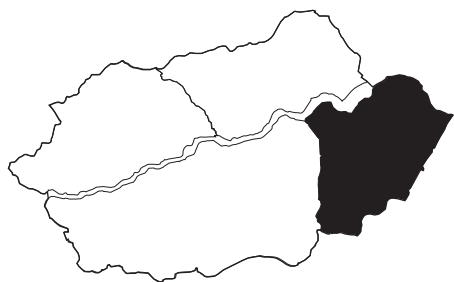
## LOPIKERWAARD

The first reclamations in the Lopikerwaard from the Vlist, the Lobeke and the Hollandse IJssel took place in the middle of the eleventh century. The northern part of the *waard* depended on the IJssel for drainage, either directly or via the Vlist; the drainage of the southern part was directly, or via the Lobeke, into the Lek. Channels, of which the most important was the Benschopperwetering, were dug for the land further away from the river. In 1155 a sluice was built at Haastrecht for discharge from the Vlist into the Hollandse IJssel. Discharge was only possible at ebb. The Vlist therefore acquired a storage function. Thanks to the damming of the IJssel in 1285, the water levels dropped here, while the Lek had to deal with an increased volume of water. From that moment on extra channels were dug to allow the entire Lopikerwaard to discharge via the Vlist into the Hollandse IJssel. Pumping with mills began around 1450. As the water was now drained more quickly, there was an acceleration in the rate at which the ground level fell, so that the storage in the Vlist proved to be insufficient. To increase the storage capacity, an area of 48 hectares was converted into an extra drainage reservoir: the high *boezem* behind Haastrecht. This *boezem* was higher than the Vlist *boezem* and formed an inter-

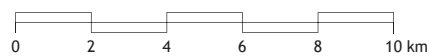
mediate stage in the discharge process. The Vlist became a low *boezem*.

The Waaier sluice was built in the Hollandse IJssel south of Gouda in 1860 to bring the water level in the Hollandse IJssel under control. This part of the Hollandse IJssel thereby came to function as a *boezem* as part of the drainage system of the Lopikerwaard. This *boezem* of the Hollandse IJssel discharges via the Waaier sluice into the Hollandse IJssel as a tidal river.<sup>18</sup>

The Lopikerwaard has the most prototypical form of a *waard*: a series of long lines running from East to West between the two parallel rivers the Lek and the Hollandse IJssel with a central axis in the middle, which is also the main drainage channel and is accentuated by ribbon development. From the Hollandse IJssel to the Lek, the lines are: seepage dike, weir, channel, main canal, channel, weir, channel, dike with watercourse. A large part of the Lopikerwaard was reclaimed from the Lobeke, so that the central Benschopperwetering, the weirs on either side of it, the central channel on the northern side and the first and second channels of Lopik make the same curve.



Vijfherenlanden



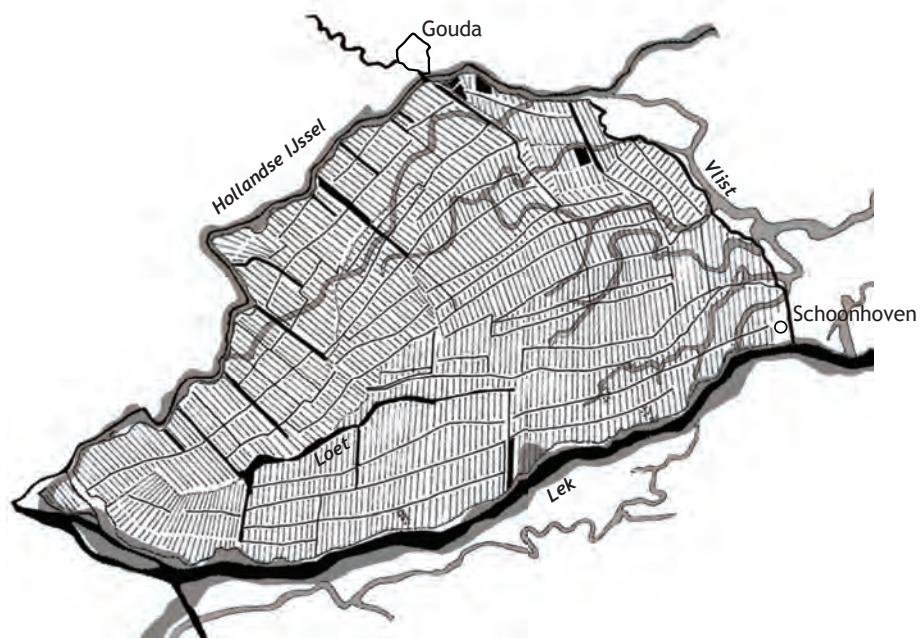
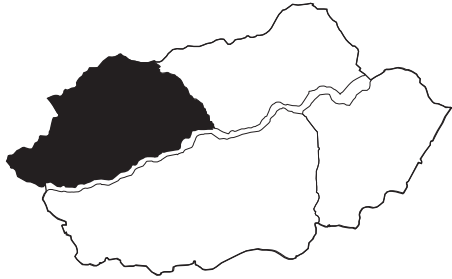
## VIJFHERENLANDEN

Reclamation of the Vijfherenlanden began in the twelfth century. The already reclaimed polders initially drained into the unreclaimed central part. When this last tract, Nieuwland (new land), was reclaimed at the end of the thirteenth and the beginning of the fourteenth centuries, that led to a drastic change in the hydraulic situation.<sup>19</sup>

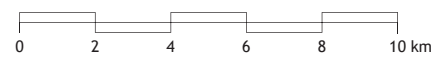
In 1284 the five lords created a water authority to tackle the problem of drainage. An important part was the digging of the Huibert. The Zederik discharged via a sluice into the Linge, which subsequently flowed into the Merwede at Gorinchem. Around 1370 the Zederik was extended with the Oude Zederik, which shifted the point of discharge from south to north. A course of mills was introduced from 1567 on and a high drainage reservoir was created at the Ameide sluices. This solution only applied to the northern polders (the Zederik fields); the southern ones still discharged directly into the Linge. Two centuries later a second high *boezem* was created. The levels of the rivers that enclosed the Vijfherenlanden proved too high for adequate discharge, so in 1818 a drainage channel was dug into the Merwede at Steenenhoek, comparable with the Achterwaterschap of the Overwaard. In

1824/1825 the Zederik Canal (later Merwede Canal) was dug, which moved the course of the Oude Zederik to the eastern side of Vianen. This also made it possible for the water from the Zederik fields to discharge into the Merwede via the Steenenhoek Canal. The building of a pumping station at the estuary of the Steenenhoek Canal in 1946 made it possible to bring the levels of both the Zederik and the Linge under control.<sup>20</sup>

The main water drainage system in the Vijfheerenlanden proved to be so unstable that only the basis of the system, the network of channels, has remained intact and been spatially accentuated by the growth of ribbon development. A compact block in the middle of the *waard* has a regular pattern of parallel channels running in an East-West orientation; the long lines are connected by transverse weirs (old water barriers) running from North to South. Between this central block and the borders there is a wide fringe of parallel or fan-shaped strip land parcellation. Between the dike and the Lek there is still a wide strip of flood meadows. The landscape of the Vijfheerenlanden is not so open and panoramic as the other *waarden*, with osier beds, orchards, poplar woods, windbreaks and planted weirs.



Krimpenerwaard



## KRIMPENERWAARD

The reclamation of the Krimpenerwaard began in the Middle Ages on the higher land beside the rivers. The Hollandse IJssel formed the basis of the *cope* reclamation of the central area. At first the polder drained towards the rivers that bounded it: the Lek, the Hollandse IJssel and the Vlist. When natural drainage proved impossible, drainage was concentrated into the Hollandse IJssel, whose water levels had fallen as a result of damming. Long drainage channels were dug high in the landscape from the central area to the Hollandse IJssel.<sup>21</sup>

Discharge into the Lek became feasible again in the nineteenth century because the construction of longitudinal embankments and groynes had accelerated the riverine drainage and low water levels became more common. This replaced the discharge into the Hollandse IJssel, while the discharge into the Vlist was maintained.<sup>22</sup>

The basic form of the land of the Krimpenerwaard is a flat island formed by two rivers with a central axis, which in this case is not the main drainage but the rear, resulting from the reclamations at a right angle to the rivers, which collided with one another in the middle. The drainage system is unusual:

it was done by means of a series of *vlieten* dug perpendicular to the river that discharged into the Hollandse IJssel. The channels have been fitted into the pattern of parallel parcels. These watercourses lie high in the landscape, sometimes a couple of metres above ground level. The advantage of discharge into the IJssel was that the water ‘had the wind behind it’ as it was pushed towards the river.<sup>23</sup>

## THE WAARDEN

The parcellation, draining and diking form a whole in close interaction with the natural basic form of four riverine islands. There are many similarities between the different *waarden*, with a coherence at every scale level, from parcel to *waard*, which suggests that they have been designed rather than evolved naturally. The system of *boezems* makes the *waarden* unique within the range of peat polders; while the landscape of peat reclamation polders is generally determined by the sum total of the smallest units, the parcels, here the most important units are the *waarden* with their *boezems*.

In the first instance the form of the cultural landscape was no different from that of river

polders elsewhere in the lowlands: a collection of autonomous little polders, each of which drained independently into the river and had to defend itself from the water that flowed down from the hinterland. However, the *waard* developed from these small polders into a large hydraulic unit enclosed by the rivers. The pieces of the individual small polders have merged to form a coherent elongated form, demarcated by the ring dike. The main drainage is parallel to the boundary rivers: from East to West.

Each *waard* has in a certain sense a central axis: an ensemble of water, road and ribbon development. This is clearly visible in the Alblasserwaard and the Lopikerwaard and functions as a central *boezem*. However, even when the drainage structure did not directly call for it, a central axis has nevertheless emerged: in the Krimpenerwaard the growing together of two rear channels, and in the Vijfheerenlanden the most central of the hydraulically equivalent parallel main water courses has been given a strong spatial accent by the ribbon development.

This central axis is the support of a modular system: clusters of long narrow parcels form long strips, with the basis of the reclamation on the front side and a channel or weir at the rear. Transverse weirs and channels border the strips on either side. The

strip is repeated from the central axis of the polder until the edge of the polder has been reached.

The northern and southern *waarden* differ from one another because, at an early stage in their development, the Hollandse IJssel was dammed to turn it into a controllable *boezem*. In the southern *waarden* the main support of the drainage system is a channel that has been dug parallel to the rivers to discharge at the westernmost point possible, preferably outside the polder. The northern *waarden* were characterised by a series of *boezems* perpendicular to the river.

There is a difference between the eastern and the western *waarden* in the pattern of parcellation. This is connected with the natural landscape, but even more with the political context in which they arose. In the eastern *waarden*, which fell under the authority of the Bishop of Utrecht and where the rivers follow a more parallel course, regular *cope* parcellation with strip reclamation prevails, while in the western *waarden*, where the Count of Holland held sway and where the rivers meet, elongated parcellation was predominant. The western *waarden* are spatially much more open than the eastern ones, which are more strongly influenced by the rivers. Outside the dike system the larger influence of the river in the





De Donk, Alblasserwaard

eastern *waarden* can be seen in the flood meadows, which are narrower or are sometimes completely absent in the western *waarden*.

With the introversion of the drainage system, a certain inward-looking character has arisen, expressed in the distinction between the inside world of the *waard* itself, on the one hand, and the outside world of the river with its flood meadows, on the other, which are separated from one another by pronounced dikes. The dikes combined with the low-lying land inside the dike system resemble a large basin.

## NOTES

1. The highest dune, West of Brandwijk in the Alblasserwaard, which is called simply 'De Donk' (The Dune), is 6.2 metres above ground level.
2. Zagwijn (1986); Oerlemans (1992) p. 107.
3. In the Vijfheerenlanden the central alluvial ridges are the oldest. The Linge levee was formed between 100 BC and 1400 AD; that of the Lek was formed before the second half of the eighth century.
4. Stegewerns (s.d.).
5. This hill now lies uninhabited amid the meadows; De Donk houses the hamlet of the same name.
6. A number of osier beds are still to be found in the Vijfheerenlanden.
7. Van Groningen (1989) pp. 15-17; Van Groningen (1991) pp. 50-51; Oerlemans (1992) pp. 93 and 113.
8. Van Groningen (1992) pp. 42-44; Van Groningen (1989) p. 12; Coeterier (1985) p. 22.
9. A deed from 1549 indicates that before the introduction of watermills the land was usually dry from May to September, and after the introduction from March to November.
10. In the nineteenth century the windmills were replaced by steam-driven water pumps, and later still by motor-driven ones.
11. The measures required to keep out the water outside the dike system and to drain the land inside the dikes are interconnected, but have different backgrounds. Both types of intervention have always been kept separate in terms of organisation and administration: the *hoogheemraadschappen* (high dike boards) were responsible for the dikes, while the *waterschappen* (water boards) were responsible for the hydraulic system inside the dikes. Van Groningen (1992) p. 39.
12. When these dikes breached under extreme volumes of water, a 'wheel' (*wiel*) was created: this was a deep hole caused by the whirling water at a breach. The new dike was usually led around it.
13. The Diefdijk has given way a couple of times, when the water reached the level of the roofs of the big farms in the Alblasserwaard. A few 'wheels' still bear witness to the breaches, the largest of which is the Bassa wheel (more than thirteen hectares). It was created at the point where the dike crossed a fossile alluvial ridge. The ridge caused a lot of seepage when the flood water was high against the dike, so that the dike was undermined. The present Diefdijk is on the eastern side of the wheel, while a seepage barrier was constructed on the western side.
14. Van Groningen (1989) pp. 9-10; Van Groningen (1992) pp. 43-47; Oerlemans (1992) pp. 94 and 106.
15. Oerlemans (1992) p. 91.

16. Visser (1982) pp. 3-19; Van de Ven (1996) p. 138.
17. Schakel (1986) p. 10.
18. Donkersloot-de Vrij (1993) pp. 128-132; Brand (1990) p. 27; Den Uyl (1958) p. 15; Feteris (1992) p. 70. Although the pumping capacity was increased, the reservoir capacity of the canalised Hollandse IJssel remained the same, so that it became increasingly necessary to stop pumping. A reorganisation of the parcellation was carried out in 1979 and the drainage direction was revised again. A pumping station was built that discharges once more into the Lek.
19. Schakel (1986) pp. 11-12.
20. Van Groningen (1989), pp. 12-14; Boxma (s.d.) p. 16; Visser (1982) pp. 20-24; Oerlemans (1992) pp. 112-114; Busch (s.d.) pp. 21-23.
21. Oerlemans (1992) p. 964.
22. Van Groningen (1995) p. 44.
23. Oerlemans (1992) p. 96.



# Between the Rhine and the IJssel

*The board of the Lek dike above the Dam announces: that the same shall hold a keen inspection of the aforementioned Lek dike from Amerongen and 't Klaphek to the Heul at 10 o'clock in the morning on Thursday 18 July 1844: and therefore instructs all those connected with the maintenance of the same dike to carry out the following measures, each according to his responsibility, before then: 1. They shall restore the weir on the inside of the Dijkweder to its old height and width, and cover it on both sides with a continuous layer of green sods so that the sand comes to lie between the two layers. 2. They shall cut off the branches of the trees that hang over the dike, to prevent the drops from falling onto the dike.*

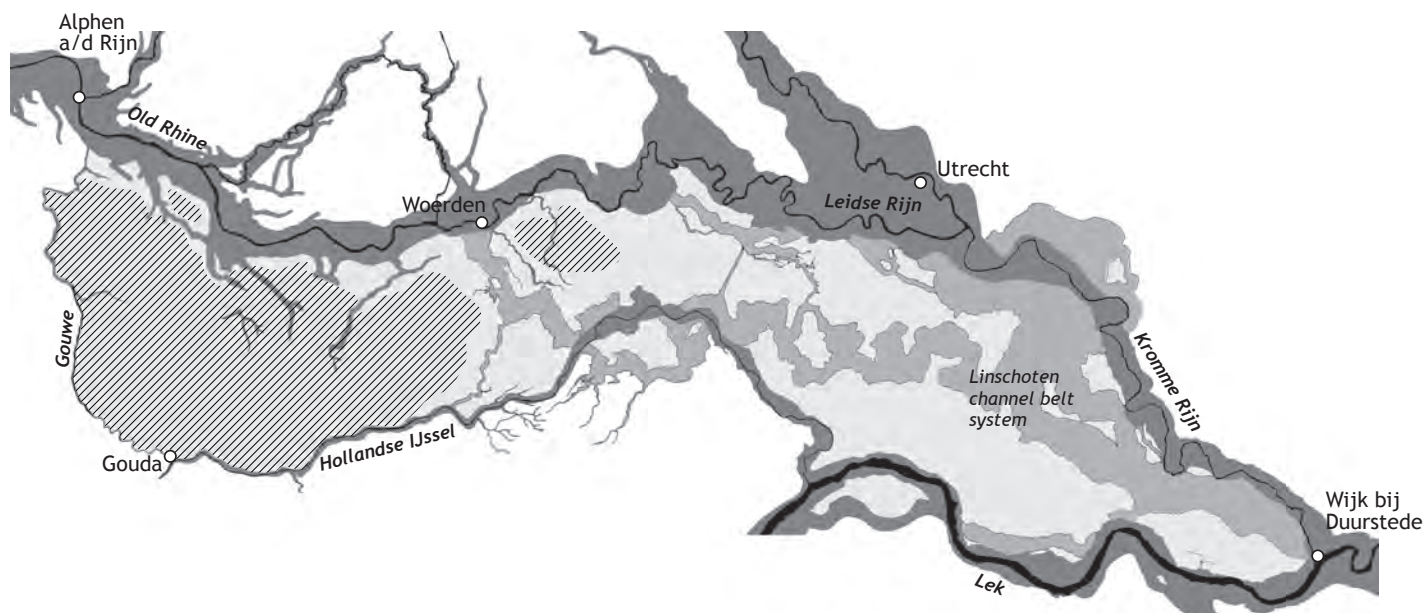
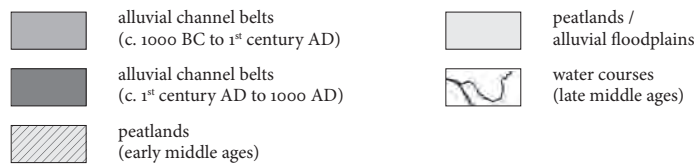
announcement of the summer inspection in 1844.

## DEMARCATIION OF THE AREA

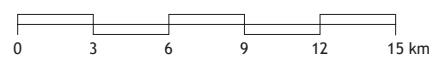
Three natural influences have determined the emergence of the Dutch lowlands: the sea, the rivers, and the stagnant water in between, the peat bog. The westernmost zone, the coastal strip, is influenced above all by the sea, followed by a zone that is dominated by peat, while the eastern zone is determined by the rivers. The landscape complex between the Rhine and the IJssel is characterised by the fact that, like the *waarden*, it lies on the transition between peat and rivers. The different patterns of reclamation show a clear succession from West

to East from pure peat (lake-bed polders), via peat that is somewhat richer in nutrients (peat reclamation landscape) to river reclamations.

The area forms an elongated strip wedged between rivers: the Rhine on the North (Leidsche Rijn, Kromme Rijn) and the IJssel and Lek on the South. To the North-East lies the Utrechtse Heuvelrug (Utrecht Hill Ridge), which marks the furthest limit reached by the ice in the last Ice Age. The Kromme Rijn runs along the foot of this ridge. On the West side the Gouwe forms the border with Central Holland. From the fork at Wijk bij Duurstede to



The Natural Landscape



the Gouwe, the rivers follow more or less parallel courses, after which they fan out to the estuaries at Katwijk and the Hook of Holland.

## THE NATURAL LANDSCAPE

**RIVERS** After the last Ice Age, the rivers came to follow a peaceful, meandering pattern. The Rhine now flowed through the South of the province of Utrecht. It had a relatively narrow bed and often overflowed its banks, so that a wide strip of levees was formed. During this flooding river sediment was deposited: coarse material near the riverbed, resulting in levees, and fine sediment in the basins behind the levees. Constant sedimentation in the inner curves and erosion in the outer curves caused the river curves to move, sometimes leading to the diversion of whole riverbeds. The river found a new course in the nearby basin area and the old riverbed silted up. The levee and the silted riverbed were left behind in the landscape as high alluvial ridges, which in turn combined to form alluvial belts. The oldest alluvial ridge was formed some 6000 years ago. A total of forty-eight different ridges of these fossil courses of the Rhine can be traced. They belong to different river systems, of which the

Linschoten river system is the most important in this area.<sup>1</sup>

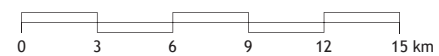
The present Old Rhine was formed about 3000 years ago and was for a long time the main river with a bed averaging 100 metres wide. Around the beginning of the first millennium, the Old Rhine, whose main course flowed into the sea at Katwijk at the time, was one of the most important rivers. Around 1000 the riverbed silted up and its course has now almost entirely disappeared.<sup>2</sup> The Lek, which arose around the beginning of the first millennium, took over that function.<sup>3</sup>

**PEAT** After the end of the last Ice Age the sea level rose by some 30 metres, and so did the groundwater level in the plains behind the coast as a result. Where the groundwater came close to the surface, bogs developed and peat began to be formed. About 8000 years ago the groundwater had risen so much that peat was formed in the wind-borne sands to the West of the Utrechtse Heuvelrug. The peat cushion is thicker in the West than in the East, where the rivers had a larger influence. When the rise of the sea level began to decelerate, peat formation slowed down too.





Water Boards and *Buurschappen* Around 1250



**THE FORM OF THE NATURAL LANDSCAPE** The belts of watercourses, both those that have dried up and those that still carry water, of the Linschoten, the Old Rhine and the Lek form long, sometimes very wavy lines with an East-West orientation, with the low basins in between. The western basins, where no clay was deposited, consist of peat.

## RECLAMATION HISTORY

The area between the Rhine and the IJssel was a typical border area for centuries, where the unpredictable border between the provinces of Holland and Utrecht ran and where boundaries between the different water boards continually changed. In administrative terms too, it was a transitional area where the competences could vary from shire to shire and from polder to polder.

For centuries dikes, canals and sluices were managed by small local independent agricultural communities (*buurschappen*). The administration was in the hands of a sheriff and those with an entitlement to land (*buren*). In this period the different reclamation blocks in the basin areas were separate administrative and hydraulic units, but

as hydraulic interests grew too complex for the individual authorities to deal with, the need arose for a separate authority in charge of water management. Representatives were chosen to conduct the inspection: the dike representatives. The main difference from the peat areas in the North was that there was a feudal authority here; the count and the bishop could promulgate laws concerning the dikes and mediate between the individual communities if necessary. The dike boards formed the executive, while ultimate jurisdiction lay with the feudal authority. The water boards that were formed did not need to concern themselves with every branch of water management; sometimes they were only responsible for a dike ring, a drainage system, a sluice or a dam. Regional water boards were set up to coordinate the different administrative bodies. The Lek dike above the Dam is one of the oldest.<sup>4</sup>

To protect the reclaimed land from flooding by the Rhine, dikes and dams were constructed. The damming of the Kromme Rijn at Wijk bij Duurstede in 1122, at the initiative of the bishop, was an important event. By then the Kromme Rijn was already silted up and did not carry much water any longer. The diking of the Lek and the Hollandse IJssel was also completed in the second half of the thirteenth century.<sup>5</sup>

**LEK DIKE ABOVE THE DAM** The construction of the dam at Wijk bij Duurstede in 1122 led to the establishment of the later dike board of the same name. At the same time as the construction of the dam, the front weirs beside the river were raised and connected to form the Lek dike, under the supervision of the Count of Lek and IJssel, who was in turn dependent on the Bishop of Utrecht. The owners of the adjoining reclamations, that ran more or less at right angles to the dike, maintained the major part of the Lek dike. Small sections of the dike were maintained by local communities from further away. Supervision was regulated locally. Around 1230 a major flood led to a repair and reinforcement of the Lek dike. The first board of the Lek dike above the Dam water board was instituted in 1234. The dike-reeve together with five dike boards became responsible for the supervision of the maintenance of the dike. In 1285 a dam was constructed in the Hollandse IJssel at 't Klaphek, because the river had become so silted up by now that it was growing increasingly difficult for the adjacent reclamations to drain into it. The dam marks the border between the high dike boards of the Lek dike above the Dam and the Lek dike below the Dam (later Lopikerwaard).<sup>6</sup>

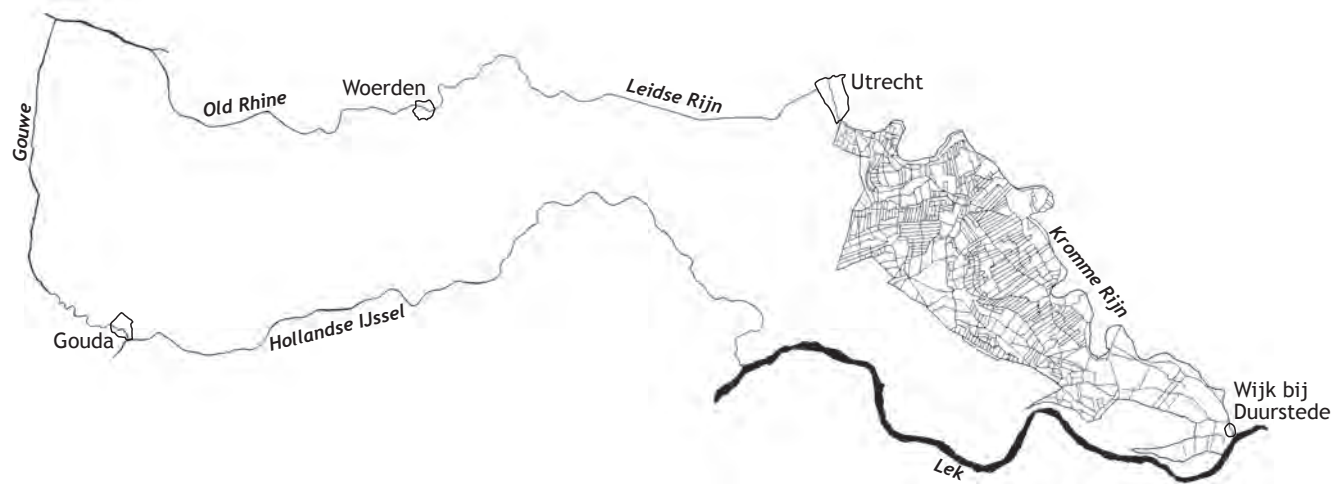
**UTRECHTSE BUURSCHAPPEN** The difficulties with discharge into the Old Rhine from around 1200

led a number of small agricultural communities (*buurschappen*) West of the city of Utrecht to switch to discharging into the Vecht in the first quarter of the thirteenth century. To this end two drainage channels were dug and the Old Rhine was dammed. The Meern dike was also constructed between the high land beside the Hollandse IJssel and that beside the Leidsche Rijn, to stop the settlements East of the Meern dike from discharging their surplus water further westwards. The eastern settlements were therefore also obliged to switch to discharging into the Vecht, which they did by connecting their part of the Leidsche Rijn with the canals of the city of Utrecht.<sup>7</sup>

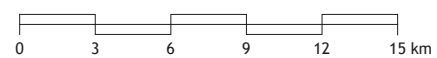
**RIJNLAND** The Rijnland regional water board owes its origins to the activities of the small agricultural settlements in the area of the Old Rhine. They were also obliged to cooperate in order to adopt measures to tackle the drainage problems after the silting up of the estuary of the Old Rhine. They jointly created the dam at Zwammerdam, dug drainage channels to the lake district North of Leiden, and went on to establish an overarching water board. They cooperated with the Utrecht settlements in maintaining the sluices at Wendeldijk, the dike beside the Leidsche Meer, into which their drainage channels discharged. (see drawing on p. 128)<sup>8</sup>



The Kromme Rijn near Ossenwaard



## River Reclamations

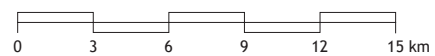


## RIVER RECLAMATIONS

In the Carolingian era (750-900) the population in the area of the Kromme Rijn increased and transformed parts of the wooded riverbanks into agricultural land. The Franks won the territory from the Frisians at the Battle of Dorestad in 689, and the episcopal see was established in Utrecht. Settlements arose on the alluvial ridges of Houten and of the Kromme Rijn, with farms around a village green or common land. On the higher parts of the land around the farms was arable land for grain, while the lower parts were used for hay and pasture. The parcellation pattern in this area is characterised by relatively large, block-shaped parcels with an irregular form. By the first quarter of the twelfth century all the riverbanks had been entirely taken over by reclamation settlements, while the interior was often still wild peat bog.<sup>9</sup>



Peat Reclamations





## PEAT RECLAMATIONS

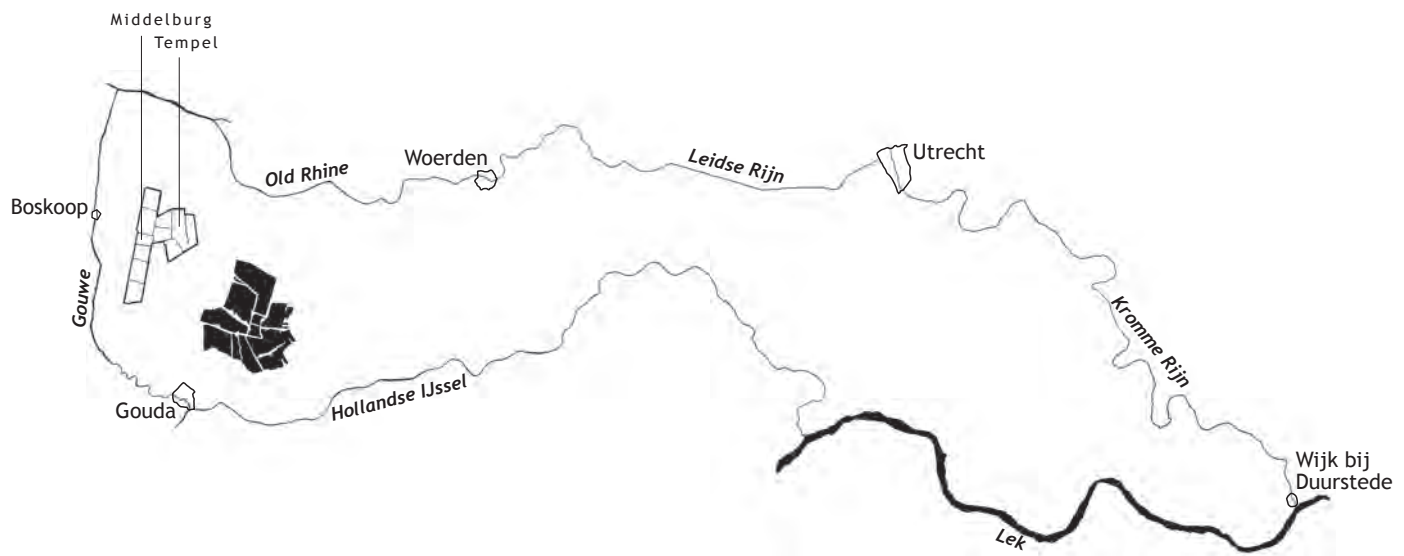
Around 1050 the higher land was becoming crowded and the opportunities for expanding the surface area under cultivation were exhausted. The marshy basin areas were gradually reclaimed; access was by river. Reclamation started from the East, from the settlements in the area of Utrecht that had been inhabited for centuries, along the banks of the Hollandse IJssel. The Bishop of Utrecht issued parts of the marshes, so that the reclamation of the basins was systematic and based on a system of agreements (*coptes*). Unlike the river polders, the water management in these reclamations was regulated beforehand. By about 1300 the last land in these marshy basins had also been reclaimed.<sup>10</sup>



lake-bed polders



peat extraction lakes

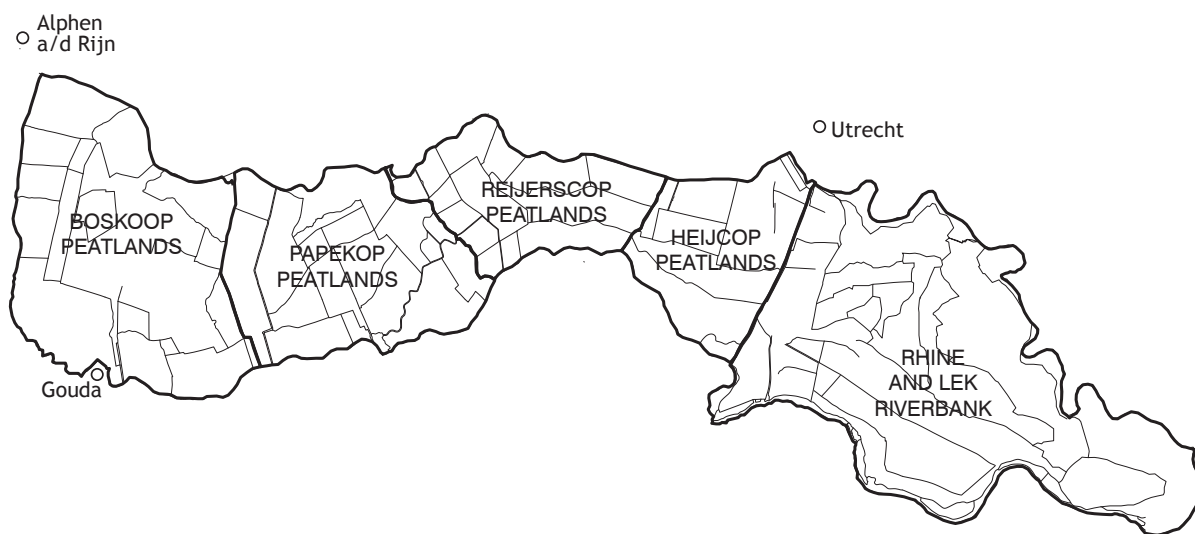


Lake-bed Polders

## LAKE-BED POLDERS

There were few peat extractions in the area between the Rhine and the IJssel. Because the influence of the rivers was so strong, the peat was generally too poor to be used as fuel. Only North of Gouda was peat extracted as fuel for Gouda from a relatively small area. Peat extraction went on in a total of thirteen lakes here between the sixteenth and the nineteenth centuries, but only the northernmost was drained. This polder was excavated again in the twentieth century for its sand.<sup>11</sup>

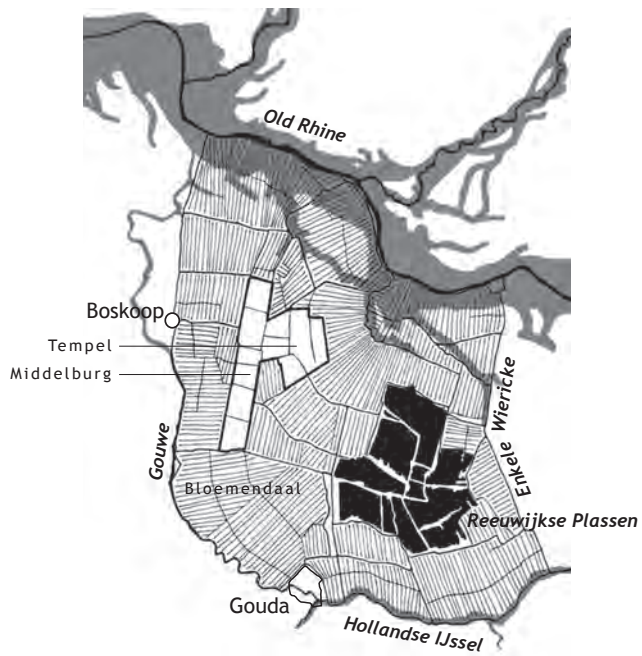
Peat was also cut to the East of Boskoop, not for fuel, but to raise the nurseries in Boskoop. The peat was not extracted right to the bottom, so that the resulting lake-bed polders, Tempel and Middelburg, are relatively shallow and have a peaty soil.



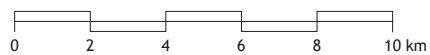
Patterns of Reclamation

## PATTERNS OF RECLAMATION

The elongated strip between the two parallel rivers – the Rhine and the Lek/IJssel – is intersected by a number of lines from river to river: natural links such as peat streams and alluvial ridges, and man-made links such as drainage channels and dikes. In spite of the difference in genesis and function, they play the same role in the administrative, hydraulic and landscape breakdown of the Rhine-IJssel complex. The Gouwe, the Enkele Wiericke, the alluvial ridge at Linschoten, the Meern dike, and the Vaartse Rijn bring about a rhythmical division of the peat landscape and mark the borders between the different patterns of reclamation. The areas lying in between have been reclaimed both from the banks of the larger rivers to the North and South, and from these ridges and water lines. East of the Vaartse Rijn the landscape changes from a peat landscape to a riverbank landscape, which is clearly reflected in the parcellations.



## Boskoop Peatlands



## BOSKOOP PEATLANDS

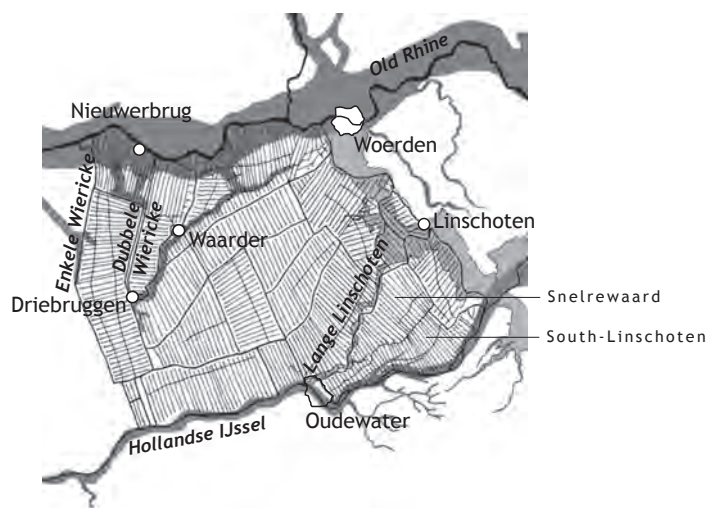
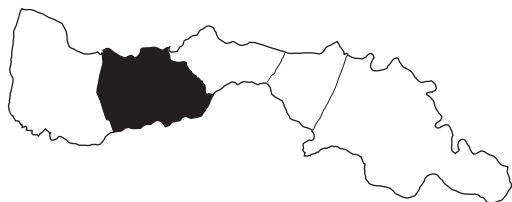
The Old Rhine was already dammed at Wijk bij Duurstede in 1122, but the Hollandse IJssel was still a functioning arm of the Rhine, which made drainage problematic here, and the Gouwe was a small peat stream that flowed into the IJssel. Later it was connected with the Rhine by the digging of a canal, and from that moment formed a through navigable route between the Old Rhine and the IJssel. The Enkele Wiericke *boezem* forms the eastern border.

Around 1150 only the clay borders of the rivers and the adjoining peatlands had been reclaimed. The Bloemendaal polder near what was later to become Gouda was reclaimed in 1139 with a pattern of ditches orientated towards the Gouwe. There were still peat cushions a few metres high between the settlements, and the reclaimed land was protected from the water from these peat mounds by rear weirs. Between 1170 and 1220 there were serious drainage problems, partly caused by the silting up of the estuary of the Rhine, and it was impossible to reclaim new land. After the completion of a new drainage system to the North-West and of the Heimans channel in 1202, reclamation could get under way again. The first intervention was in 1222 in the area to the North of the later Boskoop. The reclama-

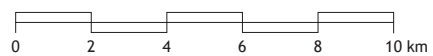
tion took place in three blocks, and the system of ditches was orientated towards the Old Rhine. One of these ditches was widened to form a broad drainage channel to connect the Gouwe with the Old Rhine, so that the Boskoop peatlands were separated from Central Holland. After the completion of this channel, the area to the South of Boskoop was reclaimed at a fast tempo. The reclamation of the area to the East of Boskoop also took place in the thirteenth century and followed the same pattern of small blocks. These reclamations also drained into the Old Rhine. After the damming of the Hollandse IJssel in 1285, drainage was switched to the IJssel. New drainage channels were dug for this purpose.<sup>12</sup>

The Count of Holland built a manor in what is now Boskoop in the ninth century. It was sold to Rijnsburg Abbey in the thirteenth century. The monks began to grow vegetables, fruit and herbs. For a long time market gardening and cultivating fruit trees were a subsidiary activity of the farmers, until in the eighteenth and nineteenth centuries they grew to become a separate commercial activity which has left its mark on the region. The narrow, small parcels are characterised by a wide diversity of vegetation, and particularly in the oldest part of Boskoop the parcel ditches are wide because they were dredged to raise the arable land with the





## Papekop Peatlands



sludge. The Boskoop nurseries were raised with turf cut from the neighbouring Tempel and Middelburg polders, the Reeuwijkse Plassen or even all the way from Vinkeveen.<sup>13</sup> It is noteworthy that the parcel-lation in the Middelburg (1870) and Tempel (1878) polders followed the same pattern after they had been drained as before the peat extraction.<sup>14</sup>

Of the thirteen peat extraction lakes that combine to form the Reeuwijkse Plassen only the northernmost was drained (1892). In the 1960s, however, this polder was excavated again for sand. This lake is 30 metres deep at some points, while the neighbouring peat extraction lakes are around five metres deep.<sup>15</sup>

## PAPECOP PEATLANDS

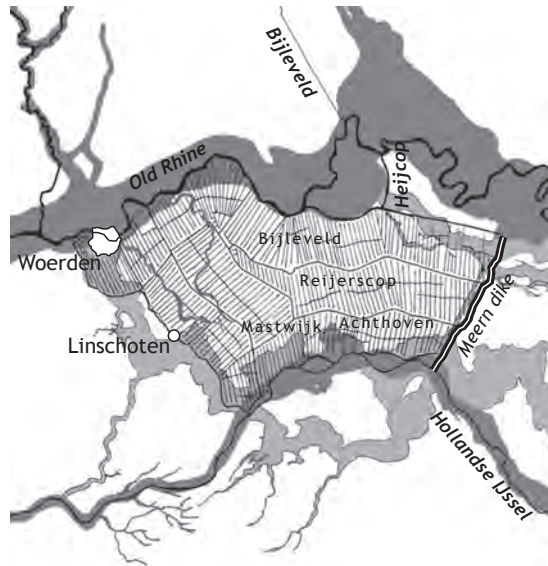
The Enkele Wiericke *boezem* forms the western boundary of the Papecop peatlands.<sup>16</sup> The eastern boundary is formed by the Linschoten alluvial ridge of an old course of the Rhine, which was abandoned around the beginning of the first millennium. The Enkele Wiericke and the Dubbele Wiericke were dug in the second half of the fourteenth century for the polders which used to discharge into the Old Rhine, and after the damming of the Hollandse

IJssel had shifted their drainage to the South with these new drainage channels.<sup>17</sup>

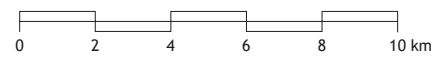
The village of Linschoten was built on the firm sandy ground of the Linschoten alluvial ridge, and the Lange Linschoten, which ran into the Hollandse IJssel, still flows there. It is the westernmost spur of the river area, which finds expression in the irregular block parcellations and the many orchards. The border between the South-Linschoten and Snelrewaard reclamations lies between the Lange Linschoten and the Hollandse IJssel. The strip parcellation here is orientated partly towards the Lange Linschoten and partly to the Hollandse IJssel.<sup>18</sup>

Further westwards a peat stream ran which ended up in the Old Rhine. The villages of Waarder and Driebruggen were built on the clayey banks of this stream, which also functioned as the reclamation base for this area. The parcels are 1250 metres long, with a weir covered with a copse at the end.<sup>19</sup>

Between Nieuwerbrug and Woerden is the ribbon development beside the Rhine but at a distance of 200 to 400 metres from the river. This is because the first farms were built before the Rhine had been dammed, and thus regularly burst its banks.<sup>20</sup>



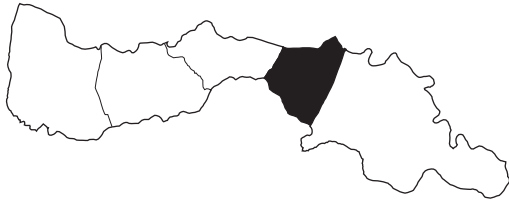
## Reijerscop Peatlands



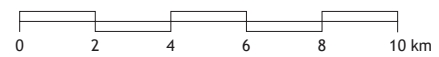
## REIJERSCOP PEATLANDS

The Reijerscop peatlands lie between the old Linschoten alluvial ridge and the Meern dike, which was constructed in the thirteenth century by the Woerden water board to keep out the water from the polders to the East of it.

After the damming of the Hollandse IJssel, the Reijerscop and Bijleveld polders decided to discharge here as well. In 1363 they joined the main water board of Woerden, but it soon became clear that the Hollandse IJssel was silting up rapidly because of the damming and the polders had to look for a new discharge point in the East. In 1413 they created a watercourse to the Amstel, the Bijleveld. (see drawing on p. 128) A committee consisting of a dike-reeve and dike representatives was set up to manage the Bijleveld by the residents of Bijleveld, Reijerscop, Mastwijk and Achthoven.<sup>21</sup>



## Heijcop Peatlands



## HEIJCOP PEATLANDS

Between the Meern dike and the Vaartse Rijn lie the Heijcop, Oudenrijn, Galecop, Papendorp, Westraven, and Nedereind van Jutphaas polders. The Vaartse Rijn was dug in 1122 as a navigable route between the city of Utrecht and (via the Hollandse IJssel) the Lek.

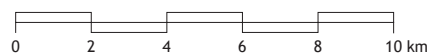
The construction of the Meern dike created serious problems for the polders of the Heijcop peatlands. The polders were excluded from the 1220 agreement between Rijnland and the Land of Woerden to discharge into the Old Rhine (see p. 195). The dike also dammed the channel which drained the Oudenrijn polder.<sup>22</sup> It is probable that the Heijcop polder was almost constantly under water until a definitive solution was found in 1385.

The polders were now obliged to look for a discharge point in the East: via the canals of the city of Utrecht into the Vecht, or via the Vaartse Rijn into the Hollandse IJssel. The damming of the latter in 1285 made discharge into the river possible again. From 1298 the Heijcop polder discharged into the Hollandse IJssel, but since the polder was exceptionally low, this could not function for long. In 1385 the Lange Vliet or Heijcop drainage chan-

nel was dug from the lowest point in the polder to the Vecht to the North of Breukelen (see drawing on p. 128). To this end the polders of the Heijcop peatlands joined to form the 'Heijcop Water Board called The Lange Vliet'. However, when the Vecht was high they could not discharge into it. The drainage was therefore moved in 1424 to the Amstel via the Aa and the Angstel, which in turn led to conflicts with the Amstelland water board.<sup>23</sup>



Rhine and Lek Riverbank





## RHINE AND LEK RIVERBANK

A riverbank landscape emerged in the armpit of the forking of the Kromme Rijn and the Lek. From the eighth century it was cultivated with typical riverbank parcellations. These riverbank parcellations gradually turn into peat parcellations as far as the western border of this area, the Vaartse Rijn, after which only peat parcellations are to be found.

The Kromme Rijn was an important navigational route in the Roman era. Around 650 the town of Dorestad (Wijk bij Duurstede) was founded at the forking of the Kromme Rijn and the Lek. Dorestad was the biggest and most important settlement of the Dutch lowlands. Until 863, when the town was definitively destroyed by the Vikings, it was a European centre of trade and industry. After the silting up of the Rhine estuary in the twelfth century, it became almost impossible to still discharge into it, especially in the winter, and there were many floods. That is why a dam was built in the Kromme Rijn at Wijk bij Duurstede in 1122.

The reclamations beside the northern bank of the Lek initially benefited from the levee of the Lek. Later low weirs were constructed here, which were

eventually connected with one another and raised to form the Lek dike.<sup>24</sup>

The structure of parcellation is a direct reflection of the basic natural form. The complex of fossil alluvial ridges on the northern side is characterised by the irregular, block-shaped parcels of old river reclamations (8-12th centuries) with orchards and arable land, while the zone between the alluvial ridges and the Lek dike consists of the regular parcellations of the peat meadows. The Amsterdam-Rhine Canal was dug in the middle of the twentieth century along the edge of the Linschoten alluvial ridge, thereby emphasising the border between the two types of landscape.

## PEAT RECLAMATIONS AND RIVER RECLAMATIONS

The parallel course of the rivers on the northern and southern sides made it possible to reclaim a large area in regular strips with an East-West orientation. The North-South intersections of the landscape were a reason to deviate from this pattern: the strips run from North to South beside the Gouwe river, the Enkele Wiericke drainage channel,

and the alluvial ridge at Linschoten. East of the Vaartse Rijn there is a clear change in the landscape. Fertile levee soils with river reclamations have sprung up beside the Kromme Rijn.

The transition from peat reclamations to river reclamations can be clearly seen in the series of reclamation patterns between the Rhine and the IJssel. The westernmost point, the Boskoop peatlands, lies on the spur of the peat cushion. Peat reclamation has taken place here, though on a limited scale. The three units in the middle are regular blocks with systematic reclamations based on agreements, separated from one another by old river courses or land barriers. The easternmost polder unit has very little peat in the subsoil, and has all the characteristics of a diked riverbank landscape.

## NOTES

1. Stichting voor Bodemkartering (1969) pp. 36-39; Weerts and Cleveringa (2002) p. 118; Donkersloot-de Vrij (1993) pp. 14-16.
2. To provide Utrecht with a navigable link with the West after the river had silted up, the Leidsche Rijn was created at the end of the fourteenth century by widening a number of existing channels.
3. Borger (1997) pp. 49-51; Donkersloot-de Vrij (1993) p. 18.
4. Donkersloot-de Vrij (1993) pp. 45-47; Van de Ven (1993) pp. 67-68.

5. Donkersloot-de Vrij (1993) pp. 21-22.
6. Donkersloot-de Vrij (1993) pp. 27-32; Van de Ven (1996) p. 69.
7. Van de Ven (1996) p. 67.
8. Van de Ven (1996) pp. 69-70.
9. Donkersloot-de Vrij (1993) pp. 18-20; Van de Ven (1996) p. 60.
10. Donkersloot-de Vrij (1993) p. 20; Van de Ven (1996) p. 60.
11. Oerlemans (1992) p. 87.
12. Van de Ven (1988) pp. 11-13.
13. This was necessary because the trees and shrubs were sold with a clump of soil around the roots, so that a lot of soil disappeared from the region. Moreover, the soil was rapidly impoverished by the cultivation of leafy crops, and turf is very rich in humus.
14. Oerlemans (1992) pp. 82-84.
15. Oerlemans (1992) p. 87.
16. The Enkele Wiericke and the Dubbele Wiericke one and a half kilometres away formed part of the defensive line known as the Old Holland Water Line. The strip of land between these two drainage channels is the narrowest part of that line.
17. Van de Ven (1988) p. 14.
18. Borger (1997) pp. 52-53.
19. Oerlemans (1992) pp. 87-88.
20. Oerlemans (1992) p. 89.
21. Donkersloot-de Vrij (1993) p. 50.
22. Donkersloot-de Vrij (1993) p. 50.
23. Donkersloot-de Vrij (1993) p. 50.
24. Donkersloot-de Vrij (1993) pp. 19 and 27-29.



The Lange Linschoten



# Between the Rhine, the Vecht and the Drecht

*What is immediately striking from a perusal of the topographic map is the typical confluence of all roads and waterways at a single point, the centre of the Ronde Venen area, that lies just to the North of the village centre of the municipality of Wilnis in the so-called inner ring of the Ronde Venen. The parcellation has also been adapted to that, for the longitudinal axes of most of the parcels are orientated towards this centre. Only the parcelling of the lake-bed polders, as one would expect, does not follow this pattern.'*

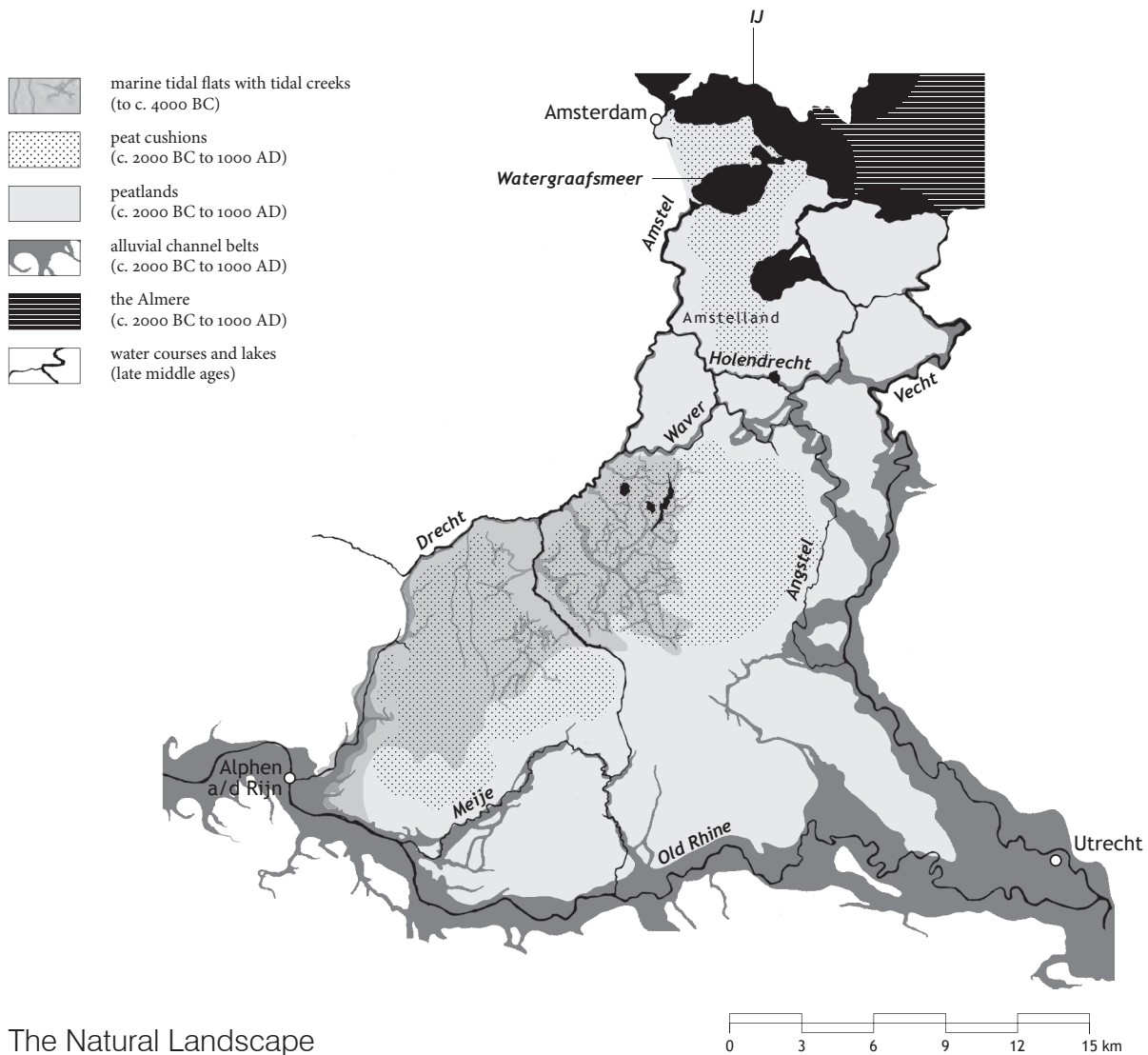
F.H. De Bruijne,

*De Ronde Venen; Een sociaal-geographische studie van een gedeelte van het Holland-Utrechtsch weidelandschap, 1939.*

## DEMARCATIION OF THE AREA

The area was originally part of a much larger, continuous peat area, but it became isolated from Waterland with the formation of the IJ, so that now the Zuyder Zee (the present IJsselmeer) and the IJ form the northern boundary. The Old Rhine and the Vecht rivers form the southern and eastern boundaries and have, at different periods, played an important role in the drainage of the delta. They developed a wide strip of levees so that they formed natural boundaries in the peat landscape, even after their role in the drainage system had diminished.

The western boundary is formed by the Drecht and the Amstel. These peat streams were relatively insignificant before the reclamation – the Amstel flowed from its source in the Watergraafsmeer southwards to the Vecht, while the Aar flowed into the Old Rhine – but they were linked to form a through waterway between Alphen aan de Rijn and Amsterdam.



## The Natural Landscape

## THE NATURAL LANDSCAPE

The Rhine-Vecht-Drecht complex lies outside the river delta proper, where the Vecht and the Angstel are relatively small tributaries. Unlike the previous complexes, there is thus relatively little influence from the rivers to be seen; the marine influences play a larger part.

**PEAT** After the last Ice Age the area consisted mainly of sediment deposited by the wind, a subsoil that slopes relatively evenly westwards, from some five metres below NAP (Normal Amsterdam Level) at the Vecht to more than ten metres below NAP at the eastern boundary, the Drecht. This subsoil became covered by peat because the rising sea level also caused the groundwater level in the hinterland to rise. Bogs and freshwater lakes emerged in which peat was formed, the Basisveen. As a result of later deposits of clay, this layer of peat was compressed, so that it is now only 30 to 50 centimetres thick.<sup>1</sup>

**SEA** The same rise in the level of the groundwater created a lagoon between the beach ridges and the higher land in the East, which was connected with the sea. The eastern boundary of the old sea clay that was deposited in this inland lake runs through the middle of the area. Sea clay deposited via creeks

in various stages is still present at varying depths just below the surface in the Groot-Mijndrecht and Wilnis polders. Compaction of the peat that was accumulated later has now made the creeks visible as ridges in the terrain.<sup>2</sup> Slight saltwater seepage still occurs in the more deeply situated polders (Groot-Mijndrecht) because these sea clay beds are saline.<sup>3</sup>

**PEAT** Some 4000 years ago the beach ridges were closed and the sea could no longer reach the hinterland. The high groundwater triggered a new period of extensive peat growth, the Hollandveen, which continued until after the beginning of the first century AD. Precipitation, which emerged from the ground of the sandy Heuvelrug as seepage, also played a role in that process. The low, flat areas received slightly more nutrient-rich water and developed to become sedge peat bogs. The rich swamp vegetation that flourished along the rivers and the peat streams resulted in forest bog, while bolls of sphagnum peat were formed in the central areas beyond the influence of the nutrient-rich river water. In the West the peat rests on the old sea clay, while in the East the basis consists of the older peat layers of the Basisveen, and even further eastwards the layer of wind-borne sand.<sup>4</sup>



Until the early Middle Ages the peatlands of Amstelland and Waterland (North of Amstelland) were continuous. The Amstel still ran southwards from what would later become the Watergraafsmeer before flowing into the Vecht. The emergence of the IJ in the twelfth century separated the two peat areas. The Amstel was later connected with a tributary creek of the IJ after the digging of a connecting channel.<sup>5</sup>

**SEA** At a later stage the area once again came under the influence of the sea, but this time from the North. In the second half of the twelfth century storms in the northern part of the Netherlands eroded the peat and the Almere became openly linked with the North Sea via the Waddenzee. From then on this area was subject to tidal movement and salt water. The same factors led to the northern part of the Vecht coming under tidal influence and receiving deposits of brackish sea clay.<sup>6</sup>

**RIVERS** About 5600 years ago a new river course arose on the northern boundary of the original river plain of the Rhine: the Old Rhine. 1000 years later this had become the most important branch of the Rhine, and was to remain so until the end of the ninth century.

3000 years ago the Rhine formed a branch to the North, the Vecht/Angstel. This flowed via a delta into the Almere, which was still an inland lake at the time, before passing via the original IJ into the North Sea. The Angstel was formed earlier, branching into the Waver and the Holendrecht. The Vecht is a couple of centuries younger and took over the role of the Angstel through several links. The Vecht formed not only levees on either side of the current, but also crevasse complexes, where water flowed over lower points in the levee into the surrounding area and formed small creek systems there. Sometimes these tributaries were so big that they took over the task of the original main river. The abandoned rivers remained open, because their distance from the start of the Vecht/Angstel prevented the little river sediment from reaching them. Until the Roman era the Vecht was a navigable river, afterwards it became less important and served only to drain the seepage from the Utrechtse Heuvelrug (Utrecht Hill Ridge). The area became wetter and peat started to grow there again.<sup>7</sup>

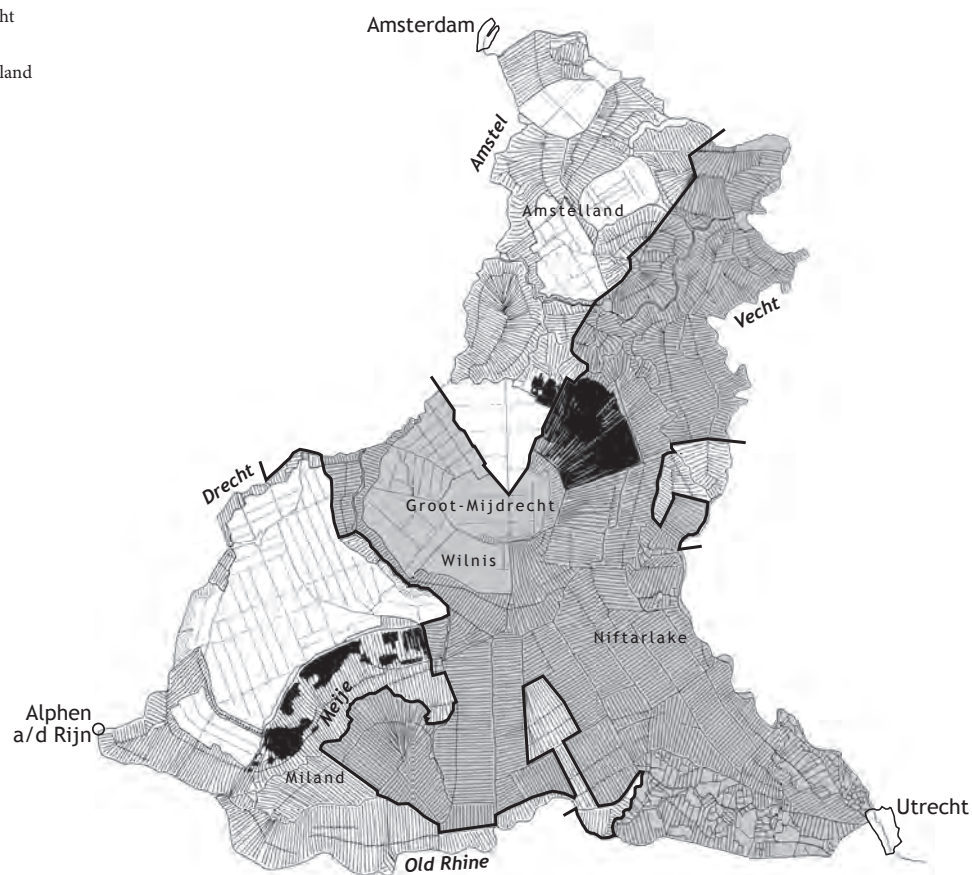
The Old Rhine also had less and less water to carry. From the start of the first millennium AD an increasing volume of water was diverted to the Maas and to the estuary in Rotterdam. The Lek, which originated around the same period, took over

the main water transport function. In the twelfth century the Rhine estuary at Katwijk aan Zee silted up. At the same time Holland was affected by floods on several occasions, which accelerated the silting up of the estuary and of the river bed.<sup>8</sup> The river became much narrower, the difference between ebb and flood disappeared, and eventually most of the river silted up. As a result of this and the construction of a dam at Wijk bij Duurstede in 1122, the Old Rhine became a dead river. The peat streams on both sides of the river silted up as well.<sup>9</sup>

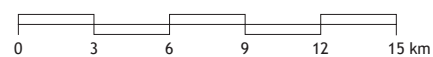
**THE FORM OF THE NATURAL LANDSCAPE** The active forces of the natural landscape are mainly the peat cushions and the seepage from the Utrechtse Heuvelrug. The Vecht makes a large bend at the top of the Heuvelrug. This bend encloses a wedge-shaped area of peatland that gradually merges into the estuary plain of the Vecht.

The rivers are flanked on both sides by levees with deposits of fertile clay. The levees of the Rhine and the Vecht are wide upstream, growing longer and narrower in the lower reaches. The intervening basins also grow lower towards the West; because of the peat in the subsoil, the ground has compacted much more here. The river system on the eastern side, where the various branches enclose small

basins, is also more fine-meshed, while the complex of large bog areas is located in the western half. At Utrecht the difference of level between the high and wide levees and the small basins is between half a metre and one metre; the corresponding difference between the narrower and lower levees and the flat basins in the western part is between one and a half and two metres.



Administrative Relations Around 1300



## RECLAMATION HISTORY

In the Frankish empire the area between the Rhine, the Vecht and the Drecht consisted of a number of administrative units called *Gaue* (corresponding to the Roman *pagi*). The core of these *Gaue* consisted of a river, and they were bounded by marshlands or other wildernesses further inland. The Niftarlake *pagus* covered the high clay soils on both banks of the Vecht. Isla et Lake extended over the clay soils on either side of the Lek and the IJssel. These two *Gaue* were separated by the extensive low peat bog of West Utrecht and South Holland.<sup>10</sup>

At the beginning of the tenth century, Count Walther, Count of Goye, received the *Gaue* of Niftarlake, Isla et Lake and Teisterbant as fiefs, but the German Emperor Otto, who wanted to put an end to the large degree of independence of the dukes and counts and to create a single large Holy Roman Empire, defeated the count and gave all the estates as fiefs to Bishop Balderik of Utrecht. A letter of donation to this effect was drawn up in 965, in which 'all the demesnes and goods along the Vecht, estates, woods, waters and fisheries, as well as all pools and lakes which received water from the river' were to be given to the Church of Utrecht. This

Bishop Balderik commenced the reclamation of the peatlands.<sup>11</sup>

Miland, the area around the Meije, was still a contested border area between Holland and the episcopal lands of Utrecht (known as Het Sticht). After reclamation it became an episcopal fief. In the second half of the thirteenth century the Meije was fixed as the boundary between Holland and Het Sticht.

**WATER BOARDS** The various reclamation blocks in the basin areas were for a long time individual units in terms of administration and water management. Drainage was relatively simple. A channel that flowed into a peat stream was dug prior to reclamation. Part of one of the newly created channels often ran past another, formerly unreclaimed block. This was known as the front channel, which was maintained by the village territory that used it for drainage. No two village territories made use of the same channel: each one solved its own drainage problems. However, hydraulic interests grew too complex for the individual authorities to deal with, so that a need arose for a separate authority in charge of water management: a water board. The oldest water board in the area is that of Woerden (1322). Almost all of the polders in this board



## River Reclamations

drained into the Rhine via Spaarndam. The main water board of the Ronde Venen was established in 1674.<sup>12</sup>

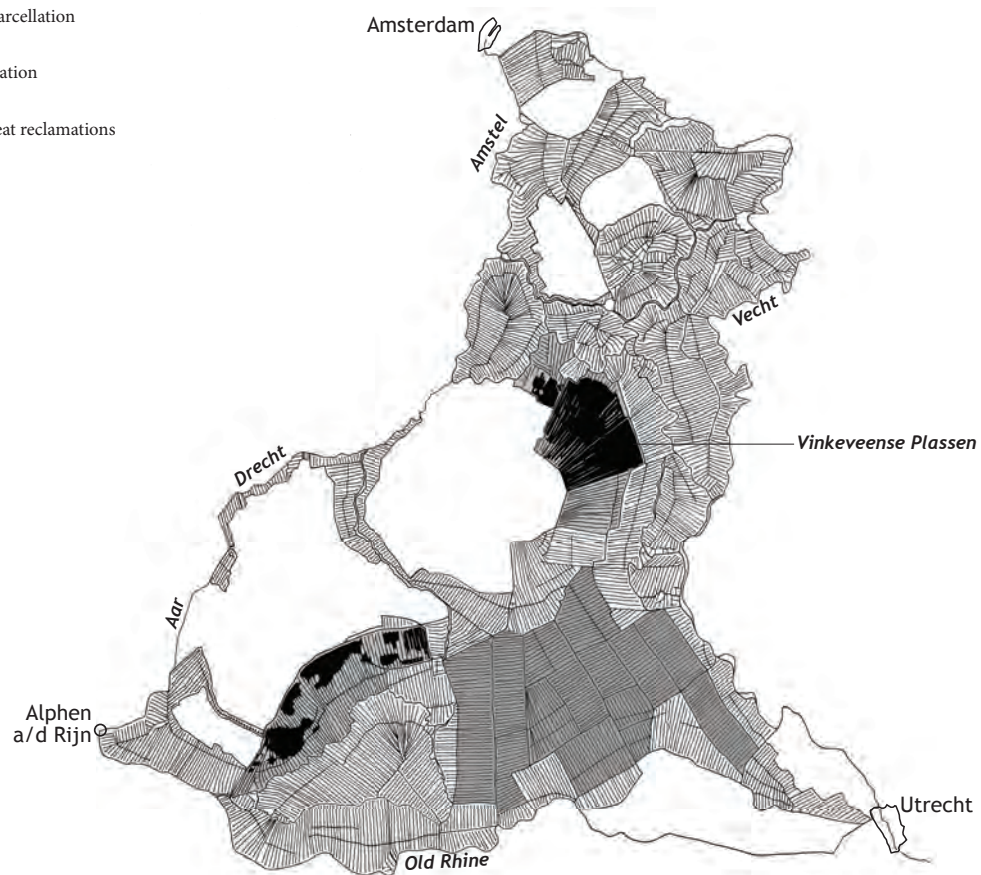
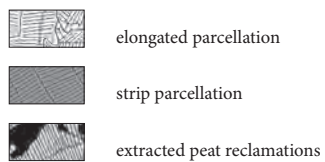
The high dike board of Amstelland was founded in 1525 when a number of earlier bailiwicks, water boards, and suchlike merged.<sup>13</sup> The waters that drained into the IJ and the Zuyder Zee fell under the jurisdiction of this higher polder authority. It was called a high dike board instead of a water board because of the sea dike of the Zuyder Zee. The reason for the establishment of Amstelland was the problems with drainage that were aggravated because, often in breach of the agreements, the Utrecht polders discharged their water into the *boezem* waters of Amstelland. The Amstelland Ring was created in 1525 as a countermeasure; this was a continuous ring of barriers that separated Amstelland from its surroundings.<sup>14</sup>

line (*limes*) – in 47 AD. Military settlements were founded along the border of the empire in the same century.

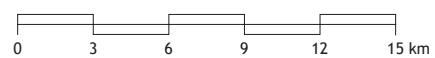
The high and firm banks of the Vecht were a traffic route through the impassable peat bog, and the Vecht itself formed part of an important shipping route from North to South. Later the levees of the Old Rhine and the Vecht also served as access roads for the colonisation of the hinterland. They were already permanently occupied in the ninth century. The parcellation is an irregular block or strip parcellation with orchards and greenhouse market gardening.

## RIVER RECLAMATIONS

The Romans, whose influence once extended over the whole of the West Netherlands, began to retreat behind the Rhine – the northernmost boundary river that formed part of the fortified border



Peat Bog Reclamations





## PEAT RECLAMATIONS

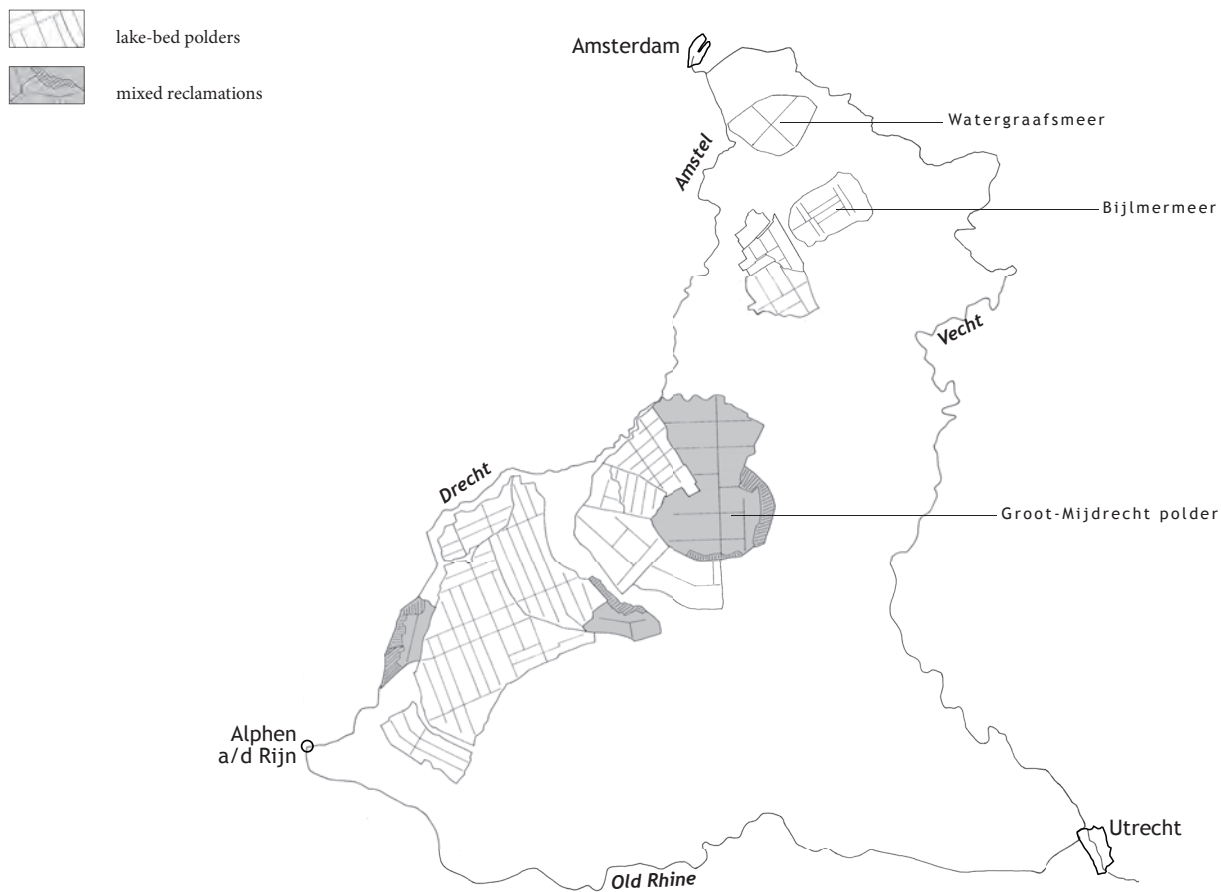
The area from the Vecht and the Old Rhine as well as from the smaller rivers and peat streams such as the Meije, Aar and Drecht was reclaimed between ca. 900 and 1400. In this initial period the Old Rhine was still openly connected with the sea and drainage was not a problem.

**ELONGATED PARCELLATION** The first reclamations were not systematic, but were carried out on the initiative of individual colonists. They laid out parcels of different lengths and had the right to extend their parcels further into the wilderness. The parcels were drawn straight through the land from the bends in the river, resulting in slanting patterns.

The emergence of the IJ and the Zuyder Zee, which created entirely new drainage possibilities, gave a new impulse to the reclamations.

**STRIP PARCELLATION** In the eastern part of the area, which fell under the authority of the bishop, systematic reclamations based on agreements were initiated from about 1000 AD, especially in the hinterland of the area through which the Old Rhine flowed.

Towards the end of the twelfth century three-quarters of the area had been reclaimed. The Rhine estuary now became blocked, which created problems for drainage and caused the reclamation process to stagnate. After the digging of drainage channels from the Rhine to the lake area north of Leiden in the beginning of the thirteenth century, it was possible to resume the reclamations and to found new reclamation settlements.<sup>15</sup>



Peat Extraction and Drained Polders

## PEAT EXTRACTION AND DRAINED POLDERS

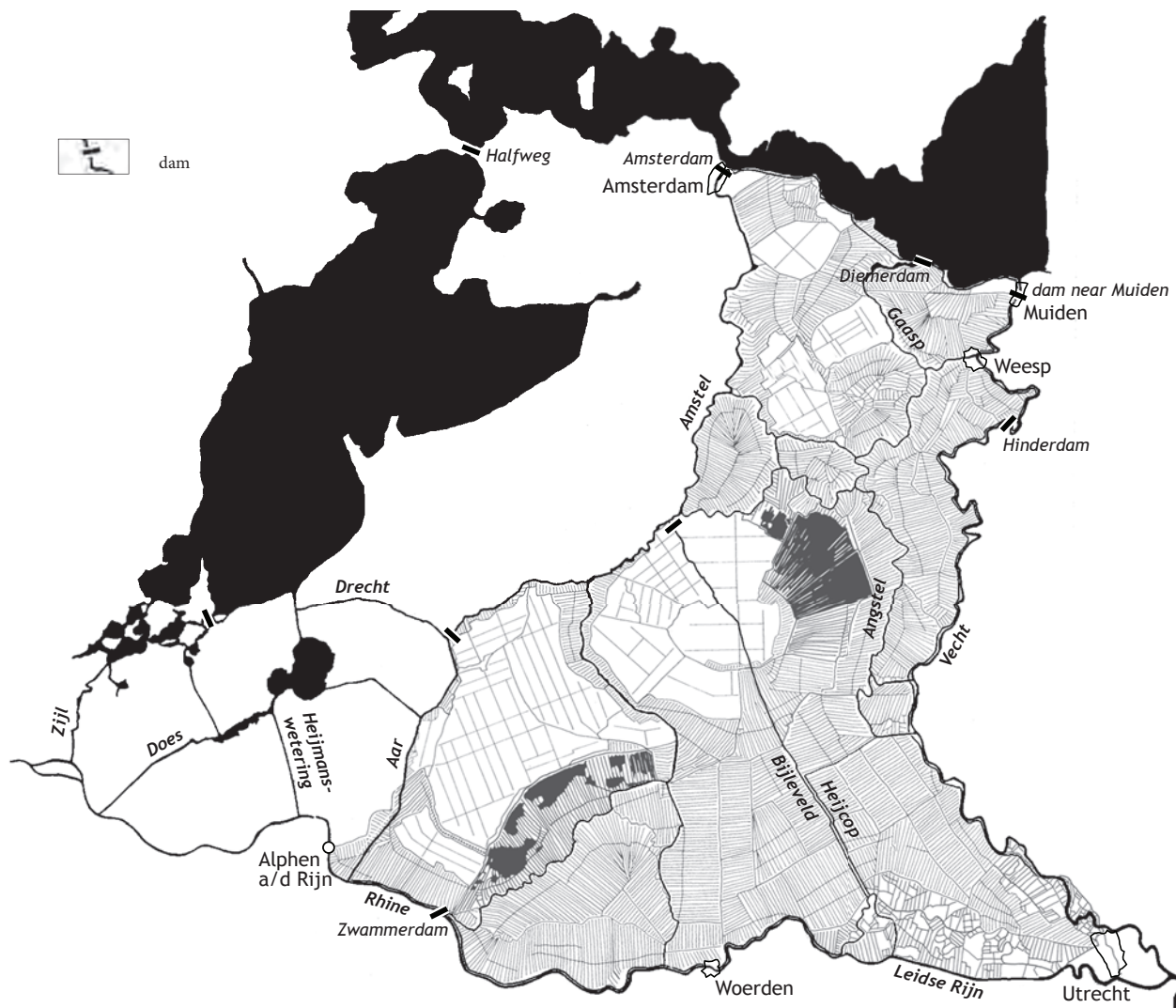
South of Amsterdam there are a few lake-bed polders which were created from natural peat lakes in the seventeenth century: the Bijlmermeer and the Watergraafsmeer. The other lake-bed polders, however, are the result of the draining of lakes created by peat extraction. They date from the end of the eighteenth century, but above all from the nineteenth century.

Already in the eighth century peat was cut from peat wells for local use; the peat in the wells grew back again. Peat cutting on a large scale soon got under way, until by 1530 there was almost no land left uncut in the Vecht area. The peat was cut down to just above the groundwater level, which meant that the original agricultural land could now only be used for hay and pasture. The land from which the peat had been extracted was replenished with a mixture of sand, manure, ditch dredge and low-quality peat in an attempt to make it suitable for agriculture again.<sup>16</sup>

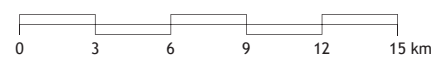
In the sixteenth century the demand for fuel was so high that the peat cutters switched to wet peat cutting and extracted the peat down to the sea clay

or, further eastwards, the Pleistocene sand. The extraction of peat continued down to the twentieth century, even down to the 1950s. The government undertook many measures – with varying degrees of success – to counteract the loss of land as the result of peat cutting. One of the more effective measures was a provision of 1790 that no polder could be stripped of peat any more without a corresponding plan for the draining of the resulting lake.<sup>17</sup>

These plans for draining were implemented successfully in many places where there was a fertile layer of clay beneath the peat, as in the Groot-Mijdrecht polder, which was created around 1880. The Vinkeveense Plassen, on the other hand, had a far less fertile sandy subsoil, and there was heavy seepage from the Utrechtse Heuvelrug, so that the various plans to polder these lakes were never carried out. The lake-bed polders of the seventeenth and nineteenth centuries are clearly visible from the orthogonal parcellation, as opposed to the fine-meshed, usually slanting parcellation of the peat reclamations.<sup>18</sup>



Drainage



## DRAINAGE AND DIKING

With the damming of the Kromme Rijn at Wijk bij Duurstede in 1122, the Rhine was turned into a narrow stream and the Vecht also received less water to transport. When the estuary of the Old Rhine at Katwijk silted up completely in 1163, the lands that drained into the Old Rhine could no longer discharge their surplus water. To alleviate the problem, the shires of Holland built a dam in the Old Rhine at Zwammerdam. However, this only made the problems on the Utrecht side even worse. In 1165, the Emperor Frederik II, the feudal lord of both the Bishop of Utrecht and the Count of Holland, therefore obliged the shires of Holland to clear the dam away again. The next solution was to dig channels, the Does and the Zijl, to carry the water from the Old Rhine via the lake district North of Leiden and the Spaarne into the IJ. When this proved ineffective, the Heimanswetering was also dug, in combination with the construction of a new dam at Zwammerdam.<sup>19</sup>

Since the twelfth century the Vecht region had been plagued by heavy storms, resulting in much flooding. To put an end to this the Bishop of Utrecht had a dam, the Hinderdam, constructed in the Vecht around 1438. Since the river mouth of the Vecht at

Muiden was under the jurisdiction of Holland, it was decided not to build the dam there but further upstream. The result was that the territory of Holland downstream suffered even more heavily from the flooding. Dikes were constructed on either side of the Vecht, but they often gave way under a storm. It was not until 1674, when the influence of the bishop in the Republic of Holland had been brought under control, that a dam with sluices was constructed at Muiden.<sup>20</sup>

The northern part of the area, that formerly drained southwards via the Amstel into the Vecht, was also given a northward drainage into the IJ in the first half of the thirteenth century. For this purpose the upper reach of the original Amstel was connected with a small river that had previously belonged to the Waterland system of creeks, but had become detached from it by the IJ. This new river mouth was dammed in the last quarter of the thirteenth century, meeting the continuous dike beside the south banks of the IJ and the Zuyder Zee. The Gaasp and the Diemen were also dammed, so that the continuously compacting land was no longer openly connected with the sea.<sup>21</sup>

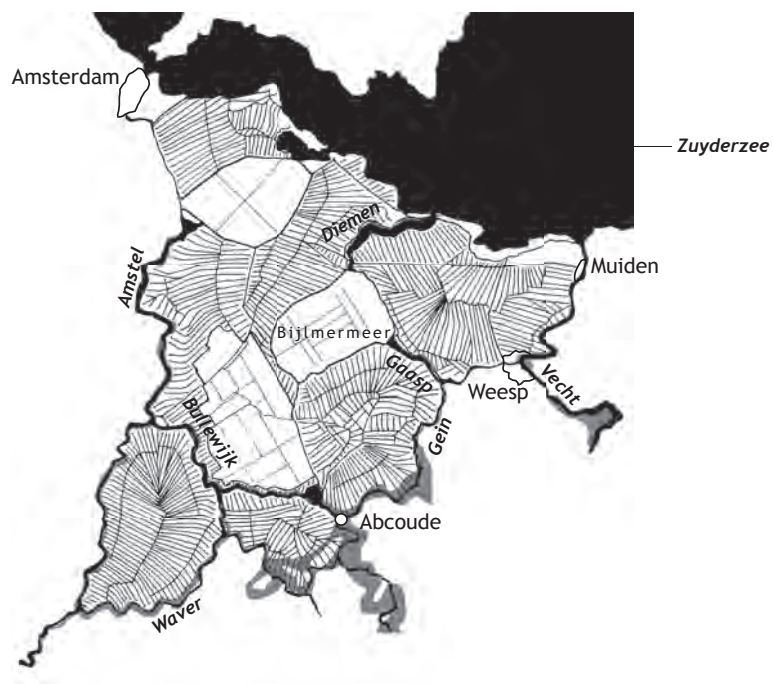


## Patterns of Reclamation

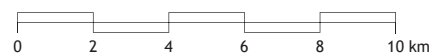
## PATTERNS OF RECLAMATION

The watercourses not only mark the contours of the landscape complex, but they also define its patterns of reclamation. The Rhine and the Vecht with their levees give rise to a clearly distinguishable strip of reclamations: the banks of the Rhine and the banks of the Vecht. In the western part of the area the peat cushions are what define the units. The peat streams, which ran at the foot of these hills, mark the borders of the Amstelland peat cushion, the Ronde Venen peat cushion, and the Nieuwkoop and Zevenhoven peat cushion. Wedged between the river banks and the peat cushions lie the banks of the Meije and the Grecht, a hybrid form somewhere between a riverbank and a peat cushion. a riverbank and a peat cushion.





Amstelland Peat Cushion



## AMSTELLAND PEAT CUSHION

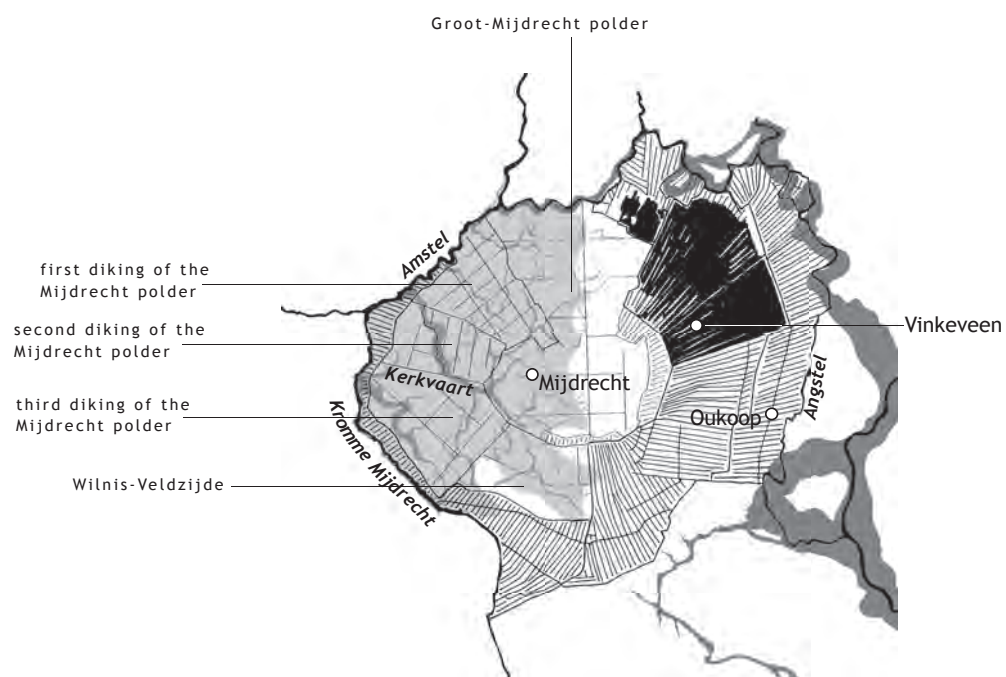
The Amstelland peat cushion is bounded on the northern side by the Zuyder Zee, on the western side by the Amstel, and on the southern and eastern sides by the Waver, Gein and Vecht. It is intersected by a fine-meshed network of small rivers, relics of the northern branch of the Rhine in the Almere before the Vecht took over this role. The irregularly running rivers enclose oval peat cushions with lobed edges.

From the tenth century the levees of the Amstel, Waver, Gein, Diemen and Bullewijk were reclaimed. Sometimes mounds were built in them for the farms. The hinterland was reclaimed from the levees, and when compaction set in, dikes and weirs were constructed along the rivers. Around 1270 a dam and sluices were made in the Amstel, and after the damming of the Gaasp and the Diemen not much later, the Amstelland peat cushion was separated from the open sea.<sup>22</sup>

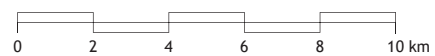
South of Amsterdam were a few natural peat lakes, which were drained by the city after the Spanish period. The Bijlmermeer was first drained in 1627. After the surrender of Naarden to the French in June 1762, the polder was flooded for strategic

reasons, but was drained again afterwards. In April 1702 there was a breach in the Diemerzeedijk, so that the Bijlmermeer also overflowed. Due to the high costs of drainage, the polder was left under water for more than a century. However, Amsterdam dumped mud from the canals here, so that new land was gradually created. The first vegetable gardens were laid out around 1850.<sup>23</sup>

Typical of the spatial structure of this area are the dense, small-scale ribbons full of bends – the (peat) streams – with agrarian building and relatively continuous vegetation. The polders enclosed by the ribbons – the former peat cushions – are very open with few vertical elements.



Ronde Venen Peat Cushion



## RONDE VENEN PEAT CUSHION

The Ronde Venen peat cushion is bounded on three sides by small rivers: the Amstel, the Angstel and the Kromme Mijdrecht. The southern side is bounded by a series of weirs that separate the elongated parcellations of the Ronde Venen from the strip parcellations that are orientated towards the Vecht and the Grecht.

In 1085 Bishop Coenraad exchanged a number of estates with the chapter of St John's church in Utrecht for an uninhabited piece of marshy land, '*terram palustrem in Midreth*', with the right to wield secular and religious authority there: 'wild, uncultivated and uninhabited lands, partly swamp, partly moorland (peatland), as well as any woodland and other areas not in use.'<sup>24</sup>

Oukoop is mentioned as the first settlement there, from which the movement was westwards. A pool was left in the central area, where accumulations of peat were continually formed. The pool drained via the Kerkvaart into the Kromme Mijdrecht, and the weir beside the waterway was extended to enclose the entire pool.<sup>25</sup>

The peat reclamations reacted to the topmost level of the natural landscape and the round peat cushion was reflected in a star-shaped pattern of reclamation. However, the peat cutting and the subsequent poldering have exposed the differences in the deeper subsoil. In the eastern part of the Ronde Venen the peat does not rest on a layer of clay, but directly on the underlying Basisveen and the Pleistocene sand. The peat layer is here so thick (8 to 9 metres at some points) that peat extraction was unable to remove it completely. Moreover, there is heavy seepage here from the Heuvelrug. This is why the peat extraction lakes to the East of the Ronde Venen have not been poldered.<sup>26</sup>

Administrative differences also played an important role in the history of reclamation. Since export duties had to be paid on peat per province, the fuel for the main cities of Holland was extracted by preference in the province itself. As a result, the western part of the Ronde Venen, which belonged to the territory of Holland, suffered from peat extraction much more heavily than the eastern part, which belonged to Utrecht.<sup>27</sup>

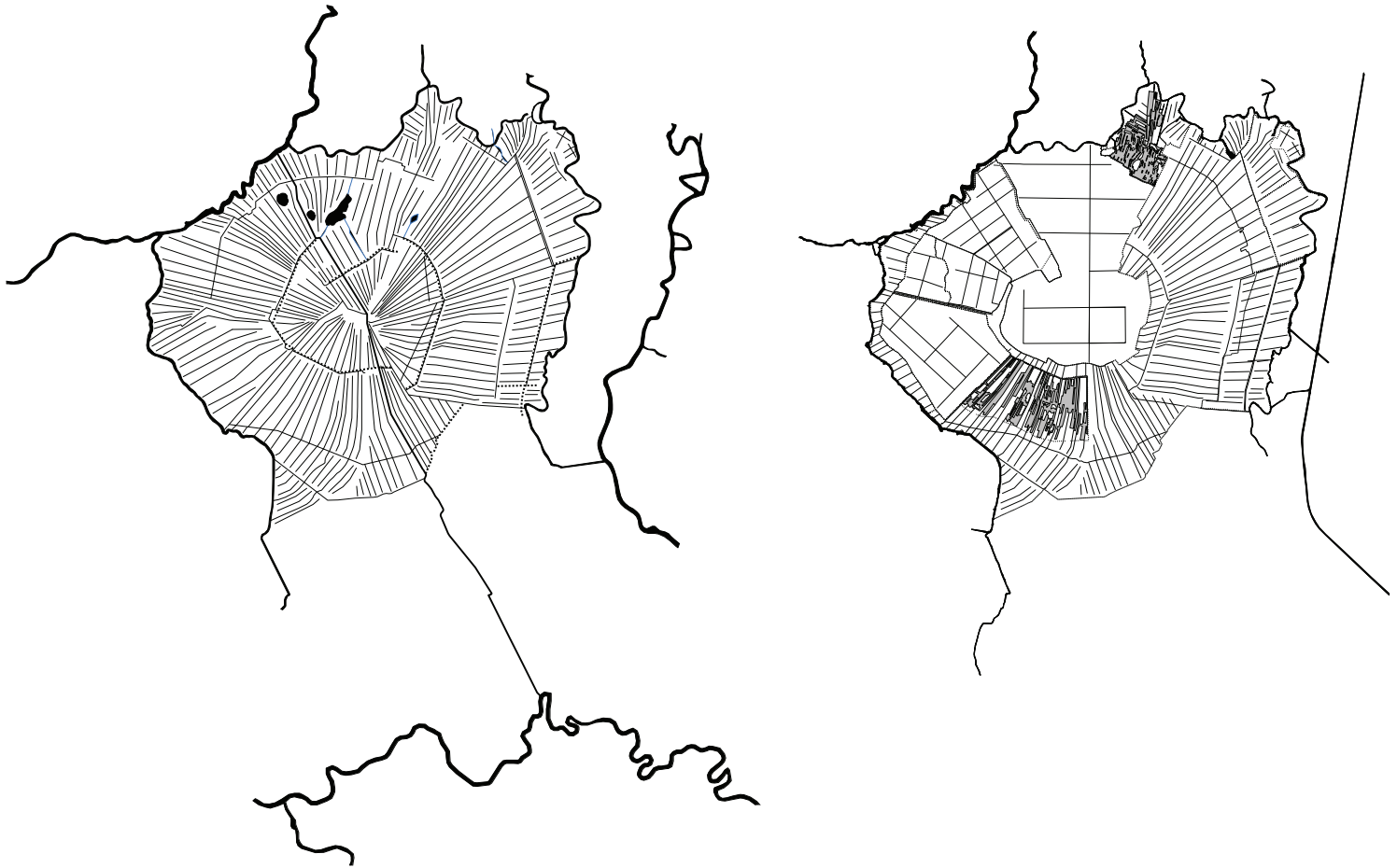
At the end of the eighteenth century poldering began with the 'First Diking of the Mijdrecht Polder'. This was prompted less by the desire to obtain new

land than by the attempt of the residents to evade the export duty, combined with the danger of the ever expanding lakes. Thirty years later the polder was still a pool, with reeds as the only product, and the national government had to intervene to improve the polder so that the first parcels could be sold in 1852. The second diking was completed in 1856, and the third in 1864. This diking was imposed by the government, so that there was a good deal of land which had not suffered extraction, leading to a very uneven soil. Different water levels were therefore made possible within the polder by means of a number of small mills.<sup>28</sup>

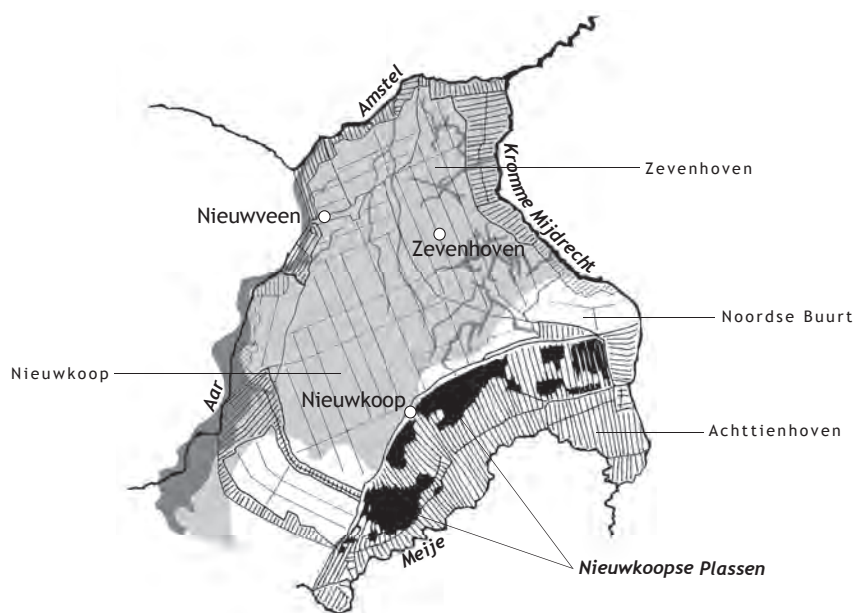
By 1880 the poldering of the Groot-Mijdrecht polder – the lake from which peat had been extracted within the inner ring of the Ronde Venen, combined with the adjacent water to the North of it – was complete. To protect the Vinkeveen dike, a strip of foreland was not excavated. This still stands out above the poldered land.<sup>29</sup>

The Wilnis-Veldzijde polder was not completed until 1925. It was conceived on a much larger scale in the first plans from the end of the eighteenth century, but as the use of peat had diminished in the meantime, the annual amount of peat extracted declined, so that the time to start polder operations

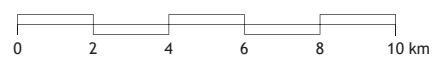
was constantly postponed and it was eventually decided to extract the peat and to carry out poldering afterwards in the northern part alone. Here too large tracts of uncut land remained. For a long time they rose high above the land like ribs and were still visible from the former ditches, until the land was levelled as an employment creation project.<sup>30</sup>



The Ronde Venen in 1696 (left) and in 1920



Nieuwkoop and Zevenhoven Peat Cushion





## NIEUWKOOP AND ZEVENHOVEN PEAT CUSHION

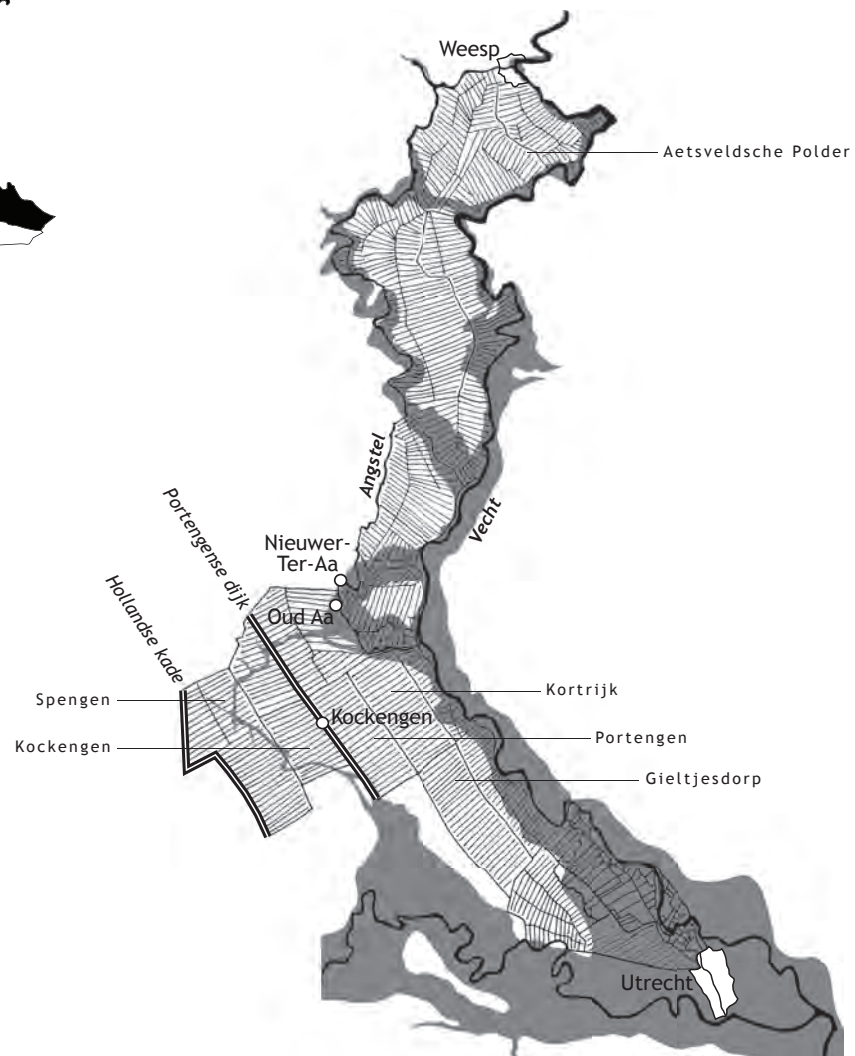
The Nieuwkoop and Zevenhoven peat cushion is bounded by the peat streams the Kromme Mijdrecht, the Meije, the Aar and the Amstel. The geogenesis is comparable to that of the Ronde Venen: a large continuous peat cushion, with a creek landscape with sea clay only below the western part. The peat stream the Kromme Mijdrecht cuts the cushion in two to form the more or less round Ronde Venen cushion and the triangular Nieuwkoop and Zevenhoven cushion. The differences in the natural basic form and the administrative relations have led to two different landscapes.

The reclamation of the area of what are now the Nieuwkoopse Plassen began in the twelfth century. In the fifteenth century it was all in use as pasture and around 1530 the peat cutting began to expand rapidly. The peat cutting was based not on the Meije, but on the village of Nieuwkoop, where the sphagnum peat was thickest and most suitable to process as fuel. Towards the East, closer to the Meije, there was more river clay, so less peat was cut here. The clearance in the bog left broad and deep stretches of water with narrow strips of land on which the peat was heaped to dry in between, so that large pieces

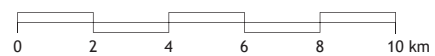
were swept away by rough weather. The lakes had reached their present dimensions by around 1700.<sup>31</sup>

The farms stood initially on the side of the reclamation base, Nieuwkoop, but as a result of the extraction works the remaining parts of the parcels – the upland beside the Meije – became separated from the farms by the lakes. That is why new farms were later built on the north bank of the Meije, so that the remains of the parcels were given a new reclamation base, as it were.<sup>32</sup>

During the clearance of the Nieuwkoop and Zevenhoven polders, strips of upland were left, so that medieval villages such as Nieuwveen and Zevenhoven lie between the new polders. Other villages, however, have disappeared, such as Schoot, which lay in the middle of the Zevenhoven polder; it disappeared into the water soon after the villagers had to evacuate the spot in 1750. The Noordse Buurt was not poldered until 1958. This polder is less deeply excavated than the others and also less compacted, so that the ground level is about a metre higher.<sup>33</sup>



Banks of the Vecht



## BANKS OF THE VECHT

The Angstel and the Vecht have taken turns to function as the northern drainage channel of the Rhine. They therefore follow a virtually parallel course over a long distance. South of the forking of the Angstel and the Vecht, the boundary of the pattern of reclamation is formed by the weirs that marked the rear boundary of the reclamations from the river.

The original deciduous forest on the alluvial ridges of the Vecht was already cleared at an early stage to create land for agriculture.<sup>34</sup> Many castles and strongholds were built on these higher grounds around which population hubs arose, some of which grew to become important centres of trade and industry. In the time of Charlemagne the Vecht was the main trade route of Utrecht, and the Vecht harbour at Muiden functioned as a sort of outpost of Utrecht.<sup>35</sup>

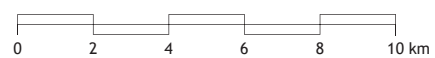
The area around the Vecht is one of the earliest peat bogs to be cleared. The first drainage of the marshy ground began soon after 953. The reclamation started on the banks of the Vecht and proceeded westwards from there. The village of Oud-Aa was already occupied before the reclamation by hunters, fishers and peat cutters, because it is situated on

an old alluvial ridge and was raised a few decimetres above its surroundings. Nieuwer-Ter Aa was founded as a reclamation settlement. A small stone church was built there in 1138 and soon afterwards Huize Ter Aa was built; a man in the service of the bishop managed the area allocated to him there. Next to be reclaimed was Otterspoorbroek, followed by Kortrijk and Gieltjesdorp. This polder was bounded on the western side by the Portengense Dijk. The Portengen polder was reclaimed even later, and finally Kockengen and Spengen bordering on the Hollandse Kade, the eastern boundary of the Land of Woerden.<sup>36</sup>

The original reclamation landscape in this area has hardly changed. The peat near the Vecht was not suitable as fuel because of the presence of clay and tree stumps, so no peat cutting was done there.



Banks of the Meije and the Grecht



## BANKS OF THE MEIJE AND THE GRECHT

Wedge between the river banks and the peat cushions is a residual form, the banks of the Meije and the Grecht. On one side the area is bounded by the Meije, on the other by the rear weirs of the Old Rhine reclamations, by the Hollandse Kade, and by the rear weir of the reclamations based on the Ronde Venen.

The Meije is an old river bed of one of the many branches of the Rhine. Many of those beds have been abandoned and now, as a result of the compaction of the surrounding peat bog, form ridges in the landscape, but the Meije continued to function as a watercourse. Colonists from West Friesland settled on the alluvial ridge on the southern side of the Meije around 1020. In contrast to the other side of the Meije (Nieuwkoop and Zevenhoven peat cushion), this area has been reclaimed from the banks of the river.<sup>37</sup>

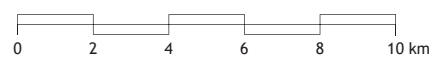
The Kromme Mijndrecht and the Meije formed a shipping route between the Amstel and the Old Rhine in the Middle Ages. Access to this route was controlled by small castles or fortified farms. In the second half of the thirteenth century the Meije

became the border between Holland and Het Sticht. That is when the weir beside the Meije, over which the present road runs, was constructed.

The Oude Grecht was dug in 1366. This improved the drainage of the Achttienhoven and Kamerik Mijzijde polders, but was above all of importance as a waterway, which was crucial for the commercial interest of the city of Woerden. The eastward shifting of the borders of Holland left Miland (Zegveld, Zegvelderbroek and Kamerik Mijzijde), which belonged to Het Sticht, as an enclave in the province of Holland. Running right through this area under control of Het Sticht, the Oude Grecht now formed a direct waterway from Woerden to the Kromme Mijndrecht and further to Amsterdam. But the lockage of the boats in the sluice for this waterway, the Woerdense Verlaat, caused flooding in the Kamerik Mijzijde polder. The Nieuwe Grecht was therefore dug on the western side of the farmlands of Kamerik Mijzijde in 1494, separated from the polder by a weir. Several bends in the Oude Grecht were cut off during the construction of the Nieuwe Grecht. Between the old and the new course lie the Kamerikse Nessen, riverbank and boezem land that has been used extensively for centuries as hayland. It has the same pattern of ditches as the Kamerik Mijzijde polder on the eastern side of the Grecht.<sup>38</sup>



Banks of the Rhine



## BANKS OF THE RHINE

The strip of reclamations along the north bank of the Old Rhine between Utrecht and Alphen aan de Rijn is bounded by a series of rear weirs. Beside the Old Rhine is a wide strip of clay deposits, formed when the river still carried a significant part of the water of the Rhine to the sea and frequently overflowed its banks. These higher levees were already occupied in prehistoric times; the Romans built their forts here to defend the northern border of the Roman Empire. Reclamation of the peat began around 900 in elongated parcellations. The colonists had an unlimited right to extend them. The parcels ran straight from the riverbank rearwards, resulting in fan-shaped patterns.<sup>39</sup>

Although these polders lie beside the river, the Old Rhine played no part in the drainage, which was only possible in the early days of the reclamation. The dam at Zwammerdam was constructed in the twelfth century on what was then the boundary between Holland and Utrecht. As a result, the river water on the Utrecht side became too high to drain into. Instead, watercourses were dug northwards towards the Vecht. Two years later the shires of Holland were obliged by the emperor to demolish the dam again.<sup>40</sup>

Many farms beside the Old Rhine are at some distance from the river. They are accessed from a drive, sometimes hundreds of metres long. The location for the farms was chosen in the early Middle Ages, when the river had not yet been dammed and frequently overflowed its banks. Building was carried out as far as possible from the river, although just on the alluvial ridge. The position of the farms thus marks the border between the alluvial ridge and the basins.<sup>41</sup>



## PEAT CUSHIONS AND STRIPS

Within the range of reclamation forms, a clear zoning from West to East can be distinguished. To the west are lake-bed polders – both drained lakes and polders resulting from the draining of peat lakes – and fan-shaped peat reclamations. In addition there are a number of peat lakes with ever clearer strip reclamations to the East, and finally, at the easternmost point, block-shaped river reclamations. This zoning is a consequence of the combination of the natural form of the soil and the political context.

The rivers on the eastern and southern sides prevented high peat cushions from being created here, so that the typical fan-shaped parcels, based on the peat streams and extending to the top of the peat cushions, are only found on the western side (Ronde Venen, Ronde Hoep). The peat extractions too are only found in the western part, because the peat influenced by the rivers yielded poor-quality fuel. There were peat extraction lakes in the central area, but they were not poldered, resulting in the Nieuwkoopse and Vinkeveense lakes. The absence of the deeper layer of sea clay on the eastern side of the area, so that the peat reached down to the firm subsoil, made it too deep for cutting. This and the heavy seepage from the Utrechtse Heuvelrug made poldering impossible here.

The strip parcellations that are characteristic of the

*cope* reclamations were concentrated in the territory that was under the authority of the bishop, i.e. the eastern part. The reclamations beside the big rivers consist mainly of elongated parcellations. Only the southeasternmost point, where the Vecht and the Old Rhine fork, leaving behind them a broad ensemble of levees, consists of irregular river reclamations.

## NOTES

1. Stichting voor Bodemkartering (1969) p. 32.
2. Stichting voor Bodemkartering (1969) pp. 33-35; De Bruijne (1939) pp. 22-25.
3. De Bruijne (1939) pp. 26-28.
4. Stichting voor Bodemkartering (1969) pp. 35-36; De Bruijne (1939) pp. 22-25. In the eastern part of the drained Groot-Mijdrecht polder the irregular ground and the groups of soft rushes, a swamp plant that is characteristic of peat land, still show that the ground consists mainly of peat.
5. De Bruijne (1939) pp. 26-28.
6. Weerts, Cleveringa and Gouw (2002) p. 68.
7. Donkersloot-de Vrij (1985) pp. 10-12; Weerts and Cleveringa (2002) p. 118; Weerts, Cleveringa and Gouw (2002) pp. 66-67.
8. In extreme weather conditions the North Sea water even reached Utrecht: 'In the same year (1170) there was a tremendous storm around All Souls Day (1 November). It was followed by a very serious inundation, so serious that ebb and flood operated right up to the walls of Utrecht. A whiting, a fish that is only found in the sea, was also found within the city walls of Utrecht.' Buisman (1995) p. 360.
9. Oerlemans (1992) p. 62; Roorda van Eysinga (1988) p. 11.

10. Van der Pas (1952) p. 19.
11. Van der Pas (1952) pp. 22-24.
12. Donkersloot-de Vrij (1993) p. 47 and Van de Ven (1993) p. 66; Postma (1964) pp. 734-735.
13. They included the water board of Asichdom and Ipersloot from 1275, which had been set up after the construction of the dam in the Amstel and the Ipersloterdam; the Aedommergerecht which maintained the Zuiderzeedijk between the Amstel and the Diemerdijk; and the Zeeburg and Diemerdijk higher polder authority for the part between Sint-Anthoniesdijk and Muiden.
14. Haartsen and Brand (2005) pp. 55-56; Postma (1964) p. 781.
15. Van de Ven (1993) p. 60.
16. Donkersloot-de Vrij (1985) pp. 19-20.
17. De Bruine (1939) pp. 36-38; Donkersloot-de Vrij (1985) p. 20.
18. Donkersloot-de Vrij (1985) p. 22.
19. Van de Ven (1988) pp. 59-60.
20. Weerts and Cleveringa (2002) p. 120.
21. Van de Ven (1993) pp. 66-67.
22. Haartsen and Brand (2005) pp. 13-14.
23. Reh and Steenbergen (1999) p. 36.
24. De Bruijne (1939) pp. 28-30.
25. Van der Pas (1952) pp. 29-30.
26. Donkersloot-de Vrij (1985) p. 22.
27. De Bruijne (1939) pp. 34-34 and Donkersloot-de Vrij (1985) p. 20.
28. De Bruijne (1939) pp. 38-43.
29. De Bruijne (1939) pp. 43-53.
30. De Bruijne (1939) pp. 53-57.
31. Oerlemans (1992) p. 60.
32. Oerlemans (1992) p. 62.
33. Oerlemans (1992) p. 61.
34. The name of Nijenrode ('newly cleared') Castle can be connected with this.
35. Donkersloot-de Vrij (1958) pp. 17-18; Van der Pas (1952) pp. 26-27.
36. Van der Pas (1952) pp. 26-27.
37. Oerlemans (1992) p. 62.
38. Handboek Natuurmonumenten, p. 238; Borger (1997) p. 49.
39. Oerlemans (1992) pp. 62-63.
40. Van der Pas (1952) p. 30; Donkersloot-de Vrij (1993) pp. 49-51.
41. Oerlemans (1992) p. 63.



The Grote Waard. Bakkerskil near Werkendam.

The tumultuous history of the Grote Waard provides a clear picture of the development in the Dutch reclamations. In the Middle Ages it was a coherent polder complex until a combination of human intervention and natural forces destroyed it. After the destruction several areas were reclaimed, like the accretion polders south of Werkendam.





The Grote Waard. Bakkerskil near Werkendam.





The Waarden. Polder Streefkerk.

The Waarden of South Holland are a very coherent landscape, with a parcellation, draining and diking system so closely interrelated, that it seems to be consciously designed rather than evolved naturally.





The Waarden, Polder Bleskensgraaf.





Between the Rhine and the IJssel. Oukoop at the Reeuwijkse Plassen.

The elongated strip between the Rhine and the IJssel is intersected by a number of lines from river to river: natural links such as peat streams and alluvial ridges, and man-made links such as drainage channels and dikes. They bring about a rhythmical division of the peat landscape and mark the borders between the different patterns of reclamation.





Between the Rhine and the IJssel. Enkele Wiericke.





Between the Rhine, the Vecht and the Drecht. Pumping station Kamerik-Teylingens.

The landscape complex between the Rhine, the Vecht and the Drecht is intersected by many small streams, defining different reclamation patterns: lake-bed polders, peat lakes, fan-shaped peat reclamations, strip reclamations and block-shaped river reclamations.





Between the Rhine, the Vecht and the Drecht. Kerkvaart, Mijdrecht.





Central Holland. Oude Bovenweg near Oude Leede.

The pattern of the first transformation has largely disappeared as the result of poldering, so that the connection between the present topography and the original natural landscape is layered and indirect. The lake-bed polders form the core, surrounded by peat reclamation polders and hybrid polders, part peat reclamation, part lake-bed polder.





Central Holland. The Schie near Zweth.





Haarlemmermeercomplex. Hoofddorp.

The core of the complex is formed by the Haarlemmermeerpolder, the largest reclaimed lake in the Netherlands. The polder was parcellated with a parcel of 200 x 1000 metres in modules of 2 x 3 kilometres, with the Hoofdvaart as the symmetrical axis. Two new villages were established at points where the Hoofdvaart was crossed by transverse channels, Hoofddorp and Nieuw Vennep.





Haarlemmermeercomplex. Haarlemmermeerpolder from the Geniedijk.





# Central Holland

*There and all along the former banks of the lake he will see the wretched fishermen's huts replaced by decent homes for workers, whose occupants, not exposed as their predecessors were to the vicissitudes of that profession, can meet the demands of their families through steady labour and a more stable way of life; in the poldered fields he will see a general industriousness that is a sign of prosperity, and on the newly dug canals and waterways, especially during the flax harvest, a bustle and motion that will make him form a high opinion of the inland shipping in those parts.*

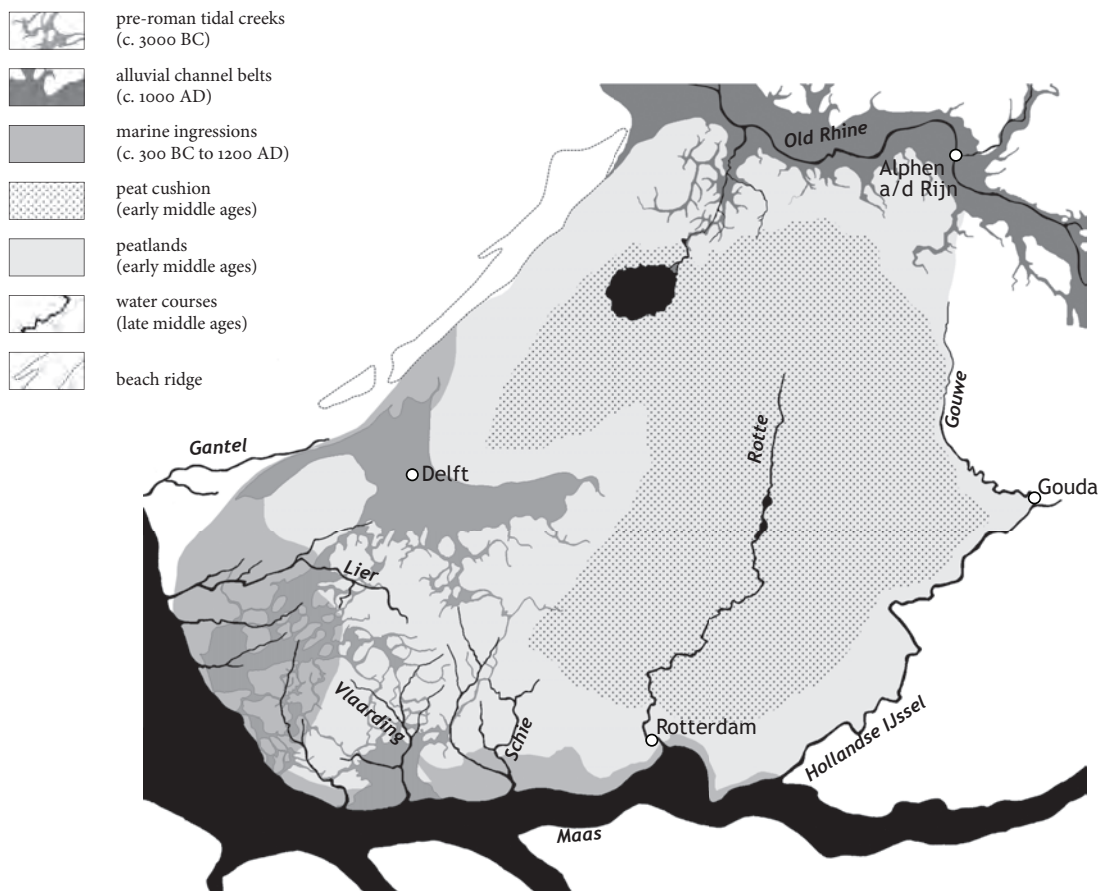
Jan-Anne Beijerinck,

*Geschied- en waterbouwkundige beschrijving der droogmaking van den Zuidplaspolder in Schieland, 1851.*

## DEMARCATIION OF THE AREA

Central Holland is bounded on the North and South by the Old Rhine and the New Maas respectively. The western boundary is formed by the easternmost sand ridge of Voorschoten in the direction of Voorburg and, as a continuation of that, the Maas estuary. The border with the sand ridge is clearly marked by the Vliet, while it is much less clearly defined in the Maas estuary. The eastern boundary is formed by the Hollandse IJssel and the Gouwe.

The heart of this landscape consists of the central lake-bed polders, which stemmed from a large peat cushion. As this area was not intersected by rivers, a peat low in nutrients was formed, which was very suitable for peat cutting. The resulting reclamation landscape was not the small-scale landscape of most peat reclamation areas – lakes alternating with uncut peat and lake-bed polders – but a continuous field of lake-bed polders fringed by borders of residual peat. That residual peat has been parcellated in feather-shaped patterns beside the rivers. On the western fringe it forms an irregular patchwork as a result of the influence of the sea.



## The Natural Landscape



## THE NATURAL LANDSCAPE

**PEAT** After the last Ice Age, a thick layer of clay and sand was deposited along the coast under the influence of the sea and the tidal rivers. A coast of beach ridges with large gaps was formed. With the closure of the gaps around 2300 BC, the process of sedimentation came to an end and a thick layer of peat (the Hollandveen) was formed on top. This peat layer was drained by small peat streams such as the Rotte, the Schie, the Gouwe and the Gantel. Thanks to the influx of nutrient-rich river water, large swamp forests grew up around these streams and beside the big rivers, from which nutrient-rich and clayey peat was formed. Where the sea still had some influence, such as in the estuaries of the Old Rhine and the Maas, brackish nutrient-rich peatlands were the result. Most of the peat, however, lay outside the sphere of influence of the sea and the rivers; a cushion many metres thick of sphagnum moss developed there.<sup>1</sup>

**SEA** Shortly before the beginning of the first millennium AD, the estuaries began to widen and the tides penetrated increasingly further inland. Large tracts of dune landscape were washed into the sea near the Maas estuary. The tide surged through this inlet and forced its way behind the old dunes deep

into the peat bog. Large creeks were hollowed out of the peat, and with every change from high to low tide a layer of sandy clay was deposited in and beside these tidal creeks. The Gantel, a tidal river, played an important part in the drainage of the southern peatlands.<sup>2</sup>

In the early Middle Ages the mouth of the Gantel silted up. A new period of peat growth resulted in an almost continuous high peat landscape. The tidal creeks were filled with peat, and the Lier was the only river to still play a role in the drainage of the high peat in the former area that had been under the influence of the tides.<sup>3</sup>

During a succeeding period of floods, large parts of the peatlands were covered with clay or were entirely swept away. In 1134 a big storm tide battered the whole South-West of the Netherlands, and another major incursion of the sea turned the Gantel, Lier, Vlaarding and Schie into wide-branching systems of gullies.<sup>4</sup>

**RIVERS** Until the first centuries AD the Old Rhine was an important river that frequently burst its banks and was under tidal influence. A wide strip of river clay was deposited on either side of the river. However, after the diversion of a number of river

courses its function was taken over by other rivers. After the silting up of the Rhine estuary at Katwijk in the twelfth century, the Rhine was diverted to the estuary of the Maas via a link that had been created 1000 years earlier. As a result, the peat streams on either side of the Old Rhine silted up and the Lek, the Hollandse IJssel, the Waal and the Merwede had to carry a much larger volume of water than in the past. The Old Rhine itself was transformed into a dry river arm, while the mouth of the Maas widened and became linked with numerous tidal creeks and peat streams.<sup>5</sup>

**THE FORM OF THE NATURAL LANDSCAPE** The basic natural form of the area is a high peat cushion bordered by the beach ridges and the rivers, which reflect the larger form of the line of the coast and the fan-shaped delta.

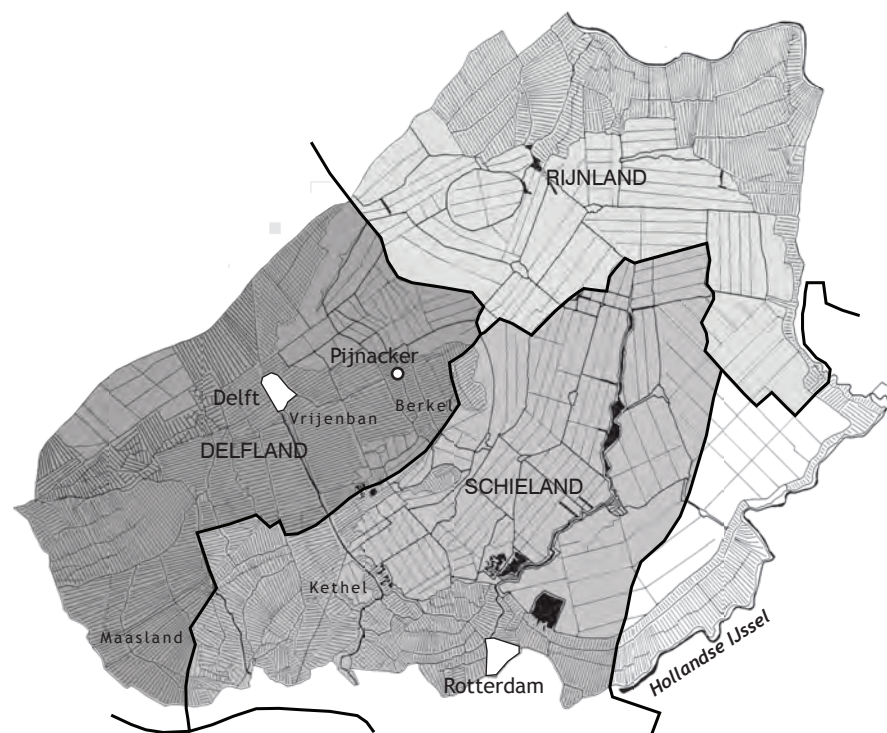
The sea creeks and peat streams drain from the centre directly into the rivers on the northern and southern sides because the westward route to the sea is barred by the beach ridge. Following the main form of the area, all these streams have a South-Southwest orientation. The difference between the sea creeks and the peat streams is that the latter only drained the surplus water from the peat cushion – pure rainwater – and thus no sedimentation took

place. The sea creeks not only drained water, but were also under the influence of the tides; moreover, at times of flooding they gave the sea access to the land, so that thick layers of marine deposits formed beside the creeks. The peat stream beside the easternmost edge of the peat cushion, the Gouwe and the Hollandse IJssel, marks the eastern boundary of Central Holland. The Rotte is the main drainage channel of this central peat cushion.

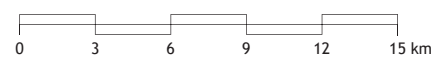


The Berkelsche Zweth





Water Boards Around 1280



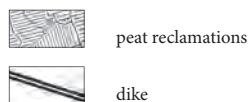
## RECLAMATION HISTORY

Central Holland was reclaimed from the edges: the rivers and the beach ridges. After this wooded area had been brought under cultivation, reclamation moved deeper into the wilderness to reclaim the bogs in the heart of the area. Later still peat was cut here on a large scale, and finally the peat extraction lakes were drained. The peat cushion has entirely disappeared, but the basic natural form is still clearly distinguishable. Now, however, the heart is the deepest part, lying at more than six metres below sea level.

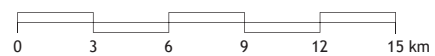
**DELFLAND** In 985 the Count of Holland acquired the rights to the wilderness between the Lier and the Hollandse IJssel from the German Emperor Otto II. There were a few pieces of solid land in this bog, the clay tongues that had been created with the silting up of the Gantel. This was where the count established the courts of Delft and Pijnacker. The organisational structure of these courts was still based on serf labour, while the surrounding area, the Vrijenban, was cultivated by free peasants. In the middle of the thirteenth century the Court of Delft-Vrijenban-Pijnacker water board formed an association with Maasland, that had already been brought under cultivation before the tenth century

and after diking had grown to form the Maasland-Kethel dike community. The new dike community that resulted from this association was called the Seven Shires (*Zeven Ambachten*). A dam was created in the Schie around 1280, whereby the shire of Berkel was added. The shires on the beach ridges were also incorporated after the reclamation of the intervening bog, which was accompanied by the damming and diking of the Lier, causing it to silt up. This made the water management organisation even more important. In 1319 the Seven Shires, Berkel and the five shires from the beach ridges presented themselves jointly as the high dike board of Delfland.<sup>6</sup>

**SCHIELAND** The Schieland water board was founded in 1273 in connection with the construction of the high sea dike (*Hoogen Zeedijk*) in Schieland. This sea dike made it possible to polder the Maas delta. Before then there was only a sheriff who supervised the dikes and dealt with judicial matters.<sup>7</sup> In the earliest period of reclamation the border was formed not by the Hollandse IJssel, but by the as yet unreclaimed peatlands between the Rotte and the IJssel. The reclamations around the IJssel were under the authority of the Bishop of Utrecht.<sup>8</sup>



Peat Reclamations



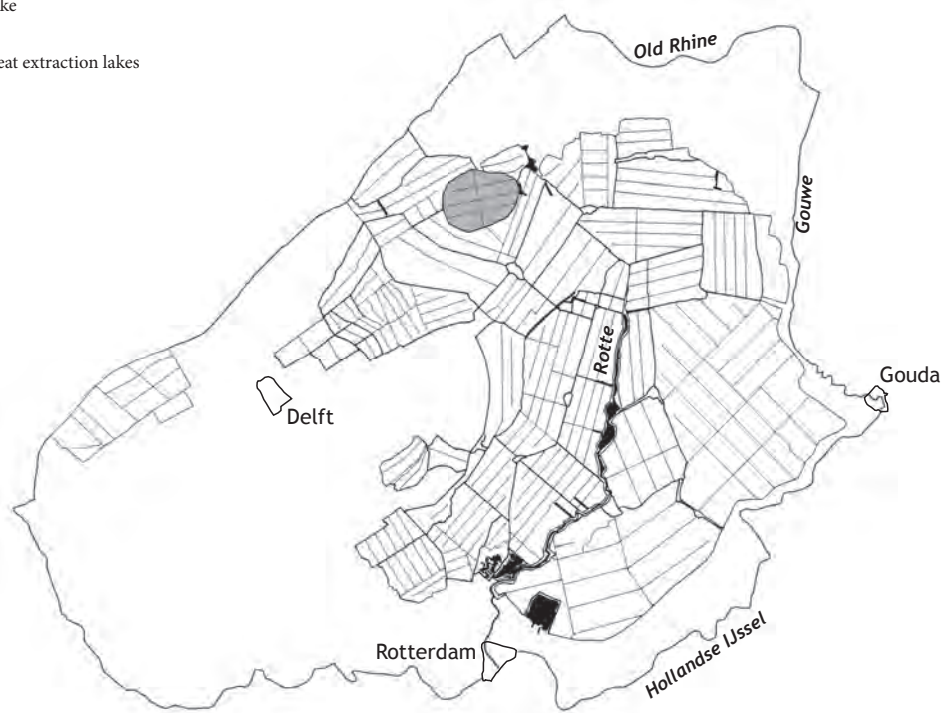
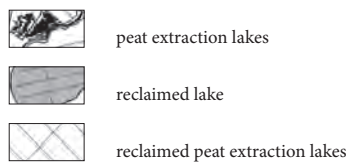
The boundaries between the three high dike boards were formed by local border weirs. These were made at the start of the reclamations to protect the reclaimed areas from water from the higher surrounding land. Where they coincided with the boundaries between Rijnland, Delfland and Schieland, they were connected to become regional boundaries.<sup>9</sup> The boundaries of the three different water boards to which Central Holland belonged – Delfland, Schieland and Rijnland (see p. 195) – run through the heart of Central Holland. They lie where initially the impenetrable peat bog marked the boundary between the administrative units that were concerned with the dunes and the rivers. The reclamation turned not only the relief but also the geographical relation upside down: the impenetrable hinterland has become the middle of the area.

## PEAT RECLAMATIONS

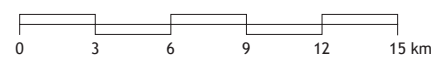
Intensive reclamations took place in the thirteenth century under the pressure of population growth. The soil beside the rivers consisted of firm and fertile river clay; further away from the rivers was a thin layer of river clay deposited on peat. The reclamations were uncontrolled, with parcels vary-

ing considerably in length up to as much as two kilometres. The parcellation beside the Old Rhine follows the twisting course of the river. As a result, the parcels fan out broadly or taper towards one another. At tight bends there is no room for this wavy pattern and two parcellation directions are interwoven. The banks of the Hollandse IJssel and the Gouwe, on the other hand, are systematic *cope* reclamations, so that the parcels proceed in parallel in spite of the bends in the course of the river. As a result of the compaction of the peat after reclamation, arable farming had to be replaced by livestock farming.<sup>10</sup>

In the area formerly under the influence of the tides, the pattern of reclamation was determined by the pattern of the old creeks. Because of the compaction of the peat resulting from reclamation and drainage, the creek ridges rose higher and higher in the landscape.



Peat Extraction Lakes and Lake-bed Polders



## PEAT EXTRACTION LAKES AND LAKE-BED POLDERS

**PEAT EXTRACTION LAKES** Peat had been cut for fuel sporadically since the Roman era. Peat cutting got under way on a large scale in the fourteenth century, when the peat became too wet even for livestock farming and the demand for fuel rose. The last wild peatlands in the interior were not even reclaimed, but they were immediately entirely dug up for peat, so that reclamation here coincided with the process of peat extraction. The parcellation of the land for peat extraction did not demarcate the rear boundaries of the parcels in the expanse of peat. For instance, the Rotte shire had no northern boundary in 1028.

Peat extraction remained confined to removing the layer just above the groundwater until the beginning of the sixteenth century. Although this did not lead to loss of land, this low-lying ground was so wet that it precluded agriculture any more. Besides, peat cutting was a threat to watersheds and weirs. Often the surrounding dikes were not maintained because the land where the peat had been extracted was of no further use, so that the dikes breached and that land was flooded. Thus the pastor of Berkel complained in 1460 that he was unable to reach his

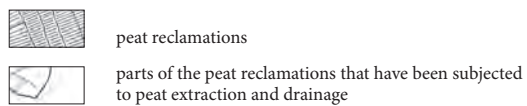
parishioners by road in an emergency as a result of the extractions.<sup>11</sup>

The sixteenth century brought major changes in many fields. With the growth of the towns, leading to an increased demand for fuel, and the invention of a tool to remove peat from below the surface of the water, the area was soon transformed into a water wasteland. Villages found themselves surrounded by water; some of them were even moved in their entirety, as in the case of Zevenhuizen.<sup>12</sup>

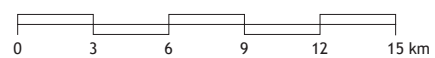
The flooding grew even worse during the Dutch Revolt, when the dikes of the Maas and the IJssel were breached to relieve Leiden. All the land in Schieland and Delfland was under water except for the beach ridges and dunes. The pro-Spanish dike boards feared that the inundation of Schieland would create big lakes because the ground was 'low, light, boggy, peaty and spongy' and intersected at many points by ditches because of the peat cutting. Two years later two-thirds of the province of Holland were flooded; Delft, Leiden and Woerden had become lakeside cities. The flooding was to be a major problem long after the ending of hostilities.

So between 1650 and 1750 an area of peat extraction lakes arose, separated by isolated strips of land on





## Mixed Reclamations



which through roads and buildings were situated. The large, irregular lakes were sometimes more than several dozen hectares in size. They were dotted with small islands that had some effect on braking the force of the waves.<sup>13</sup> In many places the wind and the waves swept away the thin strips of land on which the peat was left to dry, so that the lakes grew even larger. The dikes and the buildings began to be at risk, not only in the isolated ribbons, but even in the cities. It was prohibited to cut peat in a strip of 300 metres beside the Hollandse IJssel, and a ban on peat extraction within a radius of three kilometres of the city was issued to protect Gouda.

**LAKE-BED POLDERS** By the end of the seventeenth century the peat was exhausted and operations got under way to drain the lakes, often combined with the extraction of peat, particularly on the remaining thin strips of land on which the peat had been left to dry. In fact, the preference for the site of a new lake-bed polder was partly determined by the quality of the peat that could still be extracted from it. This quality had always been best in the higher peat cushions without much silt, which were the furthest from the peat streams. The result was a landscape of peat streams fringed by strips of higher land that were rich in silt, followed by the lake-bed polders after peat extraction and drainage. In between lie

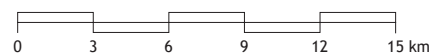
the old peat cutting villages on narrow strips of peatland that have not been subject to extraction, often beside the peat streams, sometimes in between the lake-bed polders.<sup>14</sup> As the medieval linear settlements had not suffered peat extraction, they found themselves 3 to 4 metres above ground level after the lakes had been drained. The compaction to which this would give rise would eventually have caused the houses to collapse. To prevent this, belts of canals were dug around the old settlements and they were given a higher polder level of their own.<sup>15</sup>

## MIXED RECLAMATIONS

Not all polders were systematically subjected to full peat extraction. In some cases peat extraction was only conducted on a modest scale around the edges, although concessions were issued to extract peat from the whole polder. The part that was left untouched was where the sea creeks had deposited clay over a long period. The peat that grew in clayey soil contained too much wood residue to supply good fuel, so peat cutting was rapidly abandoned there.



Patterns of Reclamation

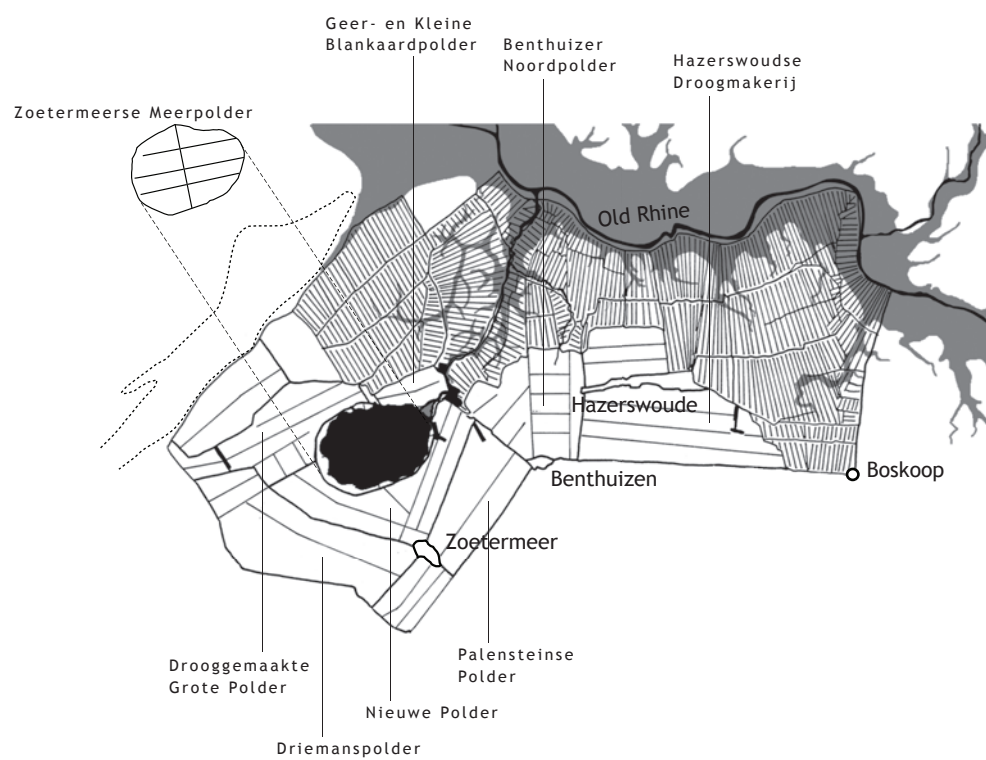


After peat had been cut from the edges of these polders, they were drained, often with the retention of the original pattern of peat parcellation at an angle to the reclamation axis. What can be seen is the difference in level – in the middle of the polder – between the untouched part and the drained part. As a result, since the start of the peat cutting the border of the sea creek landscape is plain to see running right through the polders.

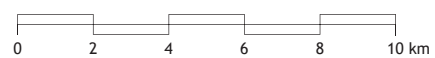
## PATTERNS OF RECLAMATION

The basic natural form of Central Holland – a peat cushion bordered by beach ridges and rivers – has a clearly distinguishable centre and clear edges, but there is a whole range of transitional areas in between. The landscape was reclaimed starting at the edges and from the only peat stream in the heart of the area, the Rotte. As a result of the difference in the natural subsoil, there are major differences in the patterns of reclamation, but the boundaries between them are vague. They are situated where different types of reclamation – those from the centre and those from the edge – met one another.

Because the starting point of the reclamation is the determinant factor for the different units, most of them derive their name from it: the banks of the Old Rhine, of the Gouwe and the Hollandse IJssel, of the Maas, the Maas estuary, and the Rotteboezem peat cushion. The old system of creeks is an exception. This is a transitional area between the sea creek landscape of the Maas estuary and the lake-bed polder landscape of the Rotteboezem peat cushion. The peat extractions that had started from the South-West and covered the entire area were replaced up to the halfway point by peat extractions that spread out from the North-East.



Banks of the Old Rhine



## BANKS OF THE OLD RHINE

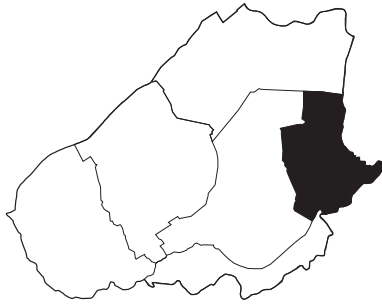
Around 900 reclamation was begun on the levees of the Old Rhine by individual colonists in a fan-shaped pattern of non-linear parcels. Many farms were built before the damming of the river in 1122, at a time when it frequently burst its banks. That is why they are at some distance from the river, on the border between the alluvial ridge and peatland, with drives of up to 100 metres in length.<sup>16</sup> On the northern side of Boskoop the Zijde road was the basis of the reclamation at right angles to the Gouwe.<sup>17</sup>

In the Middle Ages the Zoetermeerse Meerpolder was a natural lake amid the peatlands. When the extraction of peat from the banks threatened to make the lake larger, it was drained in 1614. To prevent the village of Zoetermeer from sinking because of the compaction of the peat in the polder, a canal was dug around the village during the drainage operations.<sup>18</sup> This was the first lake-bed polder in a long series, followed by the Driemanspolder (1668), the Palensteinse Polder (1762) and the Nieuwe Polder (1771). The Benthuiser Noordpolder and the Hazerswoudse Droogmakerij were drained between 1756 and 1765. The reclamation axes of the peat extraction (the road through Hazerswoude and paral-

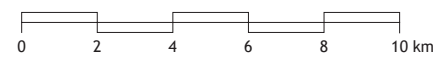
lel to it the road from Benthuisen to Boskoop) were reused as reclamation axes for the poldering. Now, however, the villages and drainage channels are 3.5 metres above ground level. Ditches to connect the polder ditches with the polder channel were dug at intervals of 500 metres parallel to the axes, at right angles to the direction of the parcellation. The Geer and Kleine Blankaardpolder was drained relatively late (1868).<sup>19</sup>

The western part of the Old Rhine levees is marshy and therefore used solely for grazing. The land is very open, the villages have an introverted character with farmyard gardens and roadside vegetation. Further eastwards the peat soil has been raised with mud from the ditches, manure and sometimes sand from the dunes too. The fertility and structure are consequently much improved. Dredging has made the ditches unusually wide, while deeper in the polder where the parcels were used for hay they were not dredged and are thus narrower.<sup>20</sup> The lake-bed polders have a clay soil and are in use for arable farming, except for the Zoetermeerse Meerpolder. When the lake was drained, there was still a lot of peat in the subsoil, so that the polder can only be used for grazing.





Banks of the Gouwe and the Hollandse IJssel



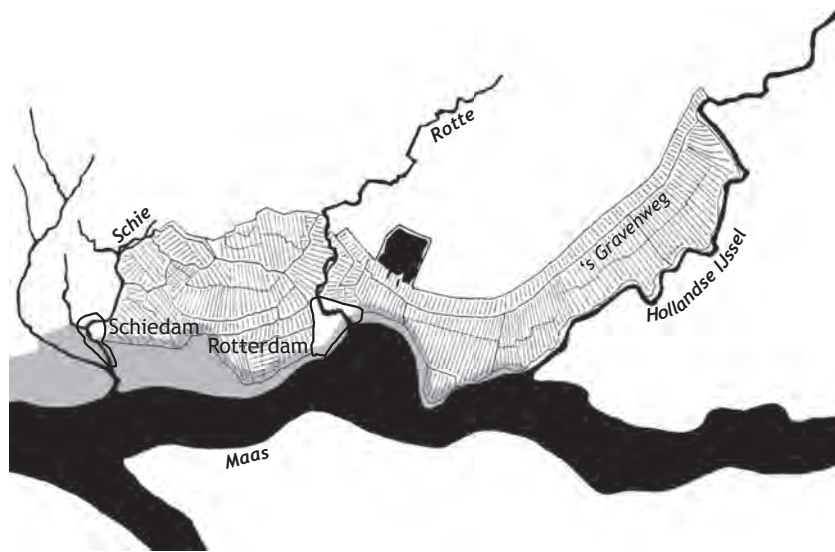
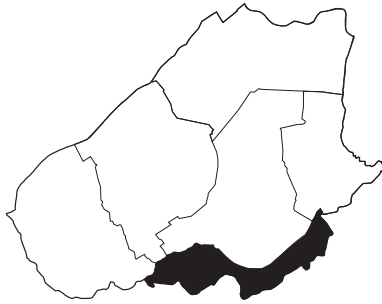
## BANKS OF THE GOUWE AND THE HOLLANDSE IJSSEL

The Gouwe, a peat stream, was not yet connected with the Rhine at the time of the reclamation, but ran from Boskoop southwards before flowing into the Hollandse IJssel. In the ninth century the Count of Holland established a farmstead near the source of the Gouwe which was the basis for the systematic reclamation of the peat forest in the surroundings by regular agreements (*cofes*). The parcels are at a right angle to the Gouwe. The banks of the Hollandse IJssel were reclaimed in the eleventh and early twelfth centuries under the authority of the Bishop of Utrecht.<sup>21</sup> Later the Gouwe was extended to the Old Rhine, resulting in the intersection of two axes perpendicular to one another at Boskoop: the axis of the road, and that of the canalised Gouwe. This point, the transition of the Gouwe as a canalised peat stream into a dug out watercourse, is now marked by a tall lift bridge.

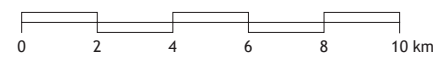
Peat cutting began between the IJssel and the Gouwe at the end of the fifteenth century. Only a narrow strip of some 300 metres was left untouched between the Hollandse IJssel, the Gouwe and the Zuidplaspolder. To prevent the dike from collapsing under the waves of the peat extraction lakes, the

Counts of Holland had banned peat cutting within 300 metres of the dikes and weirs.<sup>22</sup>

Various projects that remained in the planning stage were considered to drain the peat extraction lakes of what was later to become the Zuidplaspolder, which were still separated from one another by untouched land. In the end the lakes were drained between 1835 and 1839, not by the individual shires but by the national government, using a combination of windmills and steam-driven pumps. The orientation of the parcellation was determined by the line running between the church spires of Moerkapelle and Moordrecht.<sup>23</sup>



Banks of the Maas



## BANKS OF THE MAAS

The first reclamations started from the clay ridge that had been deposited by the partially silted up small river the Schie at the beginning of the eleventh century. The reclamations were no more than 500 to 700 metres deep. Expansion from the Schie proceeded initially southwards, and from there eastwards.<sup>24</sup> Floods in the middle of the twelfth century destroyed these reclamations and covered them with a thick layer of clay. Afterwards the old reclamation weirs were raised and new dikes were constructed.<sup>25</sup>

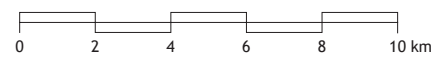
Until the twelfth century the drainage structure was fairly clear. The reclamations drained directly into the peat streams and rivers. The individual reclamations were separated from one another by lateral and rear weirs; front weirs were also made beside the open water to protect the reclamations from the tides. As the reclamations came to occupy all of the land beside the rivers, the local river dikes were also transformed into a single continuous dike.<sup>26</sup> Beside the New Maas this was the Schieland high sea dike, with openings at the estuaries of the Schie, the Rotte and the Gouwe alone. Dams with sluices were created in the Schie and the Rotte in the thirteenth

century to keep out the water outside the dike system and to discharge the water from inside it.<sup>27</sup>

One of the oldest roads in South Holland is the 's Gravenweg, parallel to the southern stretch of the Hollandse IJssel. No peat was cut from the broad strip of highland between the 's Gravenweg and the river, probably because the influence of the sea had made the peat too fertile here to be used as fuel.<sup>28</sup>



Maas Estuary



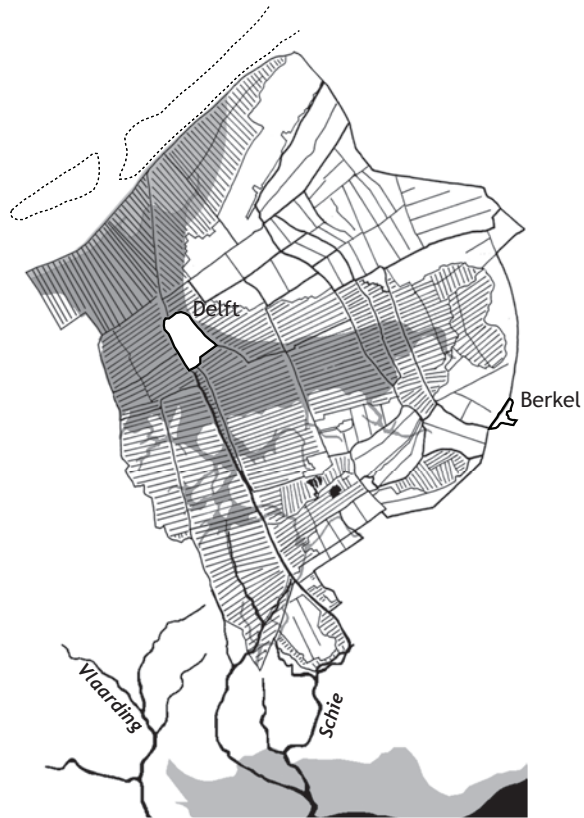
## MAAS ESTUARY

The original peat extractions of the Maas estuary were repeatedly flooded in the course of the twelfth century, so that the reclamations were destroyed and covered with a layer of clay. Fresh reclamation started from the creek ridges, as can still be seen in the parcellation. Under the direction of the feudal lord, the peat wilderness was brought under cultivation block by block. The block was divided into parcels 60 Rhineland roods (226 metres) wide and a weir was created around them. Drainage channels such as the Gaag transported the water to drainage sluices in the Maasdijk, where the Maas entered at low tide. Almost the whole of the Maas estuary was under cultivation by the end of the twelfth century. To protect the new reclamations, a continuous system of dikes was developed beside the Maas and extended further inland beside the Lier.<sup>29</sup>

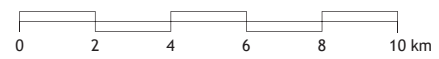
The Vlietlanden is one of the few low peatlands in the Netherlands that has not been poldered. The peat has consequently not compacted and the area is higher than the surrounding drained polders. The low peatland is characterised by open water, marsh forest, reeds and hay.

Many farms are situated in the middle of the meadows, far from any canal or road. They are connected with the canals and roads by long drives. The reason for this is that the system of old creek ridges winds its way through the meadows, and its firm clay soil offered a better ground to build on than the peat.<sup>30</sup>





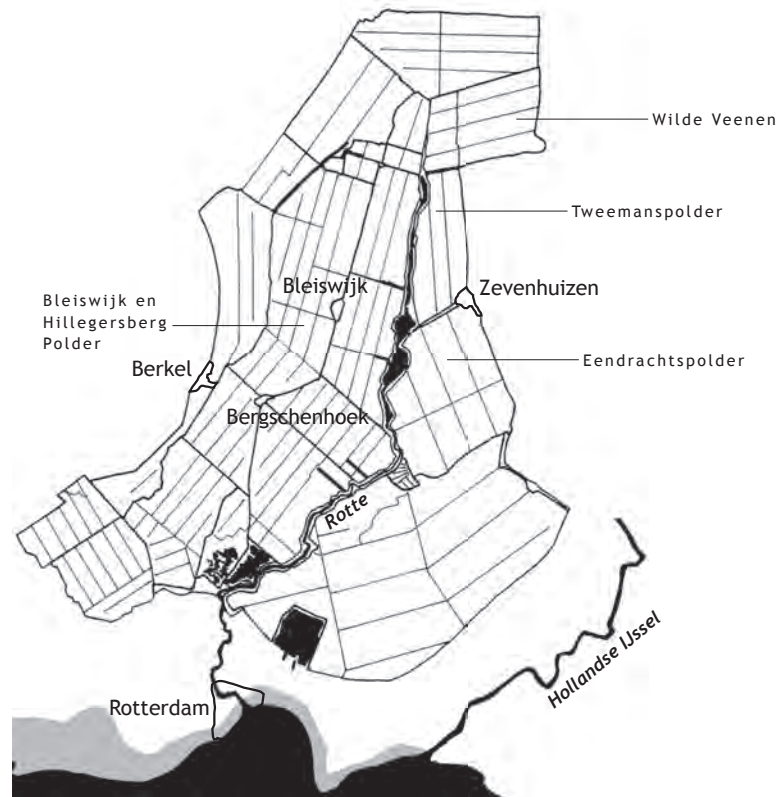
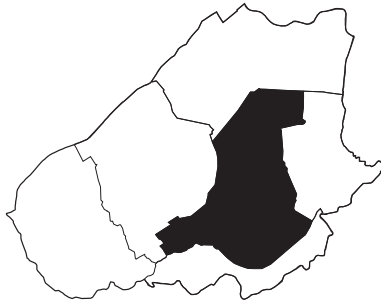
Old Creek System



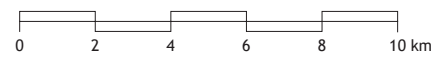
## OLD CREEK SYSTEM

This is where the original peat reclamation polders were begun from the Maas estuary area in the South and the sand ridges in the West. The second reclamation, for the extraction of peat, spread from the North-East as a spur of the lucrative central peat cushion. Here, however, on the edge of the peat cushion, peat was only cut on a modest scale. It got under way at a relatively late stage, by which time the demand for peat had declined; besides, the fact that the soil was influenced by the sea meant that the peat it yielded was inferior to that of the central area. Moreover, because the delegates were plagued by personal problems, the process of peat extraction stagnated and the western part of the polders due for peat extraction was left undisturbed.

As a result, some lake-bed polders still adhere to the pattern of parcellation of the peat extraction, at an angle to the reclamation axis. The border of the area where the peat has been extracted and drainage has been done reveals in a surprising way the contours of the pre-Roman sea creeks deep below the peat.



Rotteboezem Peat Cushion



## ROTTEBOEZEM PEAT CUSHION

The first peat extraction polder, the Wilde Veenen polder near the source of the Rotte, was drained in 1650. For a long time the polder was an island amid the lakes until it was followed much later on the eastern side of the Rotte by the Tweemanspolder (1734) and the Eendrachtspolder (1753). The Bleiswijk and Hillegersberg lake-bed polder (1772-1779) was the first large-scale poldering operation to be organised, funded and implemented by the national government because of the threat that the ‘pernicious water’ posed to the surroundings.<sup>31</sup>

The water management of each polder had implications for the others. To drain the lakes in the small agricultural communities of Berkel and Rodenrijs (Delfland water board), the weir marking the boundary with the Schieland water board, where the lakes had not yet been poldered, would have to be raised. To avoid such an expensive intervention, a form of cooperation was instigated with Bleiswijk and Bergschenhoek by which they would drain the lakes on the other side of the dike at the same time. The lake-bed polders were reclaimed from both axes, that of Berkel-Rodenrijs and that of Bleiswijk-Bergschenhoek, which rise high above the polders. The farms still follow the orientation of the original

peat parcellation, at a right angle to the parcels of the orthogonal polder parcellation.<sup>32</sup>

To drain the peat extraction lakes, the water was pumped into the *boezem*, the Rotte. The difference in level was so large that one mill was not sufficient. At some points three or four mills were linked in a course; seven such courses were in operation beside the entire Rotte in the seventeenth century.<sup>33</sup> The Rotte did not discharge easily into the Maas, and when in the course of the eighteenth century the number of lake-bed polders that discharged into the Rotte increased, it became necessary to pump this water reservoir and a new *boezem* had to be dug. In 1775 the Schieland water board created the high *boezem* of the Rotte with a capacity of 60,000 m<sup>3</sup>. This consisted of two parallel channels, a low and a high *drainage channelboezem*. The low one was directly connected with the Rotte, from where the water was pumped by eight windmills into the high *boezem* before discharging via a sluice into the Maas.<sup>34</sup>

## SEA CREEKS, PEAT RECLAMATION POLDERS AND LAKE-BED POLDERS

The basic natural form of Central Holland – the peat cushion fringed by beach ridges and rivers – has resulted in two basic forms of reclamation: the peat reclamation polders, and the lake-bed polders. The latter, the former peat cushion, form the core, surrounded by peat reclamation polders. Because the sand ridges in the southwestern corner have given way as a hard edge, the peat reclamation polders are strongly influenced by the underlying pattern of sea creeks. The result is an area with hybrid polders: part peat reclamation, part lake-bed polder.

In principle, both types of polder follow the main forms of the natural landscape. In spite of the differences in soil composition, ground level and parcel size, there is no difference between the two types of parcellation in this respect. After all, the lake-bed polders were originally peat reclamation polders and have only undergone major transformations in their internal organisation. Their position has remained unchanged. The lake-bed polders in the Rotteboezem peat cushion follow the course of the Rotte; on the banks of the Old Rhine they are draped around the Zoetermeerse Meer; and the Zuidplaspolder is wedged between the Rotte and the

Gouwe. The peat reclamation polders follow the meandering course of the river. In the most dynamic part of the area, where the sea and rivers meet, the pattern of parcellation is also the most dynamic.

Central Holland was originally one single continuous peat cushion that drained at the edges. The middle was impassable and the borders were the cores of the administrative and hydraulic bodies and the bases for reclamation. Now it is an enormous saucer in which the geographical, hydraulic and spatial relations have been reversed. So the complex is actually one big inversion landscape.

## NOTES

1. Van Wallenburg (1966) pp. 3-5; de Mulder et al. (2003) p. 227.
2. Van Wallenburg (1966) pp. 5-7; Oerlemans (1992) p. 128; Roorda van Eysinga (1988) pp. 10-11 and 135; de Mulder et al. (2003) p. 229.
3. Roorda van Eysinga (1988) p. 135.
4. Van de Ven (1993) p. 63.
5. Oerlemans (1992) p. 62; Roorda van Eysinga (1988) pp. 11; de Mulder et al. (2003) p. 234.
6. Hendrikx (1998) p. 40.
7. Verheul (1936) p. 12.
8. Van der Ham (2004) p. 25.
9. Van der Ham (2004) p. 65.
10. Van der Gouw (1987) pp. 51-52; Oerlemans (1992) pp. 63 and 69-70.

11. Van der Gouw (1987) pp. 54-55.
12. Oerlemans (1992) p. 77.
13. This whole situation is not represented in any maps of the time. This was partly due to the irregularity of the pattern of extraction, which made it difficult to represent these lakes precisely. On the other hand, those who commissioned the maps did not want it, either for reasons of propaganda or because it was too expensive to measure the damage.
14. Hendrikx (1998) pp. 115-119.
15. Van de Ven (1993) p. 134.
16. Oerlemans (1992) p. 63.
17. Oerlemans (1992) pp. 81-82.
18. Oerlemans (1992) pp. 72-73.
19. Oerlemans (1992) pp. 72-73; Rijkswaterstaat (1967) pp. 53-55.
20. Oerlemans (1992) p. 71.
21. Oerlemans (1992) pp. 81-84; Van der Ham (2004) p. 34.
22. Oerlemans (1992) pp. 78-79.
23. Den Boer (1981); Van Houdt (1990) pp. 9-13.
24. Van der Ham (2004) p. 26.
25. Van der Ham (2004) p. 38.
26. Van der Ham (2004) pp. 35-36.
27. Van der Ham (2004) pp. 39-42.
28. Oerlemans (1992) pp. 78-79.
29. Roorda van Eysinga (1988) p. 63; Oerlemans (1992) p. 128.
30. Oerlemans (1992) p. 130.
31. Thürkow (1990) pp. 33-38.
32. Oerlemans (1992) pp. 74-76.
33. Oerlemans (1992) p. 75.
34. Van der Ham (2004) pp. 156-158; Thürkow (1990) pp. 33-38.





# Haarlemmermeer Complex

*An endless, monotonous expanse, only interrupted by farmhouses in bleak surroundings and irregularly scattered huts: – a plain that in the winter, with its snow-covered roofs, recalled the barren steppes of Siberia and Lapland.*

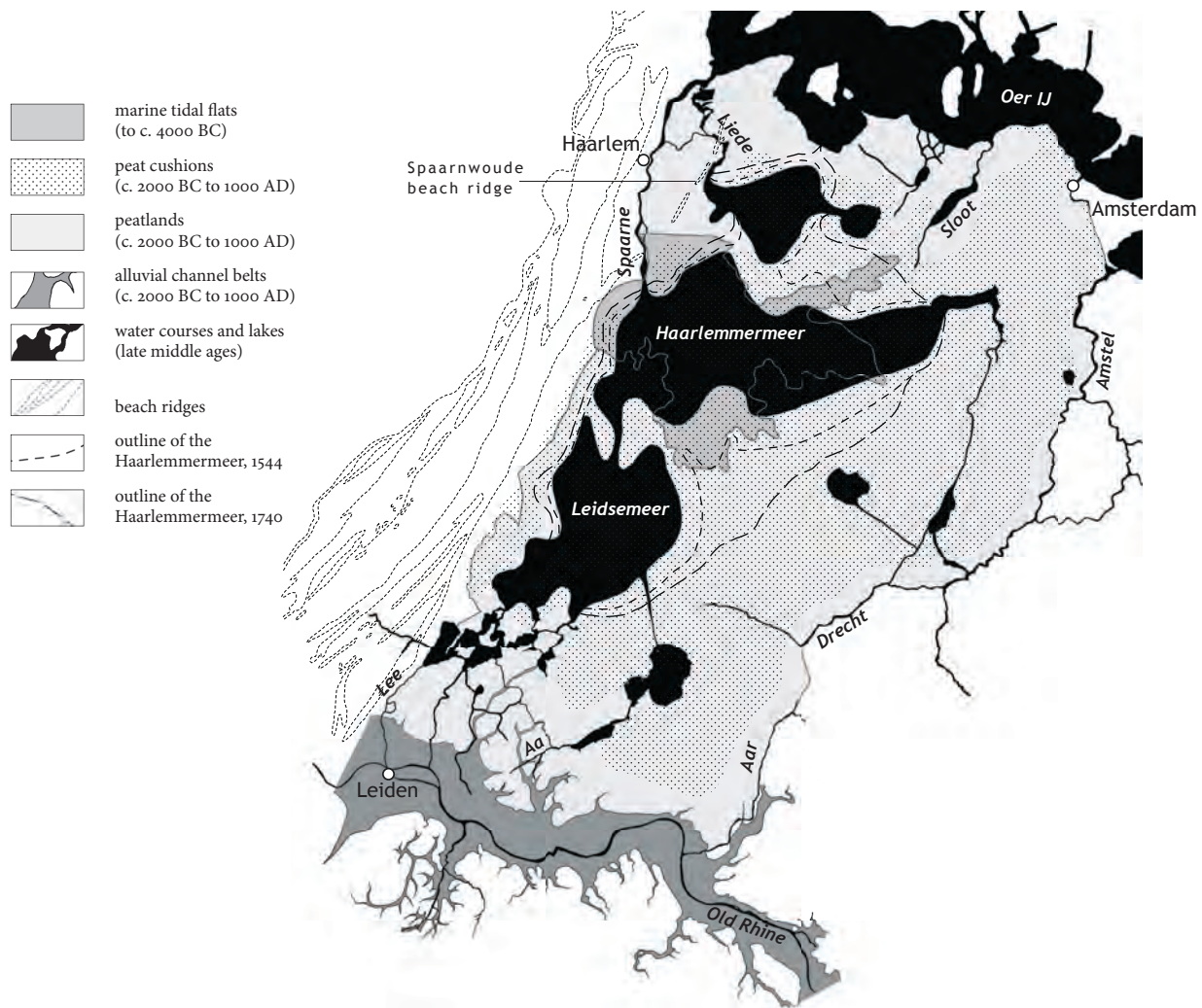
P. Boekel, Description of the Haarlemmermeer polder in its early years, in: *Geschiedenis van het Haarlemmermeer in schetsen en taferelen*, 1868.

## DEMARCATIION OF THE AREA

The Haarlemmermeer complex was originally part of an elongated peat cushion between West Friesland and the Old Rhine, bounded by beach ridges. With the formation of the IJ it was cut off from Waterland, so that the IJ now marks the northern boundary. On the southern side the Old Rhine divides it from the peat cushion of Central Holland. The Sassenheim-Heemstede beach ridge forms the western boundary, while the eastern one is formed by the Amstel, the Drecht and the Aar.

## THE NATURAL LANDSCAPE

**SEA** After the last Ice Age, a thick layer of clay and sand was deposited along the coast under the influence of the sea and the tidal rivers. A coast of beach ridges was formed with large gaps, such as the two estuaries – the Oer IJ and the Old Rhine estuary – on either side of the Haarlemmermeer complex. About 4400 years ago the various beach ridges joined to form a virtually closed coastal line. This continuous line is the western boundary of the Haarlemmermeer complex. An isolated beach ridge between Haarlem and Spaarnwoude marks an



## The Natural Landscape



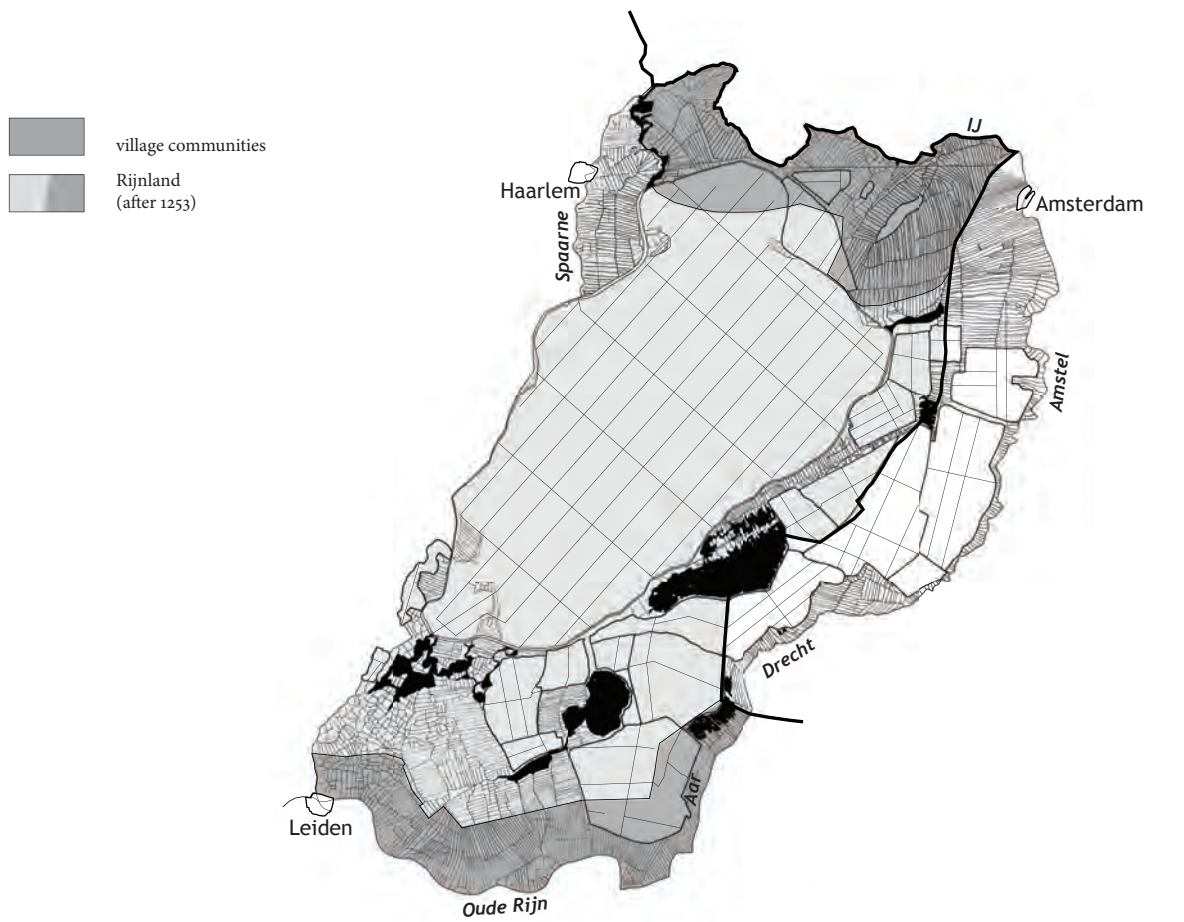
old incursion of the sea at IJmuiden and indicates the moment when the rising sea level started to fall, around 5000 years ago. From then on the coast of Holland began to extend westwards as a result of the formation of an increasing number of such ridges.

**RIVERS** The estuary of the Oer IJ enabled the tidal areas in its hinterland, the old high peatlands of Zaandam and Halfweg and the Flevo lakes in Flevoland to drain into the sea. After 1500 BC the Oer IJ was connected with the Utrechtse Vecht, a tributary of the Old Rhine. When a new link with the sea arose to the North, the Flevo lakes acquired a natural link with the Wadden Sea. The Oer IJ thereby lost its drainage function for a large part of the hinterland, which caused the estuary to begin to silt up. The inlet of the Oer IJ was finally closed about 2300 years ago, and around the beginning of the first millennium it was still a modest river that linked the Vecht/Amstel with the North Sea. The Old Rhine was still a wide river at the time, but a link was already formed with the Maas so that the main discharge came to flow via the Maas estuary. Around 1000 the Old Rhine estuary silted up as well.<sup>1</sup>

**PEAT** Peat formation began in the whole area around 3000 BC, forming a cushion between 4 and 5.5 metres thick. The peat streams formed two separate drainage systems: the Spaarne, the Liede, the Sloot and the Drecht drained northwards into the Oer IJ; the Vennip, the Lee and the Aa drained southwards into the Old Rhine. The watershed ran through the middle of what is now the Haarlemmermeer. The Kager lakes are a relic of the southern drainage system.<sup>2</sup>

Peat formation came to an end in the Roman era. Natural drainage was constantly improved, and an increasing number of peatlands were also reclaimed and thus drained. The southern part of the peat cushion subsided because of natural drainage into the estuary of the Old Rhine. Besides compaction of the peat, the drainage also had the same effect on the clayey subsoil. A relief of roughly half a metre was formed in the clayey bed of the Haarlemmermeer, where all the peat has disappeared, because the thinner layers of clay compacted much less than the thicker ones.<sup>3</sup>

The improved natural drainage weakened the peat so that, under the influence of the wind, the peat streams widened to become peat lakes. The erosion of the banks was furthered by peat cutting, and



Development of the Water Board Rijnland

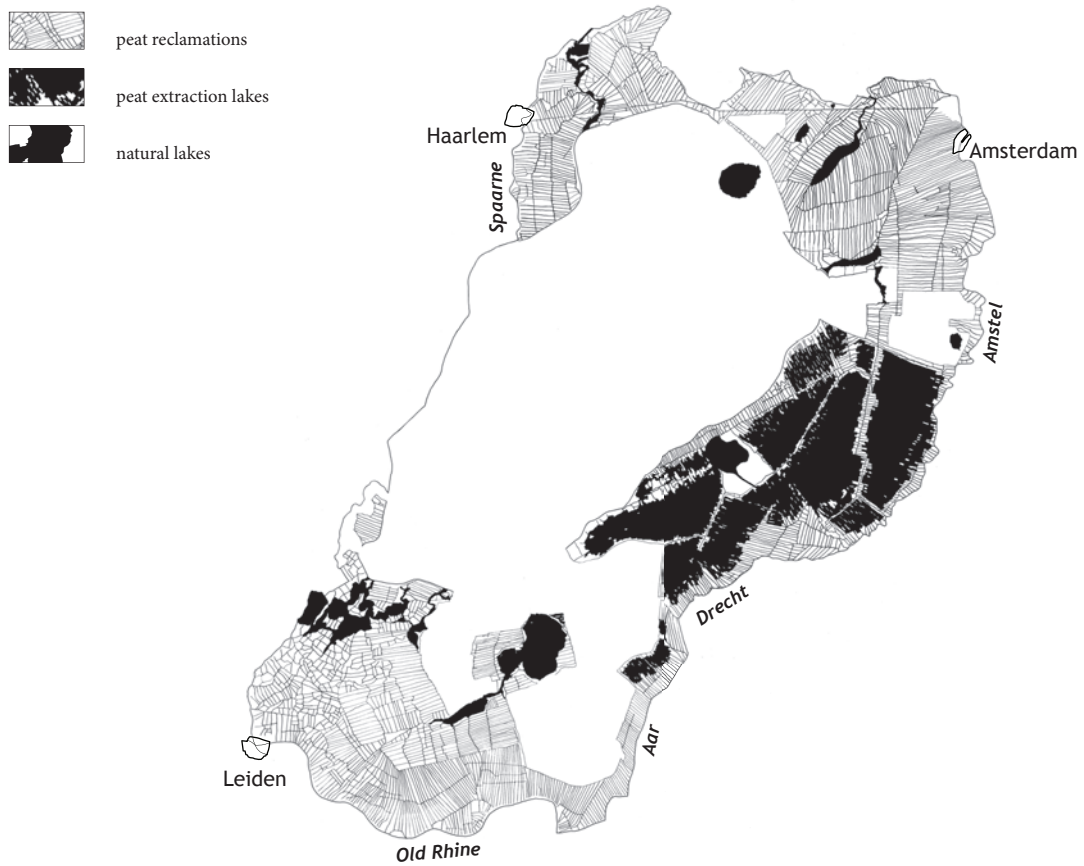
during big storm tides in the fifteenth, sixteenth and seventeenth centuries large open links were created between the lakes. The eventual result, in the nineteenth century, was the Haarlemmermeer.<sup>4</sup>

**THE FORM OF THE NATURAL LANDSCAPE** The form of the complex is determined by the estuaries of the Old Rhine and the Oer IJ and the Sassenheim-Heemstede beach ridge. The form is an echo of the form of the Haarlemmermeer, which assumed the rough shape of a triangle under the influence of water and wind, with the Kager lakes forming its southern point, the Spaarne and the Liede its northwestern point, and the Schinkel its northeastern point. The western bank owes its shape to the Sassenheim-Heemstede beach ridge, while the eastern bank follows the direction of the southwesterly wind. The peat streams that intersect the peatlands on the northern, eastern and southern side of the Haarlemmermeer follow the same direction, driven by the southwesterly wind.

## RECLAMATION HISTORY

**RIJNLAND** The Rijnland regional water board was one of the first water boards. It was established because of the silting up of the Old Rhine estuary. To improve the poor drainage, fifteen small and independent agricultural communities agreed to dam the Old Rhine at Zwammerdam around 1165. Supervision of the dam passed into the hands of a high dike board. The water board also organised the digging of the channels to the lake district above Leiden (the later Haarlemmermeer) and supervised the dikes. After bitter conflicts regarding the discharge of Utrecht water into the territory of Holland, the Bishop of Utrecht and the Count of Holland agreed in 1220 to jointly construct a dike with seven drainage sluices where the Spaarne discharged into the IJ. Both Rijnland and the Utrecht small agricultural communities ultimately discharged via these sluices into the IJ. In the middle of the thirteenth century the regional water board incorporated a number of village communities between the big lakes and the IJ, and in 1253 the Spaarne was dammed by a dam with nine sluices. Six of them were maintained by these village communities, the others by the Utrecht communities. A charter of 1255 carefully apportioned the responsibilities for the dikes beside the IJ, the channels lead-





Peat Reclamations and Peat Extraction Lakes Around 1800



ing to the lake district, and the other sluices among the inhabitants who benefited from them.

The use of windmills spread rapidly after 1460, and the water board regulated their construction, as well as the poldering operations, by a system of permits. The common practice of dredging in the drainage channels was also tied to permits.<sup>5</sup>

**NATIONAL GOVERNMENT** Before 1800 the national government showed little interest in the reclamation of the infertile 'virgin territory'. This situation gradually changed at the beginning of the nineteenth century and a number of laws were promulgated to encourage reclamations. King Willem I wanted to stimulate economic growth by means of several large-scale infrastructural projects, and trunk roads and railways were constructed during his reign. The Department of Water Management (*Rijkswaterstaat*) was set up in 1798 as part of the governmental centralisation.

The draining of the Haarlemmermeer was a national project, initiated by the king, who had the plans for it drawn up by the engineers of the Department of Water Management. The Haarlemmermeer became a state polder, with the approval of a law to that end by the Dutch parliament. To stimulate the

Dutch machine industry, the Haarlemmermeer was the first polder in the Netherlands to be drained entirely using steam-driven pumps.

As a result of the poldering of the Haarlemmermeer, the *boezem* of Rijnland became much smaller after 1840; moreover, the three steam-driven pumping stations of the Haarlemmermeer meant that it had to transport a much larger volume of water than before. Rijnland was already faced with flooding, which led to major conflicts between the national government and the high dike board. In the end a number of extra pumping stations were built to solve the hydraulic problems of Rijnland.<sup>6</sup>

## PEAT RECLAMATIONS

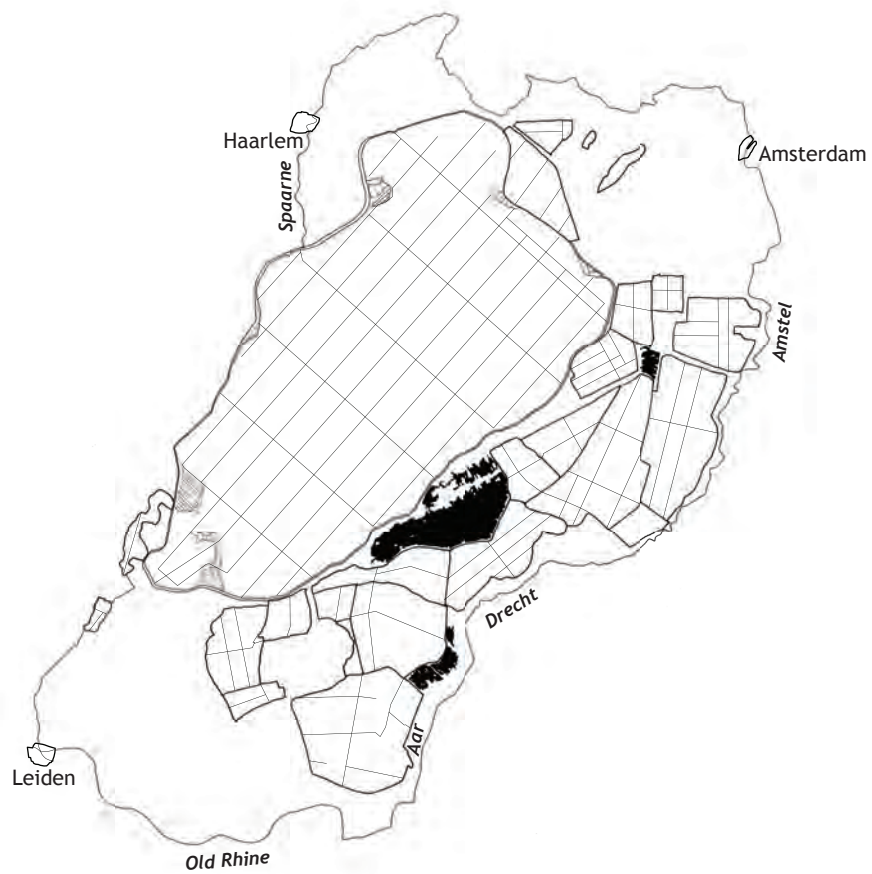
The peat reclamations began in the tenth century. The first to be reclaimed were the marshy lowlands adjacent to the sandy soils behind the dunes. Demographic pressure led to an intensification in the thirteenth century and the entire peat landscape was brought under cultivation. The next step was to follow the peat streams eastwards into the virgin territory, and finally to reclaim the central peat cushion. The northern part, which



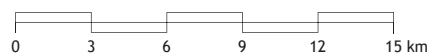
lake-bed polders



peat extraction lakes



## Lake-bed Polders



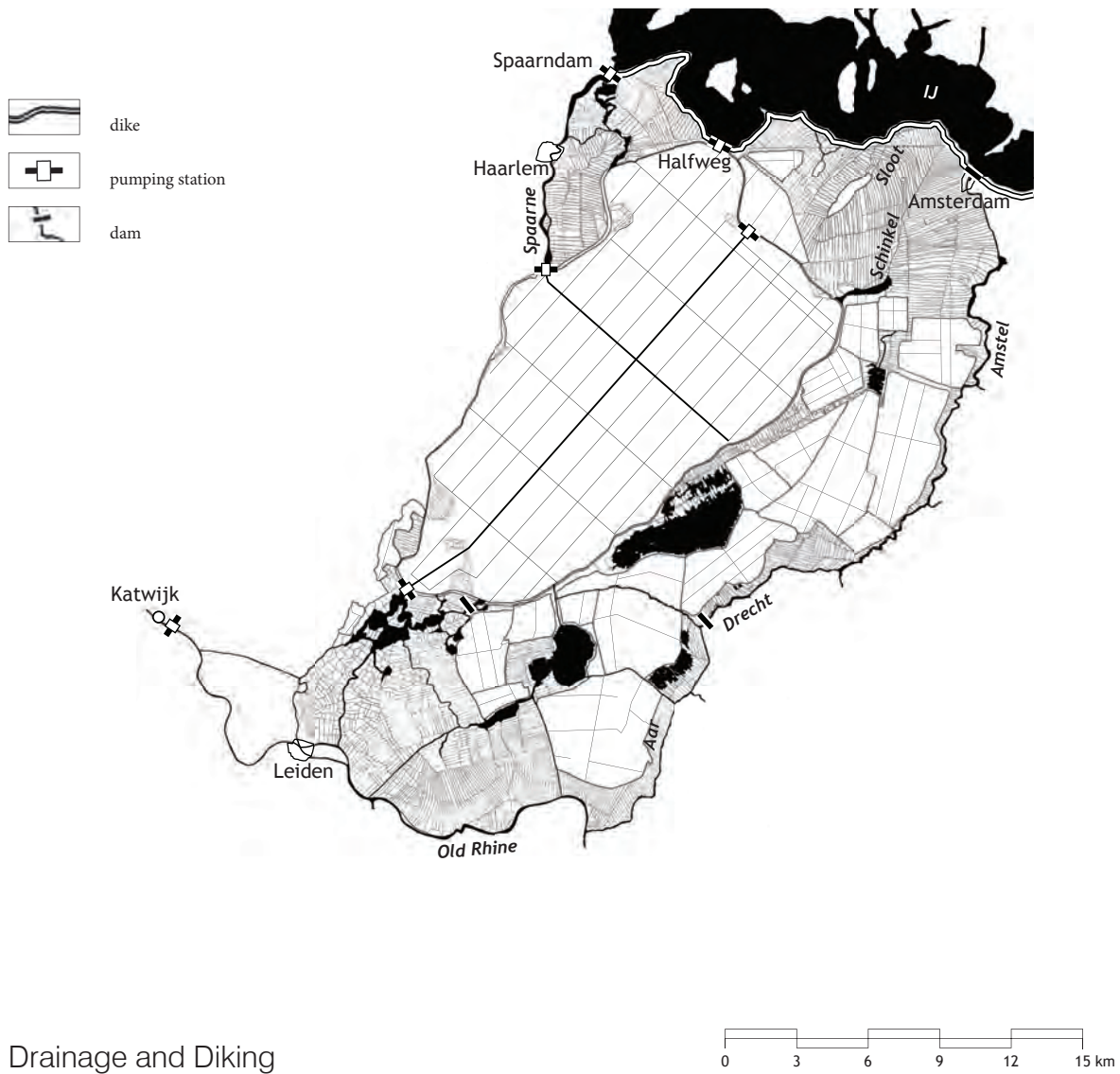
was the last to be reclaimed, still had poor natural drainage because of the silting up of the Oer IJ and was thus difficult to reach. The reclamations were not organised on a systematic basis, so the parcels varied considerably in length and could be as much as two kilometres long. The parcellation beside the Old Rhine follows the twisting course of the river; the parcels therefore alternate between broad fan-shaped or tapering ones. Two parcel directions were interwoven at tight curves.<sup>7</sup>

## PEAT EXTRACTION LAKES AND LAKE-BED POLDERS

As a result of the weakening of the peat due to improved natural drainage and a few periods with serious storm tides, the peat streams widened to become peat lakes. In the end more than half of the surface of the peatlands was covered by water. Moreover, large areas of land disappeared as a result of peat extraction. In the course of time the area between the Haarlemmermeer and the Amstel underwent peat extraction before being poldered.

In the meantime, however, the water surfaces had begun to function as a *boezem* for the water

pumped out of the compacted peat reclamations, and all these poldering activities resulted in a decline in the surface area of the *boezem*. Consequently, it filled up much more quickly than before when the river water was high, resulting in flooding. Besides the objections of Leiden and Haarlem, for whom the Haarlemmermeer was important for fishing and shipping, the loss of the *boezem* was for a long time the main reason to oppose the poldering of the Haarlemmermeer. On the other hand, the same Haarlemmermeer was a security risk; the pieces of land between the lakes were swept away by the waves and wind, and the water surface grew larger and larger and more difficult to control. An important technical condition for the poldering of the lakes in Holland was thus a water management system to cope with the negative consequences for the adjoining old land. *Boezem* capacity, drainage system and water level management were the keys to this.



## Drainage and Diking

## DRAINAGE AND DIKING

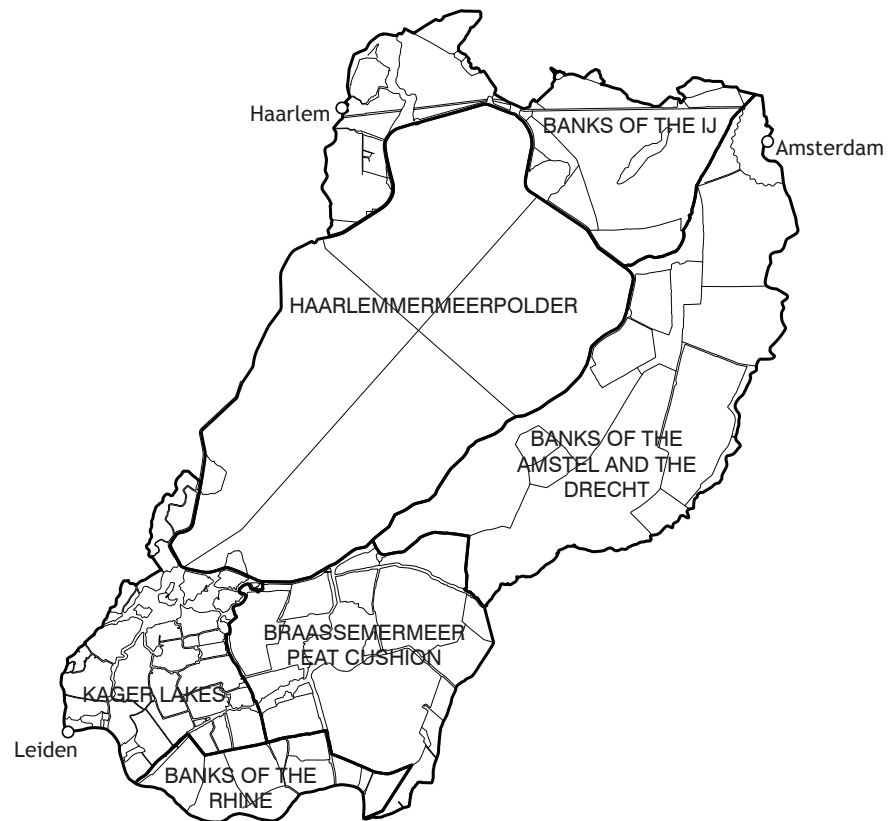
As the peat compacted, the small peat rivers such as the Amstel, the Drecht and the Schinkel were diked and acquired a *boezem* function. These dikes, plus the weirs beside the highland that had not undergone peat extraction, were used as dikes for the later polders. The continuous dike along the southern side of the IJ, which passed along the bank of the Zuyder Zee, was constructed in 1202. Dams were created in the Amstel, the Spaarne, the Drecht and the Sloot. On the several occasions when the dike gave way, the land was flooded as far as Leiden. The dike was repaired and strengthened time and again until in the sixteenth century it was reinforced to such an extent that no more breaches took place. When the IJ polders were drained in 1875, the Spaarndammerdijk was left as a reserve dike.<sup>8</sup>

The poldering of the Haarlemmermeer reduced the surface area of the Rijnland *boezem* (22,700 hectares) by 80 per cent. This required an adjustment of the entire water management system of Rijnland. The discharge at Katwijk was expanded with two sluices, the Katwijk Canal was more than doubled in width, and a second canal was dug. The Spaarne was deepened, the drainage sluice there was enlarged, and steam-driven pumps were installed at

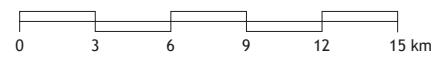
Spaarndam and Halfweg. Yet the drainage problems were still not entirely resolved. It soon became clear that the pumping station at Halfweg would not be sufficient to deal with flooding in the southern part of Rijnland, so a third pumping station was built on the IJssel near Gouda. Eventually a fourth pumping station was also required at Katwijk. All these measures led to a drainage management in which not only the maintenance of the water level but also the quality of the water could be controlled, which was also to the benefit of the Delfland high dike board. The poldering of the Haarlemmermeer thus influenced the water management of the largest part of South Holland.<sup>9</sup>

The application of steam power meant that no *boezem* was required within the dike system of the Haarlemmermeer. The determinant *boezem* system in this area is the canal encircling the Haarlemmermeer which discharges at Katwijk, Halfweg and Spaarndam.





Patterns of Reclamation

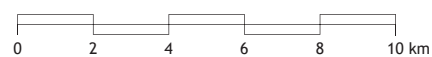


## PATTERNS OF RECLAMATION

The landscape of the Haarlemmermeer complex was reclaimed starting from the beach ridge and the riverbanks. This can be seen in the different patterns of reclamation. Some of them are clearly orientated towards the riverbanks: on the northern side the banks of the IJ (including the banks of the Spaarne and the Liede), on the eastern side the banks of the Amstel and the Drecht, and on the southern side the banks of the Rhine. A dense network of peat streams and small peat lakes has emerged to the South of the complex, resulting in a different parcellation here. The Braassemermeer was in the middle of the peat cushion and forms the centre of a cluster of polders which were drained after the peat had been extracted. In the furthest corner to the South-West the irregular patterns of the Kager lakes dictate the pattern of reclamation. All these patterns originally extended much further, but they and the reclamations from the beach ridges were absorbed by the continuing expansion of the Haarlemmermeer.



Banks of the IJ



## BANKS OF THE IJ

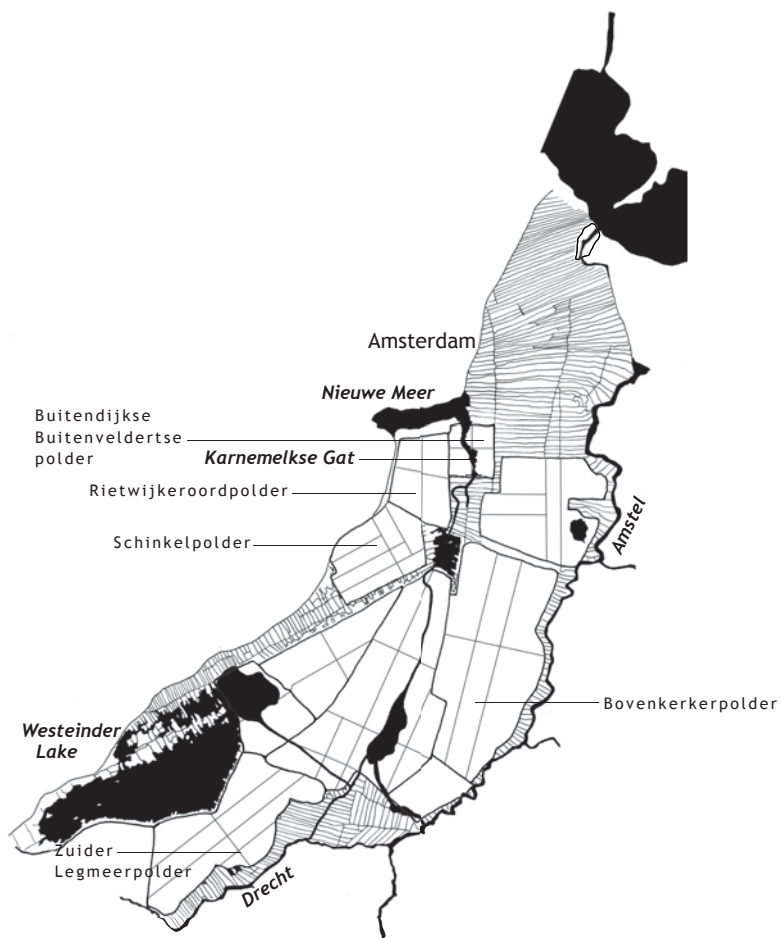
The Spaarnwoude beach ridge is one of the oldest in the Netherlands. The first settlement there dates from around 2500 BC. The ridge formed a fixed core around which the water of the IJ had to find its own way.<sup>10</sup>

Reclamation of the peatlands beside the banks of the IJ began around 1000, with the banks of the IJ, the Spaarne and the Liede as its basis. In the thirteenth century the southern sea dike beside the IJ was constructed. A large part of the shire of Sloten was swallowed up by the emergence of the Haarlemmermeer. When the Haarlemmermeer was about to do the same to the Lutkemeer it was poldered; the Lutkemeer was not poldered until 1865. The dikes already existed at the time: on the southern side the ring dike of the Haarlemmermeer, and on the northern side the Wijsentkade, which protected the peatland in the Osdorp polder from the Lutkemeer. After the latter had been drained, the polders surrounding it were stripped of their peat and then drained between 1920 and 1941. The last was the Eendracht polder in 1941. This polder was designed by the urban planner Van Eesteren as a pilot design for the IJsselmeer polders. The parcelation, with large orthogonal parcels, was orientated

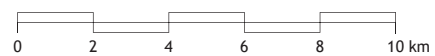
towards the Haarlemmertrekvaart. The points on the grid, which was planted with ash trees, where the roads and polder ditches intersected were accentuated with rings of trees.

The Slotermeer originated from the peat stream the Sloot, which discharged into the IJ. A dam was created in the Spaarndammerdijk at the mouth of the stream. The Slotermeer was drained in 1642. Three centuries later, the Sloterdijkmermeerpolder was dug up again to form the Sloterplas, a 30-metre deep lake for the extraction of sand for the building of the garden cities in the West. The lake is the green heart of those garden cities, a close meshing of landscape form and city form.

The pattern of reclamation is intersected by the Haarlemmertrekvaart (1631), the first boat canal to be constructed in the Netherlands. It consisted of two parts, because otherwise there would have been a direct link between the dangerous Haarlemmermeer and Amsterdam.<sup>11</sup>



Banks of the Amstel and the Drecht



## BANKS OF THE AMSTEL AND THE DRECHT

In the course of time, most of the area between the Haarlemmermeer and the Amstel has been drained after the extraction of peat. The lake-bed polders form a virtually continuous pattern, interrupted by a few peat extraction lakes such as the Westeinder lake and the Poel, surrounded by the remains of old peatlands. The Bovenkerker polder (1500 hectares) was a peat extraction lake from 1600 onwards before being poldered in 1770. The other peat extraction lakes were poldered in the second half of the nineteenth century.

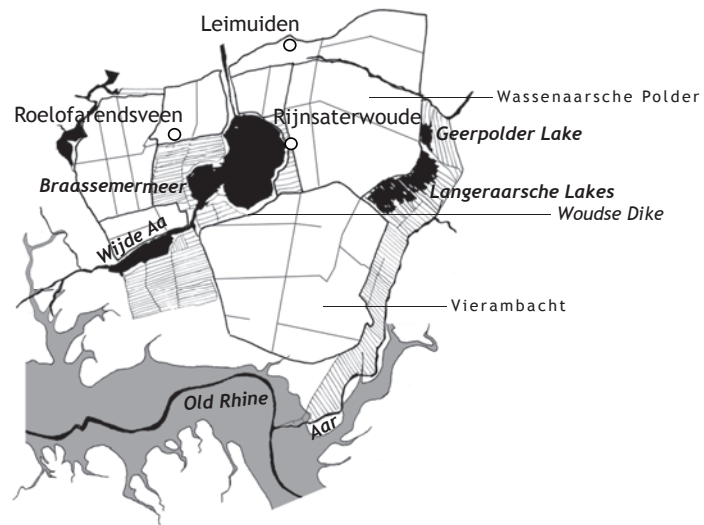
In the Buitendijkse Buitenveldertse polder, peat extraction, starting in 1904, was confined to the northern part. After drainage in 1925, the polder was reunited with the southern part, so that a difference of level of 3.5 metres arose inside this polder. This poldering led to the disappearance of the Karnemelksegat. Peat extraction did not begin in the Rietwijkeroord polder until 1879, after the Haarlemmermeer had been poldered; it seems that there was a reluctance to tackle it earlier. This peat extraction lake was drained in 1906. The boundary between the Buitendijkse Buitenveldertse polder and the Rietwijkeroord polder was formed by part

of the Blekerskade, the old boundary between the Rijnland and Amstelland high dike boards.

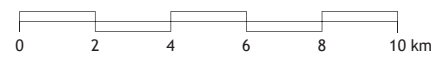
The ribbon developments of the peat reclamations beside the small rivers and Amstelveen and Aalsmeer continued to exist. New ones were created in the lake-bed polders. The southern part of the old peat extraction village of Aalsmeer juts out into the Westeinder lake and stops at the drainage canal encircling the Haarlemmermeer.

The Amsterdamse Bos was constructed on three polders: the Buitendijkse Buitenveldertse polder, the Rietwijkeroord polder, and partly on the Schinkel polder. On its northern and western sides the borders follow the natural form of the Nieuwe Meer and the drainage canal around the Haarlemmermeer; on the eastern and southern sides it is bounded by the angular forms of the Rietwijkeroord polder and the Schinkel polder. With the extraction of peat from the Buitenveldertse polder, a strip of highland was left untouched beside the Nieuwe Meer, which now forms an open belt between the Amsterdamse Bos and the Nieuwe Meer. The character of a polder landscape is still present in the micro-relief, the forms of lowland vegetation, and the difference of level at the edges.





Braassemermeer Peat Cushion



## BRAASSEMERMEER PEAT CUSHION

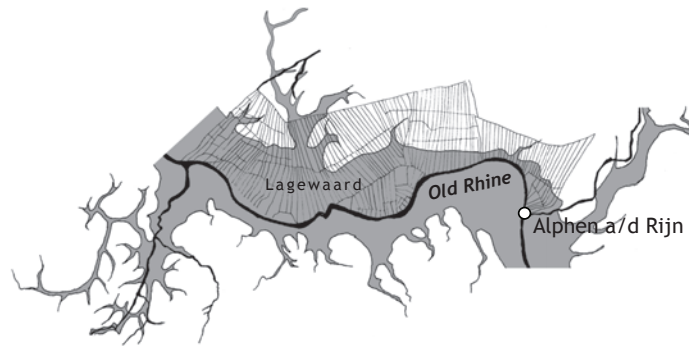
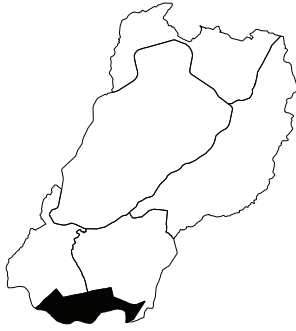
After the establishment of the Rijnland high dike board at the beginning of the thirteenth century, the virgin land was reclaimed from the villages of Leimuiden, Rijnsaterwoude and Esselijckerwoude.<sup>12</sup> A second and a third line of satellite villages were established in a westward direction from these old villages.

The Braassemermeer was a natural lake that has doubled in size from erosion of the banks after the sharp increase in the volume of water triggered by the reclamation of new polders. Dikes were constructed in the seventeenth century to put an end to the expansion. At the end of the eighteenth century, however, a number of breaches occurred and a second dike was built further inland, the Woudse Dike. Remains of the old dike still lie as small islands in the lake.

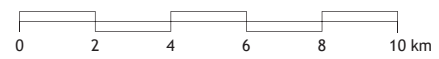
The area forms part of the peat cushion of the Haarlemmermeer. Peat extraction went on here, followed by a continuous series of polders, which were smaller on the western side of the lake and much larger on the opposite side.

Narrow strips of peat highland were left untouched at various points to protect the farms from the water. These strips were much higher than their surroundings. Where the medieval ribbon development has survived, it has been incorporated in the new parcellation. The Aar was a part of the Old Rhine river basin, so that the peat on its banks contained too much woody material (woodland peat) and clay to serve as fuel. The area beside the Braassemermeer has a strip parcellation with short strips (200 to 400 metres). This is a market gardening area and the ditches are wide because they were dredged to use the slush to raise and fertilise the ground.<sup>13</sup>

The Wassenaarsche polder was drained in 1666 on the orders of the lord of the shire of Rijnsaterwoude, the lord of Wassenaar. The Vierambacht polder was drained in 1768. This polder has a geometric grid, dominated by an intersection of axes, but in spatial terms it is also determined to a large extent by a micro-relief with differences of levels of up to half a metre, in which the former sea creek system can still be glimpsed. The Langeraarsche lakes and the Geerpolder lake were not poldered after peat extraction.<sup>14</sup>



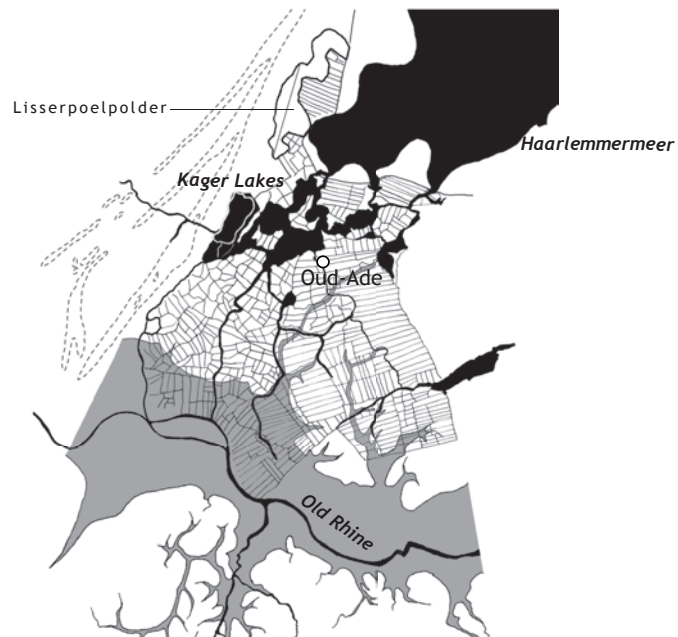
Banks of the Rhine



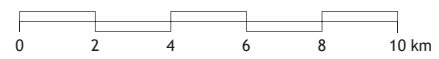
## BANKS OF THE RHINE

Around the twelfth century the Old Rhine was transformed from a big river into a calm water-course without ebb and flow and without peaks in the volume of river water. The levees had been inhabited since the Roman era, and around 900 they served as the base for the reclamation of the hinterland, with fan-shaped patterns at right angles to the meandering river. The farms are therefore at some distance from the river, just within the edge of the alluvial ridge.<sup>15</sup>

A clear departure from the fan-shaped parcellation reveals the presence of an earlier course of the river. The old levee, Lagewaard, can be clearly seen through a dense ribbon development. The peat was reclaimed from this levee.



Kager Lakes



## KAGER LAKES

A large number of peat streams converged in a low-lying and boggy area with a predominantly Southwest-Northeast orientation at the southern tip of the Haarlemmermeer. The reclamations consist of alternating regular strips and irregular block-shaped parcels. The peatlands on the eastern side, where there was not such a concentration of peat streams, have a parcellation that is somewhere between strip and block parcellation.

The block parcellations probably date from the Carolingian era. The meandering peat streams resulted in an irregular pattern of parcellation with block-shaped parcels. The wide ditches and the drainage channels with weirs are an expression of the poor drainage: during reclamation the peat streams were widened to increase their drainage capacity and extra channels were dug. As a result of the poor accessibility and hostile conditions, there was no further reclamation until the thirteenth century. Initially the reclamations drained into the Old Rhine, but when this river began to silt up the drainage was moved to the Haarlemmermeer.<sup>16</sup>

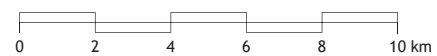
The Kager lakes consist of natural lakes dating from before the reclamation. A few others were formed

later as a result of the crumbling of the banks and the erosion of old peat streams. The predominantly southwesterly wind drove the water inland and caused the banks to recede, which is why the lakes have a Southwest-Northeast orientation. The northern part of this lake complex has been drained. The westernmost of these lakes, Lisserpoel, lies next to the easternmost beach ridge and was poldered in 1622. The other lakes were incorporated in the southern tip of the Haarlemmermeerpolder in the nineteenth century. The southernmost lake, 't Joppe, was excavated for sand for road construction and urban expansion. With a depth of 21 metres, this lake is much deeper than the natural lakes.<sup>17</sup>





Haarlemmermeerpolder



## HAARLEMMERMEERPOLDER

The Haarlemmermeer was the product of a number of interconnected peat lakes whose banks continued to recede. During a series of major storm tides in 1477, a large, open connection between the Old Haarlemmermeer and the Leidsemeer was created. The last strips of land between this big new lake and the Spieringmeer disappeared between 1506 and 1508, thereby turning the Haarlemmermeer into a single large lake. Under the influence of the predominantly southwesterly wind, the Haarlemmermeer expanded even further in the course of time. By about 1540 it had a surface of some 13,000 hectares, which had grown to 15,000 a century later. During a storm in January 1616 the villages of Nieuwerkerk, Vijfhuizen and Rijk were engulfed in one go. Improved defence of the banks in the course of the eighteenth century put a brake on further expansion of the lake, but even so it still grew to a surface of 18,000 hectares. During stormy weather the lake was a major threat to the security of the surrounding area.<sup>18</sup>

Starting in the seventeenth century, various plans were made to drain it, but the poldering did not actually take place until two centuries later, when the government under King Willem I, whose economic

policy was aimed at promoting trade, industry and agriculture, ordered it. The first spade was thrust into the ground for the digging of the 60-kilometre drainage channel around the polder at Hillegom on 5 May 1840. This channel and the ring dike were both completed in 1845 at the same time as the first steam-driven pumping station, the Leeghwater, although the latter could not begin operations until June 1848. The Lijnden and the Cruquius pumping stations followed in the spring of 1849.<sup>19</sup>

The polder was parcellated with a parcel of 200 x 1000 metres in modules of 2 x 3 kilometres, with the Hoofdvaart as the symmetrical axis. Two new villages were established at points where the Hoofdvaart was crossed by transverse channels, Kruiswijk (later Hoofddorp) and Nieuw Vennep. Satellite villages of the Kennemerland were established on the western side of the polder. The eastern side, which bordered on the old peat landscape, remained relatively empty.<sup>20</sup>

## PEAT RECLAMATIONS, PEAT EXTRACTIONS AND A BIG POLDERED LAKE

The Haarlemmermeer is roughly triangular in shape, formed by water and wind. The western bank of the Haarlemmermeer follows the line of the beach ridge between Sassenheim and Heemstede, while the eastern bank follows the direction of the south-westerly wind. The top of the peat cushion on the southern side, the Spaarne and the Liede, where the sea entered the complex, and the Schinkel as a peat drainage channel, are the points which defined the basic triangle of the complex.

The Haarlemmermeer complex was originally a continuous peat cushion which drained at the edges. The Haarlemmermeerpolder is now an enormous saucer with a depth of roughly four metres below Normal Amsterdam Level (NAP). In that sense the complex is thus comparable to Central Holland: it is one big inversion landscape.

## NOTES

1. Vos (2004); de Mulder (2003) pp. 224-234.
2. Reh, Steenbergen and Aten (2005) p. 195.
3. Reh, Steenbergen and Aten (2005) pp. 195-196.
4. Reh, Steenbergen and Aten (2005) p. 196.
5. Reh and Steenbergen (2005) p. 57; Van der Hoek (1984) pp. 16 and 18; Van de Ven (1993) pp. 69-70; Donkersloot-de Vrij (1993) pp. 49-50.
6. Reh, Steenbergen and Aten (2005), pp. 201-202.
7. Van der Gouw (1987) pp. 51-52; Oerlemans (1992) pp. 63 and 69-70; Reh, Steenbergen and Aten (2005) pp. 195-196.
8. Schroder (1955) pp. 138-139; Van der Valk and Van Leeuwen (2000) p. 58.
9. Schroder (1955) pp. 138-139; Reh, Steenbergen and Aten (2005) pp. 200-201.
10. The tower of Spaarnwoude church dates from around 1200 AD. The church was built on the beach ridge, which rises several metres above the surroundings because the peat encircling it has compacted a few metres.
11. Valk and Van Leeuwen (2000) pp. 50-60.
12. The village of Esselijckerwoude was situated at the eastern shore of the Wijde Aa, but has disappeared in the late Middle Ages.
13. Oerlemans (1992) pp. 56-58.
14. Oerlemans (1992) pp. 58-60.
15. Oerlemans (1992) pp. 62-66.
16. Borger, Haartsen and Vesters (1997) p. 66; Oerlemans (1992) p. 54.
17. Oerlemans (1992) pp. 54-56.
18. Reh, Steenbergen and Aten (2005) p. 196.
19. Reh, Steenbergen and Aten (2005) pp. 198-200.
20. Between 1891 and 1894 a new defence line and inundation weir were constructed running through the Haarlemmermeer, entirely independent of the polder grid. This line was part of the Defence of Amsterdam (*Stelling van Amsterdam*),



Haarlemmermeerpolder, Hoofdvaart



# History and Transformation

*If we look around our country, we will find cultural landscapes everywhere, often well and intensively cultivated, sometimes unjustly devoted to agriculture or forestry. Sometimes the traces of a former method of agriculture, an old occupation and cultivation can still be seen clearly, sometimes they have been erased by later developments. Sometimes the result is a particularly attractive landscape, sometimes it is dull and uninviting.*

J.T.P. Bijhouwer, *Het Nederlandse Landschap*, 1977, p. 19.

The landscape complexes of the Dutch delta show to what extent the lowlands of the Netherlands are determined by reclamations and shaped by human intervention, but at the same time to what extent the interaction with the natural conditions has determined this form too. They constitute a series that affords insight into the genesis of the polder landscape. The successive complexes show an increasingly radical transformation of the original natural landscape.

In the case of the *waarden* of South Holland, the relation between the form of the natural landscape,

the form of the reclamations and the drainage system is still clear. The original ensemble of small peat reclamations has come to form a unique continuous polder system. There is a cohesion between the different scales, from parcel to *waard*, that seems to have been designed rather than to have evolved naturally. The lake-bed polders, which were indeed designed as a coherent system, resemble the *waarden* in many ways. It is therefore possible that the *waarden* were the model for the first lake-bed polders. The Rhine-IJssel complex is an almost continuous carpet of peat reclamations, in which a gradual transition from East to West can be seen



from pure river reclamations via a number of hybrid forms to pure peat reclamations, with a few tentative examples of the successive stage of reclamation, that of peat extraction and poldering. In the Rhine-Vecht-Drecht complex, the peat reclamations form the matrix in which continuous groups of lake-bed polders, the original peat cushions of the natural landscape, are anchored like islands. The peat reclamations and lake-bed polders are in equilibrium. In Central Holland peat extraction followed by poldering is the dominant model, in a continuous patchwork that follows the structure of the former peat reclamations. The original peat reclamations have been relegated to the edges. Both the relation between the different stages of reclamation and the scale of the units have been inverted in the Haarlemmermeer complex, where the Haarlemmermeer polder, more than 18,000 hectares in size, is fringed by a fine-meshed border of peat reclamations, peat extraction lakes, natural lakes and polders.

This picture is, of course, not complete. A successive transformation, land consolidation, took place in the peat landscape in the twentieth century. After the natural forces on which the polder landscape was based and the economic forces that had led to the peat extraction landscape, it was now the turn of the violence of the Second World War to trigger

the transformation of the cultural landscape. The repairing of the damage caused by the war was accompanied by a modernisation of agriculture, which called for a major structural change. To do away with the fragmentation of the land and to improve drainage and access, parcels were combined and levelled, ditches were filled in or deepened, streams were widened and straightened, country lanes were widened and metalled, and farmyards and many other locations were replanted.

Backed by scientific research and an intensive information service, the land consolidation was rapidly transformed from a purely cultural technical intervention to a large-scale programme for the total modernisation of the countryside. This programme introduced two far-reaching changes into the geometry of the polder: the existing pattern of parcellation became less fine-meshed, and a new infrastructural grid was projected on top of it that took over or complemented the role of the waterways as a vehicle.

Urban transformations, originating as a civil engineering adaptation of the natural landscape and of the cultural landscape, have also imposed a new layer on top of the polder landscape. The urban programmes arise from the needs, norms and insights of an urban society, and they affect more

than the urban cores and their expansions; these programmes find expression in (boat) canals and railways, motorways, water reservoirs and recreational areas.

However, the indelible framework for the polder landscape shaped by the interaction between the basic natural form and the form of reclamation is still the basis for the transformations of land consolidation and urbanisation; it remains unchanged, merely further elaborated and filled in.

Topical and future themes such as new nature and water catchment, urbanisation and recreation will once again lead to large-scale transformation of the landscape. These new programmes impose their own demands on water management and infrastructure, on the dimensional grid of the polder, its spatial form and visual idiom. When the demands of these new programmes are applied primarily not as a design instrument but as a means of investigating, adapting and giving new expression to the existing framework of basic natural form and reclamation, these programmes can lead to new landscape architectural compositions in which beauty and functionality naturally coincide.



# Glossary

## **ACCRETION**

a sand bank formed by sedimentation of the particles transported by water. The accretion is attached to existing land or dike and runs parallel to the gully of the river

## **ALLUVIAL RIDGE**

the aggregate (sand) deposits from the former bed of a river

## **BAILIWICK**

district under the jurisdiction of a bailiff

## **BASIN**

low-lying area in a river landscape whose soil contains a high percentage of river clay that has been deposited during flooding. A basin is separated from a river by the **levees**.

## **BEACH RIDGE**

ridge of sand formed by the action of the tides and currents which, under the influence of the wind, becomes so high that it acts as a barrier against the sea

## **BLOCK PARCELLATION**

parcellation in more or less rectangular parcels, without shared front or rear boundaries, generally occurring in the river area

## **BOEZEM**

a coherent system of reservoirs and channels with a separate level, which serve for the storage of the water from the polder before it is discharged into the sea or a large river

## **CANAL**

artificial waterway, especially for shipping

#### CENTRAL CHANNEL

waterway that intersects the central point of a polder

#### CENTRAL HOLLAND

area between the Old Rhine and the New Maas, the beach ridges in the West, and the Hollandse IJssel and the Gouwe in the East

#### CHANNEL

watercourse dug to drain a polder

#### COPE

agreement on the reclamation of the peatlands. From 1150 the peatlands were systematically reclaimed on the basis of agreements made between the feudal lord and individual entrepreneurs or a group of colonists. These agreements specified the length and breadth of the **parcels**

#### COURSE OF MILLS (*MOLENGANG*)

series of two or more mills that transport the excess water from the **polder** into the **boezem** because a single mill could only bridge a limited difference in level of 1.5 metres

#### CREEK

tidal gully running through land outside the dike system

#### CREEK RIDGE

sand deposit created in an open coastal system where the sea had free access to the land. The compaction of the surrounding land left the sand ridges higher than the surrounding area

#### CREVASSE COMPLEX

small creek system formed by water flowing through breaches in the levee into the surrounding area

#### DAM

barrier of earth constructed crosswise to a watercourse

#### DIKE

embankment built to restrain water

#### DIKE RING

system of barriers that enclose a specific reclamation area

#### DIKE-REEVE

officer in charge of the drainage and dikes in peatlands

#### ELONGATED PARCELLATION (*OPSTREKKENDE VERKAVELING*)

type of **parcellation** in which each colonist is en-

titled to reclaim more land over the breadth of his parcel up to the boundary of the territory in question or to a natural obstacle

**ESTUARY**

funnel-shaped tidal mouth of a river

**FLOOD MEADOW**

tract of low-lying land outside the dike that is often flooded by a river

**FRONT CHANNEL**

artificial waterway that intersects the front part of a polder

**GROYNE**

a rigid hydraulic structure or breakwater built from a riverbank that interrupts water flow and limits the movement of sediment

**HIGH DIKE BOARD (*HOOGHEEMRAADSCHAP*)**

**water board** responsible not only for the hydraulic system inside the **dike ring**, but also for the dikes themselves

**HIGH PEATLAND**

a thick sponge of sphagnum moss that has gradually grown on moist, infertile sandy soil, 10 to 15

metres in thickness. When the peat is so high that precipitation is the only source of water, it is known as high peatland

**ICE-PUSHED RIDGE**

ridge in the landscape formed in the last Ice Age when the ice pushed material away and moved forwards and sideways

**HOLM**

a sand bank formed by sedimentation of the particles transported by water. Unlike the **accretion**, the holm is an islet in a river that is submerged in time of flood

**LAGOON**

tract of sea water almost or entirely cut off from the sea by a reef or **beach ridge**

**LAKE-BED POLDER (*DROOGMAKERIJ*)**

drained lake whose water level is maintained artificially

**LANDSCAPE COMPLEX**

regional complex displaying a geographical and morphogenetic coherence, defined by the interaction between the different types of reclamation and the natural subsoil



#### LEVEE

low broad ridge of sediment running alongside a river channel between the river itself and the **basin**. Levees are asymmetrical: they are highest next to the river, sloping gently down into the basin

#### LOW PEATLAND

nutrient-rich peatland produced in a freshwater environment in which the peat is watered by river water or seepage

#### MUD FLAT

stretch of muddy land left uncovered at low tide

#### NAP

Normal Amsterdam Level

#### NATURAL DRAINAGE

water discharge without pumping by making use of differences in water level

#### OSIER BED

piece of land covered with osiers

#### PARCEL (*KAVEL*)

smallest unit of a reclamation

#### PARCELLATION

- 1) division into parcels by reclamation of virgin land or of water by the construction of channels, ditches, mill-races and roads
- 2) allocation of parcels in a reclamation

#### PEAT EXTRACTION

- 1) activity of extracting peat
- 2) area in peatland produced by the extraction of peat for fuel. This area consists initially of long strips of water (*trekgaten*), alternating with strips of land (*zetwallen*, *legakkers*). Sometimes the strips of land were subjected to peat extraction too or were swept away by storms. Peat extraction was also conducted on the scale of the existing polder as a whole. The result was peat lakes, separated by isolated strips of land on which through roads and buildings were situated

#### PEAT EXTRACTION LAKE

lake formed by the systematic dredging of the former peat layer

#### PEAT RECLAMATION

area in peatland reclaimed by means of a system of ditches that drain into natural water or an artificial channel. Reclamation took place in accordance with *cope* agreements or **elongated parcellation**

**PEAT STREAM**

stream that drains a tract of peatland

**PERIMARINE**

environment in which sedimentation is strongly influenced by the tides, but where there are no marine deposits

**POLDER**

area in which the water level is controlled by discharging either naturally into a lower area by means of sluices, or artificially by means of mills or pumping stations that discharge the water into higher-lying drainage channels or reservoirs. It is a flat area where there were originally high water levels, either permanently or only in the wet season, because of the surface water or groundwater. From the moment that it is separated from the adjacent hydrological regime by watersheds and the water level is maintained independently of the surroundings, it is a polder

**REAR CHANNEL**

artificial waterway that intersects the rear part of a polder

**REAR WEIR**

low **dike** constructed to the rear of the reclaimed

area to check the seepage of acid, nutrient-poor water from the unreclaimed peatland

**RECLAMATION PATTERN**

configuration of reclamations with a common landscape morphological basis that are distinguishable within a **landscape complex**

**RIVER DUNE (*DONK*)**

mound of sand piled up by the wind at the end of the Ice Age and now often still visible because it stands out above the surrounding layer of clay or peat

**SAND DUNE**

ridge of loose sand formed by the wind on the sea coast

**SEEPAGE**

water in waterways or on land that has flowed there underground (particularly under the dikes) from a higher level

**SEEPAGE WEIR**

low barrier erected at some distance from the river dike to prevent the water that rises in the ditches behind the dike from spreading further inland. The strip of land between the dike and the weir thus

usually has a different water level from that of the land behind the weir

**STRIP PARCELLATION**

parcellation in more or less rectangular strips

**TRANSVERSE WEIR**

barrier across a river to protect the land downstream. The weir prevented water from the adjacent parcels from entering and enabled a more intensive use of the slopes of the alluvial ridges

**VLIET**

broad waterway serving for both the storage and drainage of water

**WAARD**

complex of reclamations, bounded by rivers and with a continuous **dike ring**

**WATER BOARD (WATERSCHAP)**

public body responsible for water management, water barriers, the maintenance of the quality of the water and related tasks within a fixed area

**WATERSHED**

natural or artificial boundary separating waters flowing into different rivers

**WEIR**

small barrier or embankment to restrain water

**WHEEL (WIEL)**

deep hole caused by the whirling water at the breach of a dike. The new dike was usually led around it.

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