Water in the Netherlands

DUTCH WATER MANAGEMENT FACTS AND FIGURES

WATER IN THE NETHERLANDS 2004-2005

Water in the Netherlands 2004-2005

Facts and figures

Twenty-six percent of the Netherlands lies below sea level, i.e. below NAP. Without dunes or dikes, 66% of the Netherlands would be flooded on a regular basis.

Source: *Watermonitor* 2001

NEDERLAND LEEFT MET WATER

DUTCH WATER MANAGEMENT FACTS AND FIGURES

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What is the purpose of this booklet?

As in previous editions, the Water in the Netherlands 2004-2005 is a reference book with facts and figures about water management in the Netherlands. It answers frequently asked questions about water, water quality, water supply, flood protection, water management, relevant legislation/regulation and funding.

Although the booklet is primarily intended for water managers who do not always have the answer to every question at hand, it also meant for anyone interested or involved in Dutch water management. Its size and design ensure that people can easily carry it with them.

The key aspects of Dutch water policy are addressed one at a time. The policy aims to make the Netherlands safe and liveable, now and in the future. To achieve this, a healthy and resilient water system has to be created and built-up in a way that guarantees its sustainable use.

The 2004-2005 edition is published as part of the 'The Netherlands Lives with Water' public awareness campaign. This campaign aims to increase the awareness of the Dutch society of the impact of climate change and the efforts water managers are undertaking to deal with the consequences and ensure that the Netherlands remains safe and liveable in the future. The 'The Netherlands Lives with Water' public awareness campaign is promoted by the Ministry of Transport, Public Works and Water Management, the Association of Provincial Authorities (IPO), the Association of Water Boards (UvW) and the Association of Netherlands Municipalities (VNG).

The booklet can offer no more than a snapshot. Although many facts have been updated, improved and elaborated since the last edition, it cannot offer a comprehensive picture of the present situation as facts and figures change continuously. This also applies to the measurement methods, type of data and reporting. Matters that were closely scrutinised until very recently can quickly become less relevant in response to new insight, new developments or both.

One final word: a great deal of information and many policy documents are also available on the websites of the Ministry of Transport, Public Works and Water Management, the UvW, the IPO, the VNG and the 'The Netherlands Lives with Water' public awareness campaign.

http:// www.minvenw.nl
http:// www.uvw.nl
http:// www.ipo.nl
http:// www.vng.nl
http:// www.nederlandleeftmetwater.nl

1. What is the purpose of the 'The Netherlands Lives with Water' public awareness campaign?

February 2003 saw the start of the multimedia public awareness campaign 'The Netherlands Lives with Water'. The campaign aims to explain the government's policy of 'giving water more room' and encourage support for it.

Initially, the campaign pressed home the message that the climate is changing and that this has consequences for water management in the Netherlands. Gradually, the campaign puts into plain words what measures such as storing water mean in practice. Moreover, it highlights the efforts the national government, provincial authorities and water boards are undertaking across the Netherlands to keep the country safe and dry.

Research showed that the public estimated the campaign to be informative and believable. The awareness that the government is effecting measures to balance the effects of climate change has increased significantly. At the end of 2003, 82% of the population recognised the social importance of measures to protect against flooding, and 72% endorsed the proposition that this would have to involve 'giving water more room'. Weatherman and 'Water Ambassador' Peter Timofeeff is seen as an appealing and likeable expert. On national and regional radio and television, he brings the problems and solutions to peoples' attention through cartoons and personal appearances.

Source: www.nederlandleeftmetwater.nl

Cartoon from the 'The Netherlands Lives with Water' public awareness campaign featuring Peter Timofeeff

The Netherlands protected against flooding

Floodable land if there would be no flood defences

2. Where is the lowest point in the Netherlands?

The lowest point is defined as an area of about one hectare that can be walked on by man and animal and that is more or less horizontal, for which the mean ground level measured relative to NAP, i.e. the mean sea level in the North Sea known in Dutch as '*Normaal Amsterdams Peil*', is lower than any other area in the Netherlands.

Determined in June 1995 by the former Survey Department of the Directorate-General of Public Works and Water Management, the lowest point in the Netherlands lies in Nieuwerkerk aan de IJssel. It is 6.74 metres below NAP. In the absence of dunes, dikes and other defences, Nieuwerkerk aan de IJssel would be submerged with about seven metres of water every day.

As a result of building and other human activities, soil movements, changes in the water table and soil subsidence, the ground level in the Netherlands is constantly changing. It therefore remains to be seen how long Nieuwerkerk aan den IJssel remains the lowest point in the Netherlands.

Until 1994, the lowest point in the Netherlands was the Prins Alexanderpolder at 7.0 metres below NAP. That is, until building works raised it to about 6.25 metres below NAP.

Source: www.laagste.nl

Land at an elevation near the imaginary 0 metre NAP line – where the 'low Netherlands' becomes the 'high Netherlands' – is marked by 27 notice boards at stopping places along the trunk roads. In this way, you can see whether you are standing above or below sea level and by how much. The notice boards are intended to raise awareness of the Dutch public of its dependence on effective water management and to make

Windmill at Kinderdijk

foreign visitors aware of the fact that without water defences a great part of the Netherlands would be permanently flooded. They were installed during the Dutch presidency of the European Union (from 1 July to 31 December 2004) to mark the recurring theme of international-level flood control efforts.

Source: www.nederlandleeftmetwater.nl

3. How many polders are there in the Netherlands?

There are hundreds of polders in the Netherlands – sea polders, river polders and the drained and reclaimed lakes and ponds (known in Dutch as '*droogmakerijen*'). An extensive and complex system of ditches and waterways serves to manage the groundwater level in these polders round the clock. Every drop of rain that falls in the polders must be pumped out. Consequently, every polder is connected to a pumping station that transports the water to a drainage outlet or pool. From there, it is pumped out to the other waterways and, finally, flows to the sea.

The Dutch have been reclaiming land since as early as 1533. The first polder was made by draining the Achtermeer south of Alkmaar. For centuries, the creation of new agricultural land was the main reason for creating polders. After the Second World War, however, reclaimed land – particularly the Lake IJsselmeer polders – was mainly seen as a way of finding new land for the growing population.

The polders vary enormously in size: from one or two hectares, such as those near the Lije, Kleine Waal and Zwarte Waal rivers, to the 54,000 hectare East Flevoland polder. In the lower reaches area alone, an estimated 16,000 hectares of land has been reclaimed from the rivers. Most of it was reclaimed from what are known as 'overflow areas'. The closure of the Beerse Overlaat between Cuijk and Den Bosch in 1942 reclaimed 17,000 hectares of land from the water.

Another example is the Zuiderzee. The completion of the IJsselmeer dam (Afsluitdijk) across the mouth of this brackish arm of the North Sea in 1932 created a 350,000-hectare freshwater lake (Lake IJsselmeer). Reclaiming the North-East, East Flevoland and South Flevoland polders from the lake and the draining of Lake Wieringermeer left only 190,000 hectares of open water. Almost half of the old Zuiderzee had now become dry land.

4. How many kilometres of flood defences are there in the Netherlands?

The Netherlands has a total of 3,500 kilometres of primary flood defences. These consist of dikes (along rivers, lakes and sea), dunes, flood barriers, dams and weirs. They protect the Netherlands from flooding from the major rivers (the Rhinebranches and the river Meuse), Lake IJsselmeer, Lake Markermeer and the sea. Then there are the secondary barriers such as storage basin dikes, polder embankments and canal dikes, which protect the land from flooding from the inland waters. About 90% of the primary barriers are managed by the water boards. Several dozens of kilometres are in the hands of municipal councils and provincial authorities, the remainder is managed by the national government. Primary barriers protect 66% of the Netherlands. In addition to this, there are about 14,000 kilometres of regional barriers such as storage basin and canal dikes.

Rules governing the funding, design, construction, supervision and flood protection standards of the primary flood defences are written down in the Flood Defence Structures Act. There are no such comprehensive regulations for secondary barriers, only standardisation agreements between water boards and provincial authorities.

Only 2% of the low-lying parts of the Netherlands lies outside the primary flood defences. This includes, for instance, the area outside the dikes along the rivers, the beaches and large parts of the Meuse valley in the province of Limburg. Some of these places are flooded almost every year, others rarely. To reduce flooding, some of these areas are protected by low ‘summer dikes’, which lie closer to the river than the high ‘winter dikes’.

Primary flood defences managed by the water boards (in kilometres):

Dunes	Sea dikes	River dikes	Lake dikes
260	430	1,430	1,017

Source: Association of Water Boards

5. What are the Delta Works?

After the disastrous floods in the province of Zeeland in 1953 the government set up a project called the *Delta Plan* to protect Zeeland from future floods. It provided for the construction of a series of ‘delta works’ – many kilometres of dike reinforcements and the closure a number of small and large sea arms: the Veerse Gat (1961), the Haringvliet (1971), the Brouwershavense Gat (1971) and the construction of the Oosterscheldt flood barrier (1986).

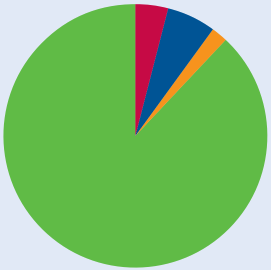
This remarkable construction was designed to preserve the marine ecology of the Oosterschelde estuary as much as possible, while providing protection against storm surges. The 62 large openings in the barrier allow the tides to flow unimpeded. Only when a storm threatens do the giant steel sluice gates fall into position and close off the Oosterschelde estuary. This ‘eighth wonder of the world’ cost EUR 5.4 billion.

In 1997, the Maeslant flood barrier was completed in the Nieuw Waterweg near Hook of Holland. This commanding storm flood barrier consists of two colossal hollow arched doors, each 300 metres long. When a storm surge reaches three metres above NAP, a computer orders the doors to close and seal off the Nieuw Waterweg. The Maeslant flood barrier completed the *Delta Works* 44 years after the 1953 disaster. This giant project has not only enhanced the flood protection of the South-West Netherlands considerably, but has also greatly improved water management in the area.

6. What is the Delta Plan for the Major Rivers?

The *Delta Plan for the Major Rivers* was established following the extremely high water levels of 1993 and 1995. The plan brought forward existing plans for dike reinforcements in a way that would guarantee the rapid downstream discharge of river water. By the end of 1996, work on the weakest dikes was complete, and since 1995, 150 kilometres of new embankment has been laid along the Limburg section of the River Meuse. In carrying out the *Delta Plan for the Major Rivers*, the government proceeded more cautiously than in the 1970s and 1980s. More care was taken to preserve the traditional landscape, the natural environment and cultural heritage, as recommended by the Becht Commission (1970s) and Boertien Commission (1993).

Progress of the Delta Plan for the Major Rivers in kilometres



- safe since 1st October 2003
- under construction
- emergency available
- not yet safe

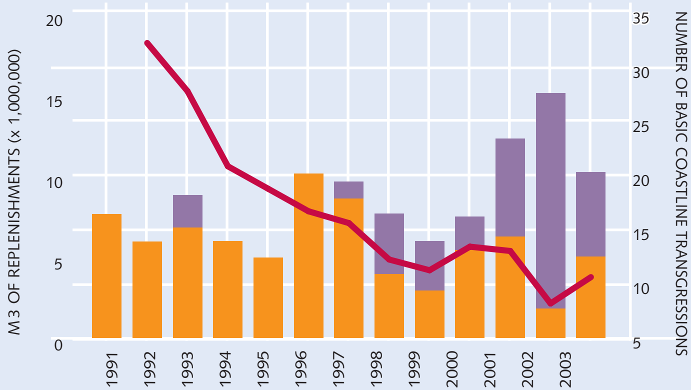
Source: Water in Data 2004

(www.waterincijfers.nl)

7. What is meant by 'dynamic maintenance' of the coast?

Dunes make up three-quarters of the Dutch coast and cover about 40,000 hectares or 11% of the land. The sandy coast is continuously in motion. As this can expose and increase the vulnerability of the land behind the dikes, the government has been keeping a wary eye on the coast for centuries. In 1990, the government decided on a 'dynamic maintenance' approach to the coastline. This means that the coast is allowed to move, within certain limits, and that wind and water have free play. Within these limits, the level of sand is maintained by bringing it in from elsewhere. Most sand replenishments these days are taken from the sea bed.

Sand replenishments and transgression of the basic coastline



- beach nourishment
- underwater replenishment
- transgression of the basic coastline (%)

Source: *Water in Beeld* 2004

Priority weak links

Source: Water in Beeld 2004 (www.waterinbeeld.nl)

Published in late 2000, the *Third Coastal Policy Document* noted that increasing pressure from the sea (e.g. climate change, sea level rise) and from the land (increasing use of space in the coastal zone) eventually leads to an increased risk to coastal towns and, in some places, to a weakening of the coastal defences. The Towards an Integrated Coastal Zone Policy document (2002) outlined possible solutions to this problem. The results of discussions concerning risk management along the coast (2004) are being incorporated into the *Beleidslijn Kust* (Coastal Policy Line).

Changing insight into the behaviour of waves along the coast has identified ‘weak links’ and led to additional sand replenishments.
In eight of these places, environmental quality played a role alongside insufficient flood protection. Provincial authorities are directing the formation of plans for integral improvement of both the flood defences and spatial quality for these priority weak spots.

Source: www.kustzonebeleid.nl

8. How are high water levels predicted?

Weather forecasts and the water levels at sea and in the major rivers are monitored round the clock. There are approximately 70 measuring stations along the major rivers in the Netherlands, Germany (River Rhine and its tributaries), Belgium (River Meuse), Austria, Slovakia and Hungary (Danube). As soon as very high water levels are predicted, the flood forecasting system comes into action. For the River Rhine, this occurs when the water level at Lobith exceeds 14 meters above NAP and is expected to rise above 15 meters. The attached figure shows how long it takes before a high water surge in the Rhine catchment area reaches the Netherlands.

Along the coast, the Storm Surge Warning Service (SVSD) follows the changing tides 24 hours a day, particularly when the wind blows

Coast at Zandvoort

between south-west and north. If the SVSD predicts that the danger level will be exceeded, they warn the flood defence managers and advise a watch on the dikes. The danger level varies along the Dutch coast between 2.50 and 3.80 above NAP.

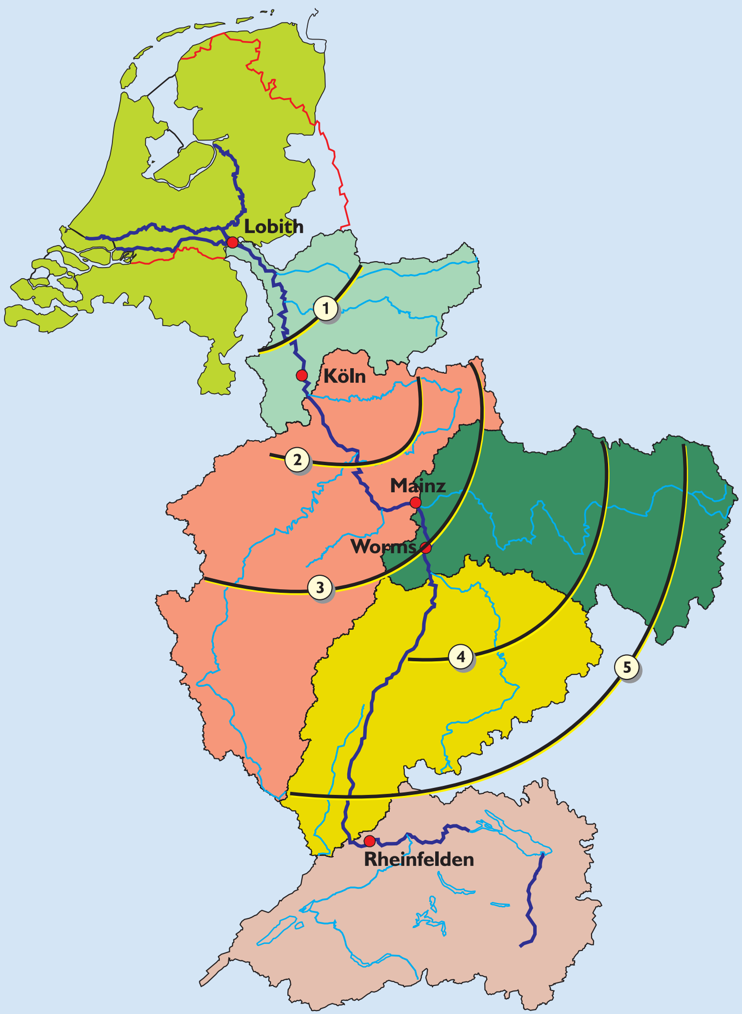
9. How many times has the Netherlands been flooded?

The Netherlands has seen many floods. The precise number is hard to estimate. The well-known storm floods are the Saint Aechten Flood (1288), the Saint Elizabeth Flood (1421), the Saint Felix Flood (1530) and the All Saints Flood (1570). In the Saint Elizabeth Flood the Grote Waard disappeared, creating the Biesbosch and the Hollands Diep, and many lives were lost. The All Saints Flood swallowed a large area of North Holland and claimed 5,000 lives.

Although the dikes were improved, there were still floods in the twentieth century, viz. 1906, 1916 and 1953. The storm that occurred on 13 and 14 January 1916 caused dikes to collapse along the entire coast of the Zuiderzee. The reinforcement plan carried out in response to this disaster was completed in 1926. In 1932, the Zuiderzee was ‘tamed’ by the completion of the Afsluitdijk. The floods of 1953 in the South-West Netherlands are deeply etched into the memories of many Dutch people. They claimed the lives of 1,800 people, involved the evacuation of 72,000 and flooded about 2,000 km2 of land.

Dikes along the rivers have also regularly collapsed. This happened 152 times between 1750 and 1800 alone. However, after the establishment of the *Bureau voor den waterstaat* (currently known as *Rijkswaterstaat* or the Directorate-General of Public Works and Water Management) in 1798, this happened much less frequently. Since the end of the eightieth

Number of days on which a high water surge reaches the Rhine catchment area in the Netherlands



Source: *de Rijn op Termijn*, WL Delft

century, the major rivers have reached very high levels eight times. On six of those occasions, it led to major dike collapses and flooding.

Overview of dike collapses in the area around the major rivers (primarily the River Rhine and River Meuse) of the Netherlands since 1780

1781	Wamel and Dreumel
1784	Ooijpolder
1799	Waal
1805	Weurt
1861	Bommelerwaard
1926	Maasdijk

Source: *De wegen van het water,* Terra / Lannoo, 2001

After high water levels in 1993 caused serious problems at various places along the rivers, another discharge occurred in 1995. This turned out to be the highest waterlevels and discharges since 1926. Because there was doubt about the stability of the dikes, about 250,000 people and all livestock were evacuated from the threatened areas in one week.

In 2003, it became clear that sustained drought can lead to dike collapses. First, a storage basin dike on the belt canal surrounding the Groot Mijdrecht polder in Wilnis gave way. This damaged the neighbouring housing estate and led to the evacuation of 1,500 residents. Shortly after that, there was an embankment breach at the Prince Alexander polder along the River Rotte. In both cases, the persistent drought seemed to be a major cause of the collapse of these ‘peat dikes’.

10. How much damage does a flood cause?

This has been studied for the River Rhine. In March 2002, the International Committee for the Protection of the Rhine (CIPR,IKSR) published a new international Atlas for the River Rhine. This atlas describes the consequences for the entire Rhine catchment area of a possible flood and estimates the value of the whole area protected by the dikes. Various Dutch studies, however, calculated greater levels of damage than the IKSR did. These studies took into account a more consequential loss and the fact that in the Netherlands there is a great deal of intensive horticulture under glass and livestock farming.

Potential material damage (in millions of euro) from extreme floods of the River Rhine

Rhine sections	*Buildings*	*Industry and transport*	*Agricultural yields*	*Total*
High Rhine	32.6	4.8	0.8	38.3
Upper Rhine	8,224.5	3 671.9	81.7	11,978
Middle Rhine	13,336.3	350.1	1.0	1,687.4
Lower Rhine	16,458.9	3,788.5	85.6	20,333.0
Rhine delta	111,011.8	19,244.0	610.6	130,866.4
Total	137,064.2	27,059.2	779.7	164,903.1

Source: Atlas 2001 – Atlas van het overstromingsgevaar en mogelijke schade bij extreem hoogwater van de Rijn (2001 Atlas – Atlas of the flood risk and potential damage from high water levels of the River Rhine), IKSR

11. What are the consequences of climate change for water management?

The climate is changing. The temperature is rising and there is more precipitation, particularly in the winter. As a result, the water levels in the rivers and ditches are higher than before. In the summer, there are more frequent periods of drought with low water levels. Furthermore, the sea level is rising and, in the west of the Netherlands, the ground level is descending.

To keep water manageable, a policy is being pursued that offers more room for water (see section 12). This will allow the water to follow a more natural course and further reduce the risk of flooding.

Climate scenarios

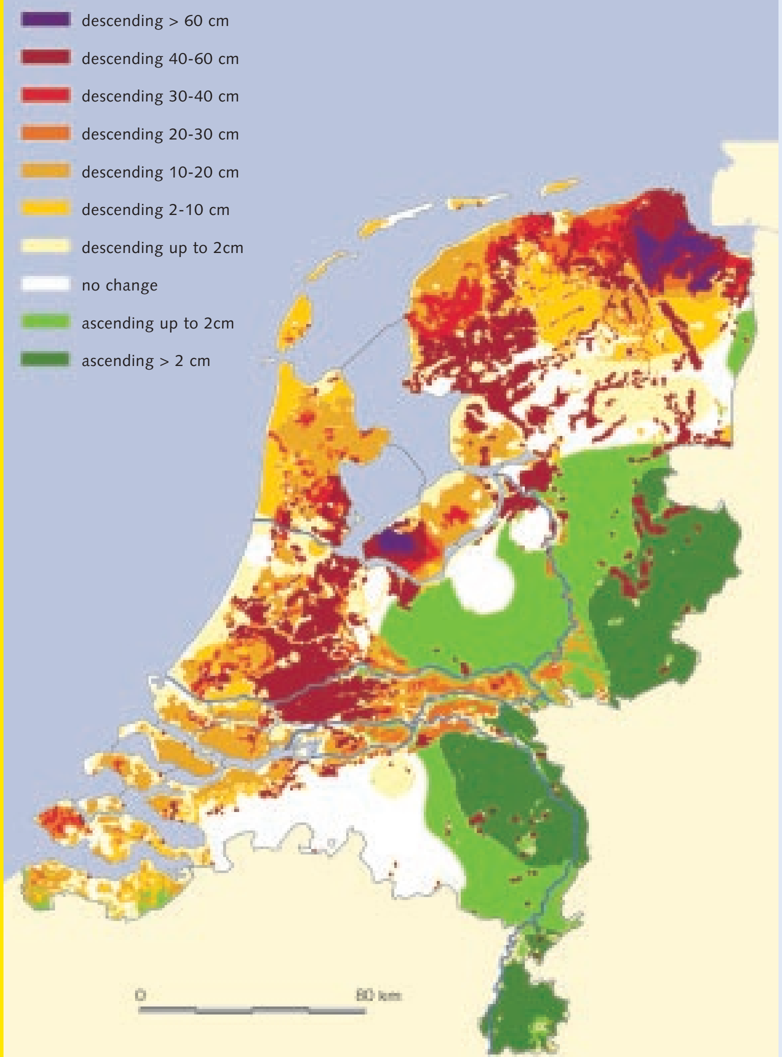
In 2001, the Royal Netherlands Meteorological Institute (KNMI) worked out climate change scenarios for the Netherlands.

Average rise	**Values between:**		
Temperature	+1 C°	and	+6 C°
Summer precipitation	+1%	and	+4%
Winter precipitation	+6%	and	+25%
Sea level	+20 cm	and	+110 cm*

*This figure takes into account the effect of soil subsidence in the Netherlands.

Source: KNMI, Third IPCC Report, 2001

Map indicating ground level changes in the Netherlands



Source: Directorate-General of Public Works and Water Management, NAM

12. Why is the ground level descending?

In many parts of the Netherlands, there is a slow, natural fall in ground level. This subsidence has various causes. In the past, natural subsidence was compensated by clay and sand deposited during the flooding of the major rivers. This was no longer possible, however, after dikes were built along the rivers. Another cause is soil subsidence and the commercial extraction of peat and clay. In the west of the Netherlands, these ground types naturally contain a lot of groundwater, and when that water is drained off, the soil subsides. In the Netherlands, groundwater has been drained off and pumped away for hundreds of years in order to use the land for agriculture.

A third cause of the soil subsidence is that peat is liable to oxidise when it lies above the water table. This is an important cause of subsidence in the peat meadows of the western Netherlands. Large-scale agriculture and the spread of cities have accelerated these processes of subsidence and oxidation.

In the nineteenth century, soil subsidence of one metre was recorded in some places. In the twentieth century, soil subsidence was limited to 50 cm thanks to better polder management. These days, the aim is to limit subsidence to 25 cm by means of more careful control of water levels. Meanwhile, the sea level has risen by about a 100 metres since the last ice age 10.000 years ago.

Source: www.geofoon.nl

River Rhine at Millingen

13. What is meant by 'room for water?

Giving the water room means acreage is made available in the flood plains and towns to store water. Streams are allowed to meander as they once did, and farmers and water boards use detention ponds to store excess rainwater longer. By lowering flood plains, moving dikes inland or digging extra channels alongside the rivers, rivers are given more room and the threat of flooding is reduced.

On 2 July 2003, the national government, provincial authorities, municipal councils and water boards signed the National Administrative Agreement on Water (NBW). This agreement sets out how and by what means, and according to which timetable, those involved would organise Dutch water management between now and 2015. The agreement also elaborates on the relation with the Water Policy for the 21st Century and the EU Water Framework Directive.

14. What is meant by 'room for the river'?

The *Delta Plan for the Major Rivers* brought forward the planned reinforcement of the dikes, but more will be needed to ensure flood protection along the major rivers. The higher the dikes, the higher the water in the rivers, and the more serious the consequences if a dike were to break. In its position paper Room for the River (2000), the Dutch government chose a new direction for the area around the major rivers of the Netherlands. The river water should be given more room by, for example, lowering the flood plains, moving dikes further back from the river or finding places where water can be temporarily stored.

The Room for the River project must ensure that the River Rhine at Lobith can safely carry 16,000 m3/s by 2015. The measures taken have to allow for a long-term strategy for the safe removal of 18,000 m3/s.

Source: www.ruimtevoorderivier.nl

15. What is an emergency flood storage area?

An emergency flooding storage area is a place where water can be retained during extremely high river discharges. They are meant to prevent uncontrollable flooding at unpredictable times so that lives can be saved and the risk of damage will be lower.

In May 2002, the Emergency Flood Storage Areas Commission (also known as the 'Luteijn Commission') concluded in its advice to the government that these areas form a useful supplementary measure to protect the Rhine and Meuse catchment areas against uncontrolled flooding in the long term.

The concept of an emergency flood storage area is not new. Similar (inland) emergency flood storage areas were regularly used during periods of high water levels along all the major rivers until well into the 1950s. Gradually, the total surface area of these emergency flood storage areas has decreased. Since 1850, about 35,000 hectares of emergency flood storage area has been lost along the River Rhine alone.

In the *Rampbeheersingsstrategie overstromingen Rijn en Maas* (Disaster management strategy for the flooding of the River Rhine and River Meuse', December 2003), the Dutch government decided in the Land Use Planning Memorandum to reserve three areas for emergency flooding. Legislation is being prepared to actually use these areas for that purpose. At the same time, further research of alternatives has been done. A definite decision is expected in 2006 in connection with the Room for the River key planning decision.

Source: www.rijnenmaas.nl.

16. What does regional water storage entail?

Temporary storage of water is possible in specially zoned storage areas. These are low-lying and preferably non built-up areas. Under conditions of extreme rainfall, the threat of flood would be met by allowing surplus polder outlet water to gradually flow into these areas. In this way, the water falls somewhat and the risk of dike breaks falls. When the threat of flooding recedes, and the water level falls sufficiently, the water can then be allowed to flow back out of the storage area.

A start has been made with the construction of water storage areas at many places in the country. Examples of these can be found on the website http://projecten.nederlandleeftmetwater.nl.

17. What is the Water Impact Assessment?

Water needs more room. In order to ensure that the contents of this memorandum are sufficiently incorporated in spatial considerations, the Water Impact Assessment has become mandatory since 1 November 2003. This obligation means that a 'water paragraph' must be included in spatial plans, describing how the consequences of these plans affect water management. Apart from safety and flooding, the water paragraph must address the effects on water quality and desiccation. The way in which areas have been urbanised or otherwise developed (e.g. glasshouse areas) is one of the causes of flooding. Spatial plans and decisions may lead to flooding, a deterioration of water quality, the desiccation of nature areas, etc. The Water Impact Assessment is designed to prevent these negative effects.

Source: www.watertoets.net

Drought at the Waal, summer 2003

18. How serious is water depletion and drought?

In 2000 in the Netherlands, almost 500,000 hectares of nature areas are water depleted to a lesser or greater extent. This is 12% of the total land area. What is 'water depletion'? 'Water depleted areas' are areas where the original wide diversity of plants (biodiversity) has disappeared. Because of falling groundwater levels, plant roots can no longer reach the groundwater. In addition, as the composition of the water changes, certain plant species find it difficult to survive. Species that are vulnerable to such changes such as orchids, Parnassus grass and sundew give way to less vulnerable species such as reeds, festuca arundinacea and stinging nettles.

There are three causes of water depletion: 60% is caused by dehydration and accelerated drainage for agriculture; 30% is due to the extraction of groundwater for drinking water, industrial water and irrigation. An increase in paved surfaces, afforestation and sand extraction account for the remaining 10%. Water depletion can be tackled in a number of ways, including the restoration of the original groundwater level or percolation pressure. This is done, for example, by stopping or reducing groundwater extraction in the area, or by ceasing to drain an area by means of deep ditches and canals. Groundwater levels in a nature area can also be raised by converting adjoining agricultural land into a buffer zone and maintaining a higher water level in the ditches.

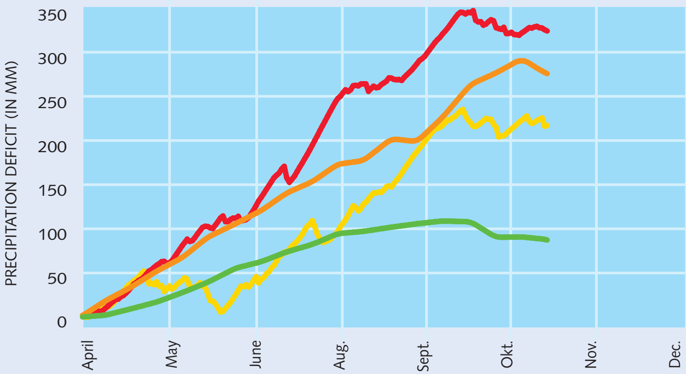
Apart from intervention in groundwater levels, water depletion can also be tackled through management measures. An example of such a measure is the removal of mowings, which also removes nutrients. This makes the area less fertile and consequently more attractive for unusual vegetation. Another example is agricultural nature management, whereby a farmer agrees to a lower agricultural output and is paid for his efforts to reclaim and maintain the original ecological values of the countryside.

Source: www.verdroging.nl

Drought

Drought is caused by occasional water shortages, partly as a result of human intervention and partly because of climatic conditions. Unlike water depletion, drought affects not only the countryside but also all water use. The summer of 2003 was hot and dry in the Netherlands, as it was in the countries upstream along the major rivers (Germany, Belgium). This caused a water shortage and water that was available became warm. Low river levels meant that inland craft could not be as heavily loaded as usual. Power stations could not be cooled sufficiently, putting the continuity of electricity supply at risk. In polder and drainage water, there was the risk that water levels could not be maintained which threatened the stability of the dikes. The Netherlands was confronted with a new phenomenon: a dike breach during a drought (Wilnis, Terbregge). Even so, 2003 was not an extremely dry year (see accompanying figure for rainfall shortages) and the 'displacement series' proved to be applicable. Established in 1976, this series sets the priorities

Rainfall shortage in 2003



Source: *Water in Beeld 2004*

for the distribution of fresh water in the event of water shortages. However, in 2003 it was decided that the countryside must be included as a factor in the displacement series. In addition, the factor of electricity supply is becoming increasingly important in the series, which is added to at a regional level as and when necessary.

Source: Evaluation memorandum on Water Management during Prolonged Drought 2003, April 2004

19. Why is river policy internationally co-ordinated?

Water does not stop at national borders. It flows always and everywhere, from high to low. On the West-European continent this actually means: 'to the Netherlands'. The Netherlands is the 'drain of Europe'. All the problems that our neighbouring countries discharge into the river, such as pollution or large volumes of surplus rainwater, end up with us. As bends in rivers are straightened and the paved area increases, this happens ever faster.The resulting problems can only be solved by working together with the other countries in the Rhine, Meuse, Scheldt and Ems catchment areas (Germany, France, Belgium, Austria and Luxembourg), focusing attention first on improving the quality of the water. This happened in particular after the Sandoz disaster in 1986, when a fire in a warehouse of the Sandoz chemical company in Basle, Switzerland, caused a large volume of chemicals to be discharged into the Rhine, together with fire extinguishing water.

Later, water quantity received attention at an international level. Together with other countries in the catchment areas, action plans for high water were drawn up and agreements made for river-widening measures. Wherever possible, the implementation of high water measures is combined with the tackling of problems relating to water quality such as polluted river and lake beds, water shortages, desiccation and diffuse sources.

European parliament, Strassbourg

20. What is the EU Water Framework Directive?

The EU Water Framework Directive has been in effect since 2000. This directive is based on (international) catchment areas. For the Netherlands, these are the catchment areas of the Scheldt, Meuse, Rhine and Ems rivers. As a result, the care and management of water has by definition become a cross-border issue. The Framework Directive states that the countries involved in each catchment area must draw up joint action plans dealing with all aspects of water. The people living in these countries must become more involved with water management, and European legislation concerning water must be co-ordinated better.

The Framework Directive requires the European member states to get the quality of their surface water in order. This must be done per catchment area. For a delta country such as the Netherlands ('the drain of Europe') the implementation of the Framework Directive is a difficult task. In principle, by 2015 we must have achieved a 'good chemical state and good ecological potential or a good ecological state'.
The standards required to achieve this will be largely set in the period 2004-2005. The possibilities for achieving this target before 2015 are being analysed until 2005, looking at the problems that may occur in the process. The parties then have until 2009 to draw up action programmes for each catchment area.

In April 2004, the government stated in the memorandum *Pragmatic Implementation of the EU Water Framework Directive in the Netherlands* how it aims to implement the Framework Directive in the coming years. This memorandum sets out the starting points and the strategy to be pursued up to 2009. The implementation will be brought in line as much as possible with existing Dutch policy.

The Rhine, Meuse, Scheldt and Ems catchment areas

21. How large are the Rhine, Meuse, Scheldt and Ems catchment areas?

	Rhine	*Meuse*	*Scheldt*	*Ems*[3]
Length, km	1320	900	350	370
Catchment area km^2	185,000	32,000	22,000	13,600
Number of countries in catchment area, km^2	9	5	3	2
Normative discharge[1] m^3/s	16,000	3,800 At Borgharen		
Average discharge m^3/s	2,200	320 At Borgharen	112	78
Summer discharge m^3/s	2,100	142 At Borgharen		15
Highest discharge in 1993[2] m^3/s	11,100	3120 At Borgharen		
Highest discharge in 1995[2] m^3/s	12,060	2861 At Borgharen		

Sources:

1 Hydraulic Preconditions for 2001, Ministry of Transport and Public Works, 2001

2 Pressure on the dikes 1995, Technical Advisory Committee for Flood Defences, 1995

3 Directorate-General for Public Works and Water Management, Directorate for the Northern Netherlands / RIKZ

4 Administration of Waterways and Seaways at Antwerp / Directorate-General for Public Works and Water Management, Zeeland

Angler at Zwarte Water north of the bridge at Hasselt

22. How clean is the water in the Netherlands?

In the course of the twentieth century, the pollution of surface water reached dramatic levels. After the Second World War in particular, it was becoming even dangerous to swim in rivers and lakes and fish mortality rose drastically. Rivers were covered in scum and the stench was sometimes unbearable.

In 1970 the Pollution of Surface Waters Act (Wvo) came into effect. Water purification boards were set up, the polluter had to pay and industry had to apply for discharge permits. Water boards constructed water treatment plants to treat wastewater from households and industry. In addition, the discharging of heavy metals, polycyclic aromatic hydrocarbons and nitrogen and phosphate compounds was severely restricted. Thanks to all these measures, the surface water has become much cleaner during the past 25 years. Now that permits are required to discharge industrial effluent into the catchment areas of the Rhine and Meuse, river water pollution has been reduced considerably. The natural quality of the fresh and salt water is currently at 40-50% of the quality level in 1950.

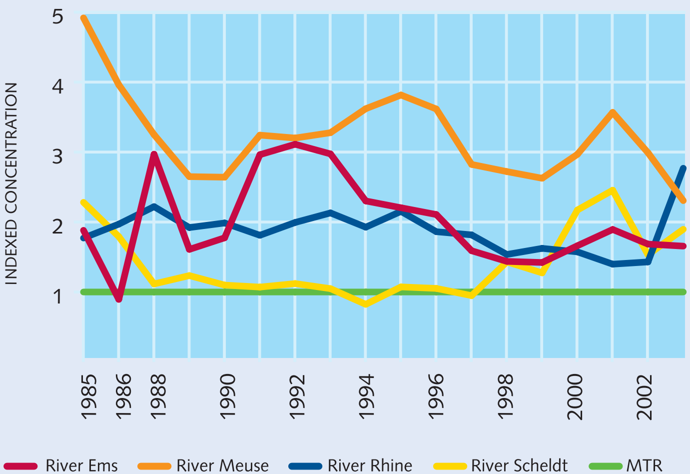
Salmon in the Rhine

An important step in these developments was the acceptance in 1978 of the Rhine Action Programme, drawn up by the International Rhine Commission. The ecological aim of this programme was that salmon should swim again in the Rhine by 2000. This was the yardstick by which the desired improvement in water quality would be measured. Salmon have been in the Rhine again since 1990, although compared to the past they are still very sparse. Until early 2003, more than 1,900 adult salmon were known to have returned to the Rhine system. Since it is not possible to count all returning salmon, the actual number will clearly be higher. At the fish ladder in Iffezheim which was put into use in mid-2000, 286 salmon and more than 1000 sea trout have been registered so far. Even so, this is still substantially fewer than the quarter of a million salmon that were caught in the Rhine in 1885. The salmon does not yet feel really at home in the Rhine and a stable population has not yet been achieved. There is still a long way to go before a breeding salmon population is re-established in the Rhine.

Water quality policy today concentrates above all on the diffuse sources, i.e. pollution that disperses and ends up in surface water or sewerage systems indirectly, e.g. from agriculture (fertilisers, chemical pesticides), built-up areas, road and rail transport, recreational craft and households. In order to comply with the EU Water Framework Directive, a ‘good chemical state and good ecological potential or a good ecological state’ must have been achieved by 2015.

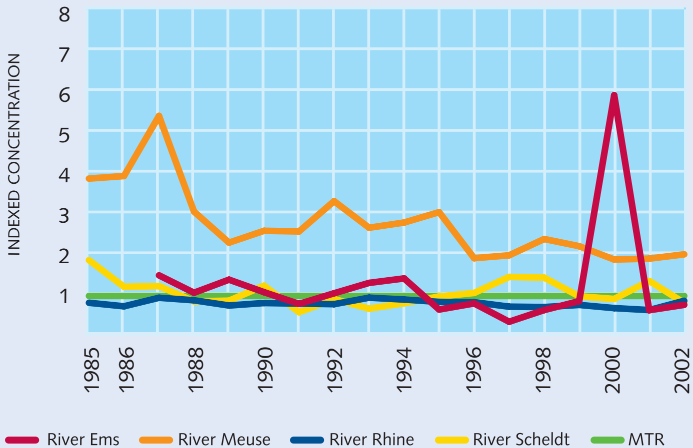
Source: www.iskr.org

Copper in surface water



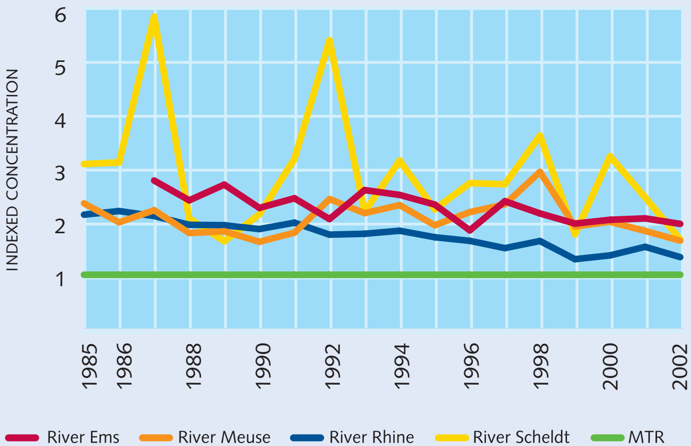
Source: Water in Beeld 2004

Zinc in surface water



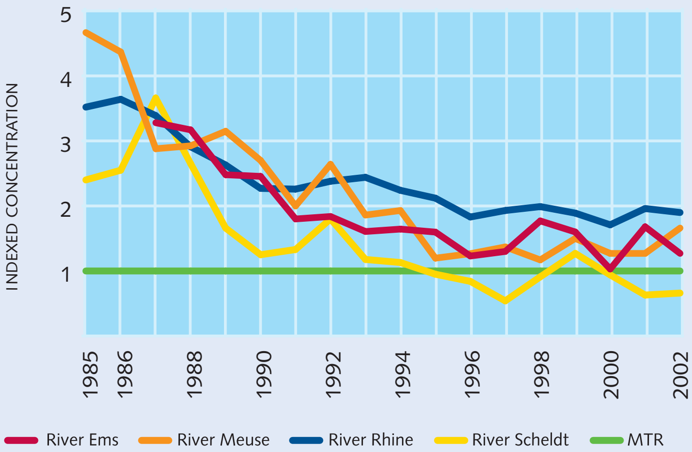
Source: Water in Beeld 2004

Nitrogen in surface water



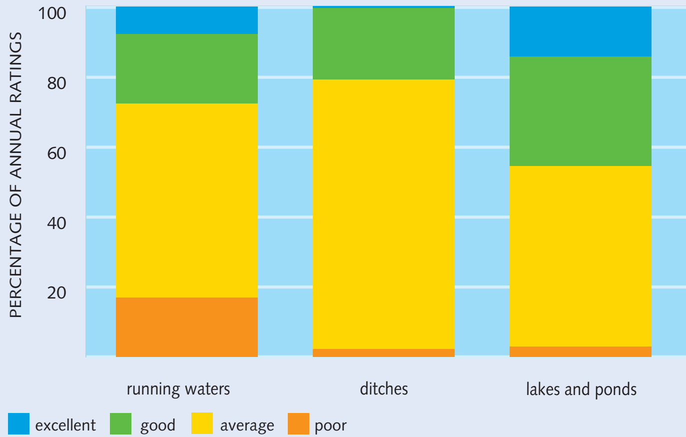
Source: Water in Beeld 2004

Phosphate in surface water



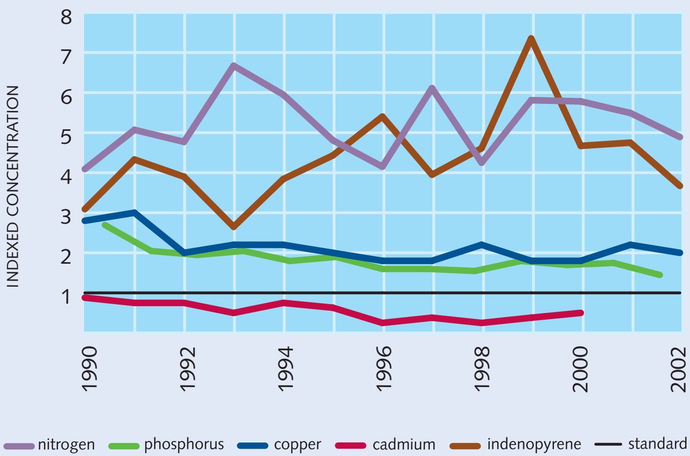
Source: Water in Beeld 2004

Ecological quality level of regional waters



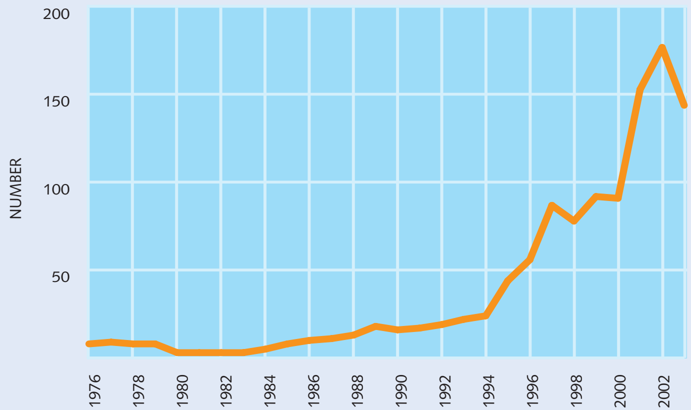
Source: Water in Beeld 2004

Development of coastal water quality



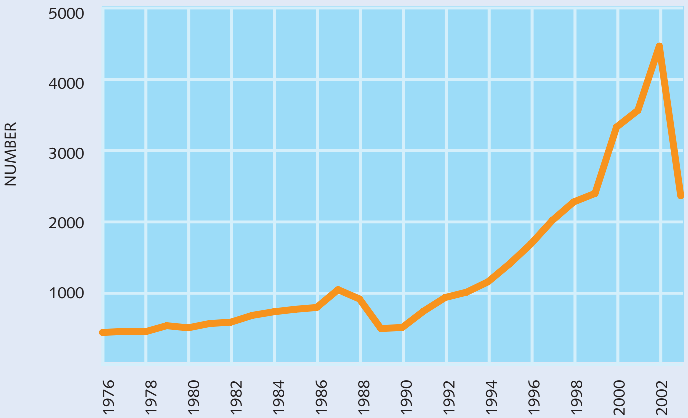
Source: Water in Beeld 2004

Seals in the southern delta



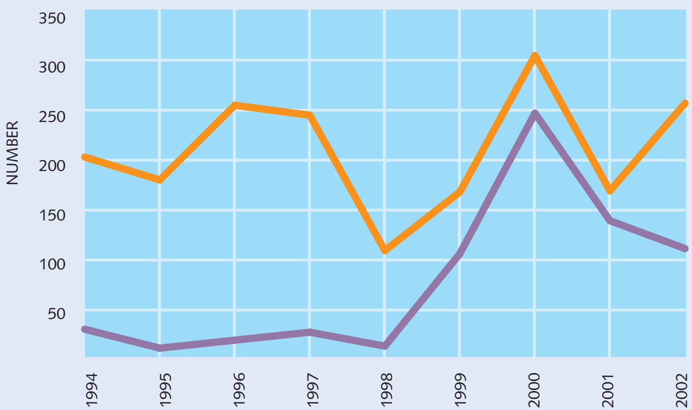
Source: Water in Beeld 2004

Seals in the Waddenzee



Source: Water in Beeld 2004

Salmon and sea trout caught



salmon — sea trout

Source: Water in Beeld 2004

Swimming in the Zoetermeerse Plas

23. How clean is the bathing water in the Netherlands?

According to a report drawn up by the European Union in 2002, compared to other European countries the quality of bathing water in the Netherlands was good: 97.8% of the bathing zones in the Dutch inland waters complied with the set norms. For the coastal waters, the score was 100%. With these scores, the Netherlands is well above the European average: 95.8% of all coastal beaches in the EU and 91.1% of the European inland waters complied with the European norms.
During the bathing season from May to October the quality of the bathing water is monitored continually. Water managers carry out tests every 14 days at more than 600 places in the Netherlands. Based on this information, the provinces may issue negative recommendations for swimming or impose a swimming ban, and provide up-to-date information on teletext, the Internet, a special 'bathing water telephone line' (*zwemwatertelefoon*) or a combination of these media.

After the bathing season, the National Institute for Inland Water Management and Wastewater Treatment (*Rijksinstituut voor Integraal Zoetwaterbeheer en Afvalwaterbehandeling - RIZA*) submits a report on the test results to the European Commission, which assesses the bathing water with respect to microbiological pollution, scum, oil and odour. The current European bathing water directive dates from 1976 and does not have any norms for algae, viruses and toxic substances that may also be present in bathing water. A new European bathing water directive is being drawn up, which will be more stringent and devote more attention to such aspects as blue-green algae.

Source: www.vrom.nl

Water treatment plant at Arnhem-Zuid
Aero photo: Brouwer, Brummen

24. How much water is treated in the Netherlands?

In the middle of the 19th century, the awareness arose that discharging wastewater without any form of treatment could not continue any longer. The stench, surface water that could not be made fit for consumption and the spread of diseases led to the construction of sewers and the first purification plants. The oldest sewer is in Maastricht and dates from 1852. After the cholera epidemic of 1866 during which 21,000 people died, the sewer systems in Rotterdam and Maastricht were tackled. The construction of urban sewer systems only began on a large scale in 1930. During the same period, the municipalities in particular built the first works where wastewater was purified before being discharged into the surface water.

The coming into effect of the Pollution of Surface Waters Act in 1970 gave a new impetus to the construction of sewage treatment plants. This also marked the start of the process of municipalities and provinces transferring their treatment plants to the water boards. Nowadays, public wastewater treatment is only carried out by water boards, which manage almost 400 plants. In addition, various companies treat their own wastewater with some 600 plants.

The volume of wastewater treated in treatment plants is expressed as ‘resident equivalents’. This is a measure of the volume of wastewater that a single person produces. An average household is estimated at three resident equivalents.

Volume of wastewater treated in public sewage water treatment plants (in millions of resident equivalents)

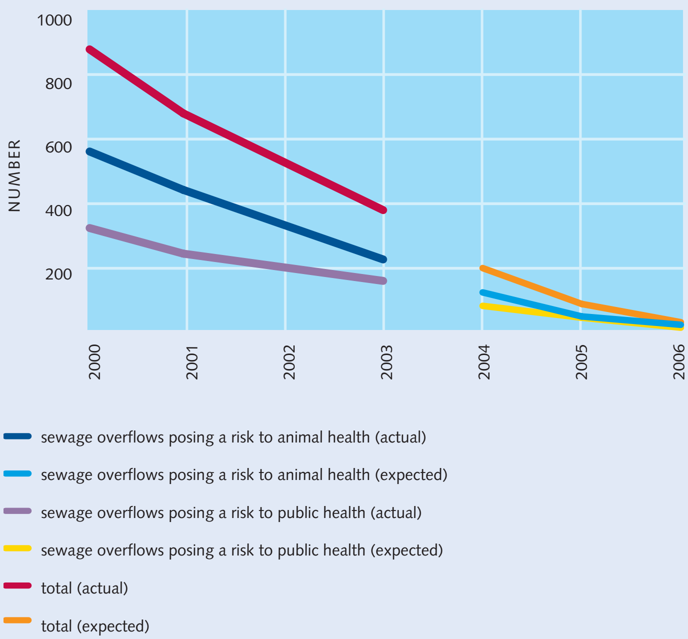
1950	1960	1970	1980	1990	1995	2000	2004
1	2	8	20	24	26	26	27

Source: Association of Water Boards

25. How bad are the sewage overflows in the Netherlands?

In the towns and cities, most rainwater is disposed of through the sewer system. If it rains very hard, sewer systems that are outdated or too small overflow. They also discharge surplus sewage water through overflows into the surface water and pollute it. In some cases there may even be a danger to animal health (through watering places) or public health. One solution is to 'disconnect' the rainwater: separating the disposal of rainwater from that of wastewater, so that the non-purified rainwater can be used for certain purposes. All high-risk overflow areas must be cleaned up by 2005.

Number of high-risk overflows



26. What happens to the water in urban areas?

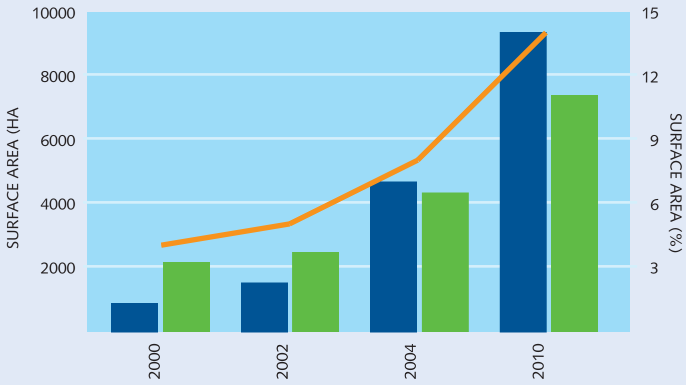
Urban water management is being tackled increasingly frequently in a different way. Examples include rainwater that runs directly into the garden from drainpipes, the construction of large ponds in the middle of new residential districts and the environmentally friendly design of urban waterway banks. Such measures aim to prevent flooding and improve water quality.

This new approach provides new opportunities for improving the living environment at the same time. Urban developers and architects are rediscovering water. Fountains, waterfalls and wadis are the obvious expressions of this. In the old town centres, filled-in canals are being dug out again and new houses are increasingly being built alongside, on or over the water.

Another aspect of the new policy is the disposal of rainwater. In most places this is done through the sewers. During heavy rainfall, sewers that are outdated or too small overflow. Polluted sewage water flows over the street and ends up in the ditches. This is prevented by ensuring that more rainwater percolates directly into the ground or flows into a canal, but this process is often hampered by asphalt and buildings. In a number of residential districts in the Netherlands, the rainwater is transported along pipelines to underground storage facilities, from where it slowly percolates into the groundwater. Only when groundwater levels are high is it discharged into the canals. All this prevents sewers from being overloaded after heavy rain. Some towns already have a 'Water Service Point' in place to answer questions about water management and policy. Individuals can obtain advice from this Water Service Point about disconnecting their rainwater drainage from the mixed sewer.

Source: *Water in de stad, sprekende voorbeelden*, 2004, *Bouwen met water - Wonen, werken en recreëren*, 2003, http://projecten.nederlandleeftmetwater.nl

Disconnected paved surface in area with existing buildings



new developments (ha)

existing urbanised areas (ha)

existing urbanised areas (%)

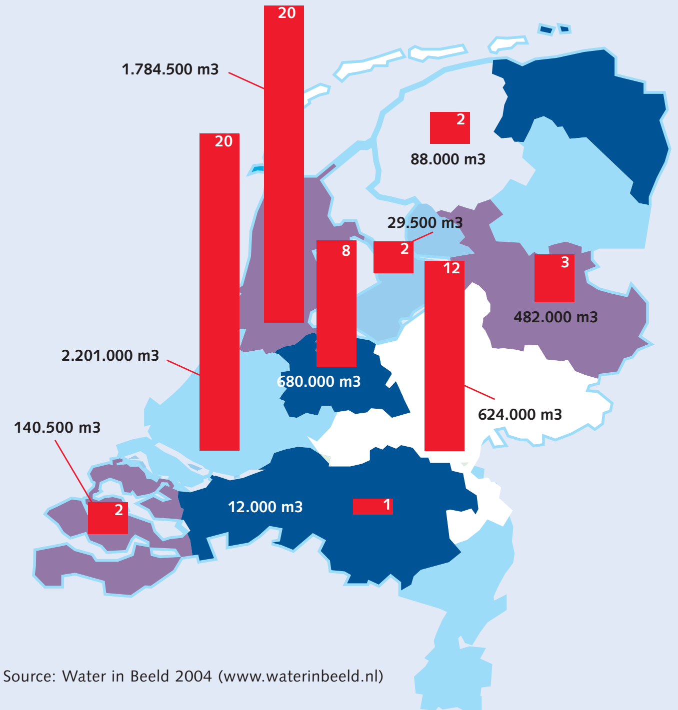
Source:Water in Beeld 2004

27. How much contaminated dredging sludge is there? What do we do with it?

Each year, dredging vessels remove about 25 million m3 of sludge from Dutch waters; this amounts to 150 buckets of sludge per Dutch citizen. Most of the sludge is not or only slightly contaminated and may be spread on the land or dispersed in the water. It is also put to good use in building and water works, or for partially infilling former sand and gravel excavation pits. A relatively small percentage of the sludge is so contaminated that it is not permitted to spread it or put it to good use directly. River sludge in particular is contaminated with heavy metals (such as lead, cadmium and chromium), pesticides, tar-like substances, oil and fertilisers such as phosphates.

The polluted sludge is stored in special depots, such as 'de Slufter' on the

Number of Subbied projects honoured per province



Source: Water in Beeld 2004 (www.waterinbeeld.nl)

Maasvlakte. This depot has a maximum capacity of roughly 90 million cubic metres and a total surface area of 260 hectares. In the Ketelmeer, the IJsseloog was put into use in 1999. This sludge depot is more than 1 km wide and has a capacity of 23 million m^3.

Because of the lack of depot space and affordable alternatives, many watercourse (bed) managers have postponed the dredging of polluted water beds. This has resulted in a backlog in the maintenance and cleaning up of watercourse beds. The first phase of the *Ten-year scenario for watercourse beds 2000-2010* involved a survey of the dredging backlog. The second phase of the ten-year scenario envisages a number of measures to clear this dredging backlog. Subsidies will be made available for

drawing up municipal dredging plans, and the maintenance dredging in built-up areas can be subsidised through the 'Subbied scheme'.
Extra financial resources have also been made available for clean-up operations in regional and national waters. An impetus is being given to processing dredging sludge and work is going ahead to build more depot space (Hollandsdiep). The aim is to have the entire backlog cleared in 25 years.

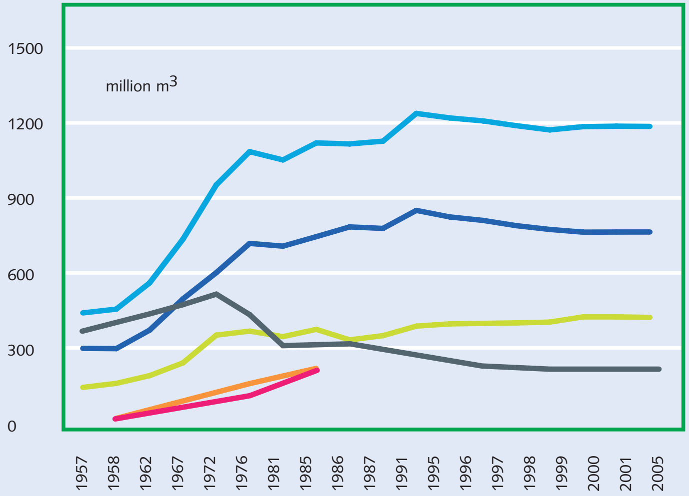
28. Where does Dutch drinking water come from?

In the Netherlands, drinking water is obtained from groundwater or surface water. Roughly two-thirds of the country (especially in the north, south and west) obtains its drinking water from groundwater. Because of contamination with seawater, the groundwater in the west of the Netherlands is not suitable for producing drinking water and so surface water is mostly used. The Rhine and the Meuse each provide about half of the volume of water required.

The groundwater that is extracted may be between 10 and 45,000 years old. It is found at a depth of 10 to 400 metres. Groundwater is rainwater or river water that has percolated down through the earth's surface.
As it moves downwards, all kinds of processes occur which remove bacteria and viruses from the water. As a result the water is generally of good quality, but not clean enough for consumption. In order to make it suitable, it needs to be purified first.

River water is exposed to all kinds of environmental threats and contains many more polluting substances than groundwater, due to, for instance, the discharge of chemical waste and the use of pesticides in agriculture. In order to make safe drinking water from it, a costly purification process is required which makes drinking water more expensive to produce from

Extraction of ground and surface water



- Drinking water consumption
- Groundwater abstraction for public water supply
- Surface water abstraction for public water supply
- Groundwater used for irrigation, based on an average year (neither wet nor dry)
- Groundwater used for irrigation, based on a dry year with 10% less precipitation
- Groundwater used for irrigation = 10% dry year

Source: Water in Beeld 2002, CIW

surface water than from groundwater. The oldest waterworks is that of Amsterdam, built in 1853, followed by the one in Den Helder. The Netherlands now has 15 waterworks.

Source: www.vewin.nl

29. How much water is used? What does it cost?

Each person in the Netherlands uses an average of 126 litres of water per day. Shower water (42 litres) and toilet flushing (34.8 litres) account for the largest proportion of this volume. The price of drinking water is made up of three elements. The water company charges a price for the drinking water supplied, the water boards charge for wastewater treatment and the municipalities impose sewerage charges: a sum for the construction and maintenance of the sewers.

Average use of drinking water per inhabitant

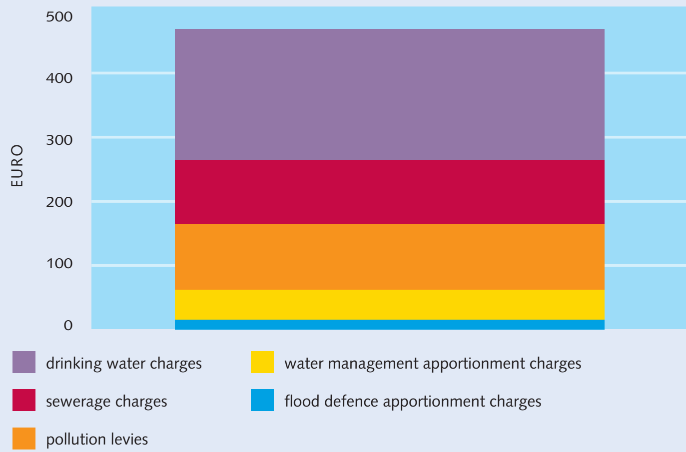
1992	1995	1998	2001
135	134.1	127.9	126.2

Categories of use in 2001

Bath	3.7 litres
Shower	42.0 litres
Washbasin	5.2 litres
Toilet flushing	34.8 litres
Washing clothes (by hand)	1.8 litres
Washing clothes (by machine)	22.8 litres
Washing up (by hand)	3.6 litres
Washing up (by machine)	2.4 litres
Food preparation	1.6 litres
Coffee, tea and water	1.5 litres
Other	6.7 litres

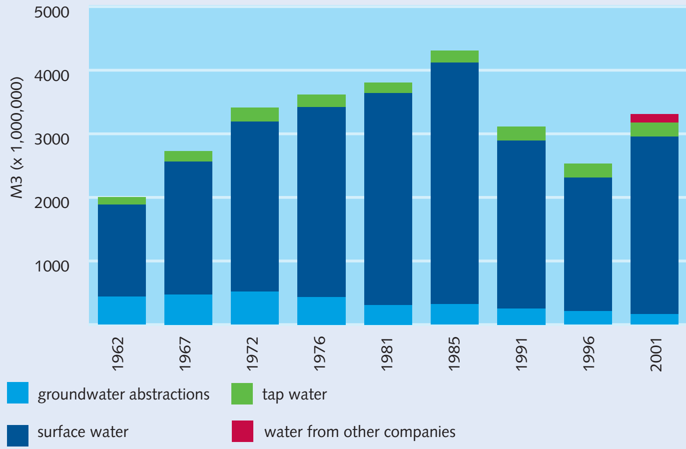
Source: Vevin, www.vewin.nl

Average costs of water consumption per household



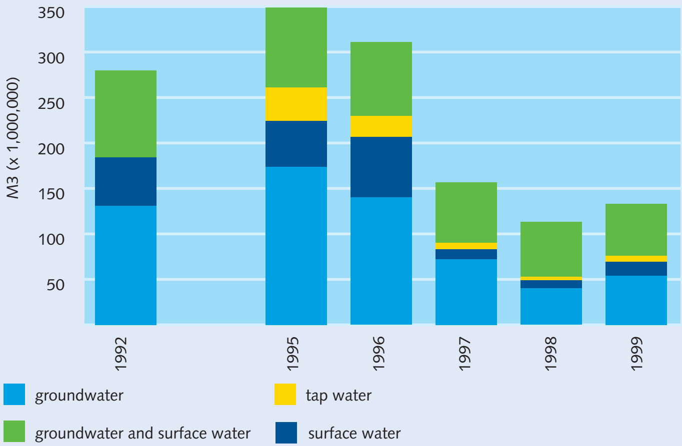
Source: Water in Beeld 2004

Industrial water consumption



Source: Water in Beeld 2004

Agricultural and horticultural water consumption



Sourcen: *Water in Beeld 2004*

30. Who manages the water?

Water boards, the government and provinces are the principal water managers in the Netherlands. Water boards have been managing the water since the Middle Ages, and as such are the oldest democratic organisations in the Netherlands. Water policy is formulated in broad outline by the government, which is also responsible for the operational management of Dutch waters and a few primary flood defences.

Within the frameworks of government policy, the province defines its own policy for non-national waters. Water boards and municipalities are responsible for operational water management and for implementing policy. The municipal tasks include the construction and maintenance of the sewers and drains in urban areas. The water boards are responsible for all the drains in the urban and rural areas, water quantity and quality, including wastewater treatment and the management of the flood defences.

Number of water boards

1940	*1953*	*1969*	*1978*	*1990*	*2000*	*2002*	*2003*	*2004*
2700	2544	1000	400	129	57	53	48	37

Sources: Two Centuries of the Directorate-General for Public Works and Water Management, 1999; Association of Water Boards

Water board personnel

1990	1997	2000	2003[1]
7.590	8.954	9298	10.406

[1] 75% men; 25% women

Source: Association of Water Boards

Personnel at Directorate-General of Public Works and Water Management: total

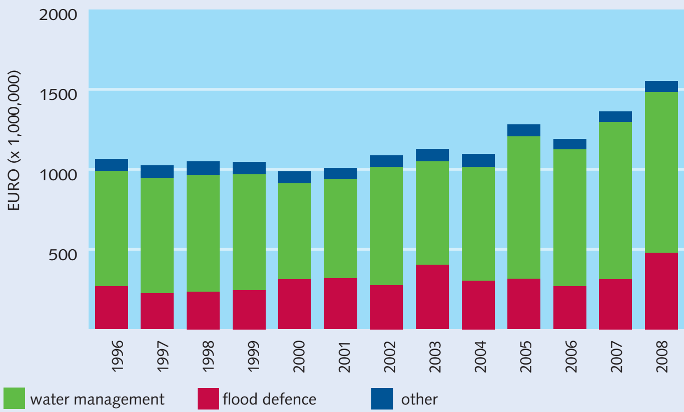
1948	1960	1970	1980	1990	1997	2001[1]
4.000	6.100	10.000	12.000	11.400	11.000	11.700

[1] 80% men; 20% women

Source: RWS Annual Report (N.B. figures rounded off)

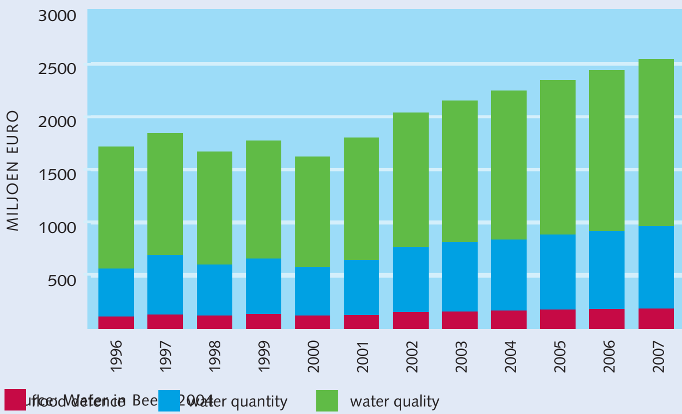
31. How much does water management cost? Who pays for it?

Development of costs at Ministry of Transport and Public Works by task

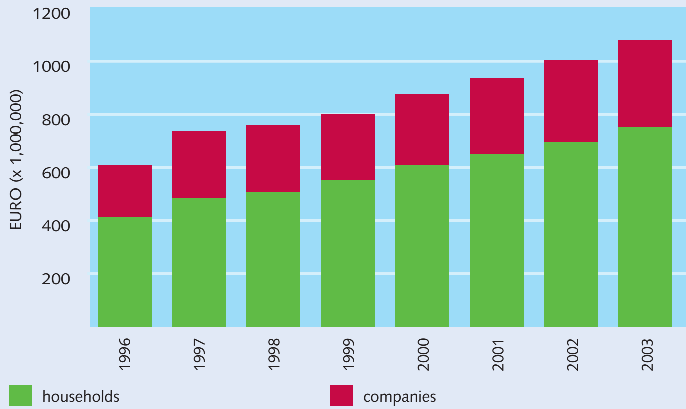


Source: Water in Beeld 2004

Development of Water Board costs by task

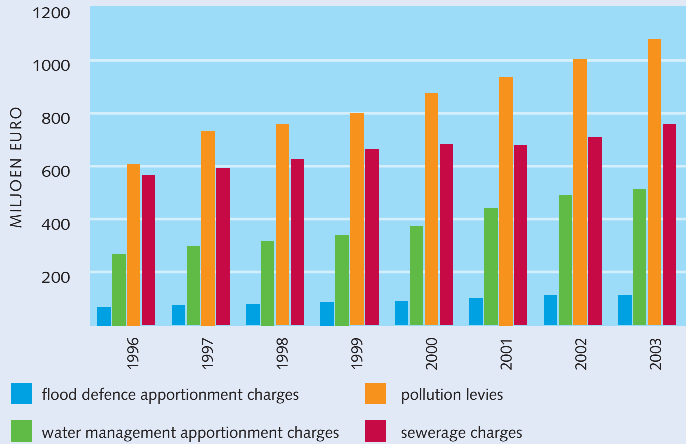


Development of income for Water Boards and municipalities



Source: Water in Beeld 2004

Development of pollution charge by category of polluter



Source: Water in Beeld 2004

National Administrative Agreement on Water: spatial and financial statement for 2015 and 2050

	Water volume (million m3)	Retention (ha)		Storage (ha)		Discharge (ha)		Investment (million €)	
	2050	2015	2050	2015	2050	2015	2050	2015	2050
Rhine	284	39,000	144,000	12,000	39,000	260	260	4,391	9,754
Meuse	91	343,000	468,000	11,000	27,000			3,285	5,669
Scheldt	23	900	1,050	180	180			176	205
Ems[1]	27		2,850[2]			275	275	95	95

[1]Excluding spatial measures (10.000 ha) and costs (€ 331 million) of the 'High Water' project.

Source: National Administrative Agreement on Water, 2003

National Administrative Agreement on Water; division of costs for action programme 2003-2007 (million €)

Expenditure on action programme 2003-2007	1300
Water management-related expenditure by water boards	680
Government contribution towards flooding	100
Links to other interests (provinces, municipalities and water boards, normal government budgets, EU subsidy schemes and any third parties)	520

Source: National Administrative Agreement on Water, 2003

32. What laws and regulations relate to water?

Legislation before 1945: total 3

1900 *Waterstaatswet* (Public Works Act)
1904 *Wet op de droogmakerijen en indijkingen* (Land Reclamation and Dikes Act)
1934 *Wrakkenwet* (Wrecks Act)

Legislation after 1945: total 11

1958 *Deltawet* (Delta Act)
1965 *Ontgrondingenwet* (Earth Removal Act)
1969 *Wet verontreiniging oppervlaktewater* (Pollution of Surface Waters Act)
1975 *Wet verontreiniging zeewater* (Marine Pollution Act)
1981 *Grondwaterwet* (Groundwater Act)
1981 *Wet op de waterhuishouding* (Water Management Act)
1983 *Wet voorkoming verontreiniging door schepen* (Prevention of Pollution from Ships Act)
1991 *Waterschapswet* (Water Boards Act)
1995 *Deltawet grote rivieren* (Delta (Major Rivers) Act)
1996 *Wet op de waterkering* (Flood Defence Structures Act)
1996 *Wet beheer rijkswaterstaatswerken* (Public Works (Management of Engineering Structures Act)

International treaties 1960-1998: total 25

1960 Ems-Dollard Convention
1960 Convention on Improving the Ghent-Terneuzen Canal
1963 Convention on Linking the Scheldt and the Rhine
1963 Agreement for the protection of the Rhine against pollution
1969 Bonn Agreement, for combating marine disasters
1972 London Convention on the prevention of marine pollution by dumping of wastes and other matter

1972 Oslo Convention on the prevention of marine pollution by dumping
1973 Marine Pollution (MARPOL) Convention on the prevention of marine pollution by ships
1974 Paris Convention for the prevention of Marine Pollution from Land-Based Sources
1976 Rhine Chemicals Convention
1976 Rhine Salts Convention
1982 United Nations Convention on the Law of the Sea
1990 Rhine Shipping Regulations
1990 Oil Pollution Preparedness, Response and Co-operation (OPRC) Convention, relating to international co-operation in tackling oil spills.
1992 Biodiversity Convention for the preservation and sustainable use of biodiversity.
1992 Review and amalgamation of the Oslo and Paris Conventions (OSPAR) for the protection of the Marine Environment of the North-East Atlantic.
1992 Helsinki Convention, cross-border watercourses and international lakes
1994 Protection of the Scheldt
1994 Protection of the Meuse
1995 Convention on the deepening of the Westerschelde
1995 Convention on the removal of water from the Meuse
1996 Rhine Convention on waste from ships and inland shipping
1996 Ems-Dollard environmental protocol
1997 UN Framework Convention on Climate Change
1998 Protocol on persistent organic pollutants (POPs)

Other

National environmental legislation
Provincial by-laws
Water Board inspections
Water Impact Assessment

European Parliament, Strassbourg

33. What steps will be taken in water policy in the coming years?

Year	Water management in the 21st century	EU Water Framework Directive	Coast	Disaster management strategy Rhine and Meuse	Room for the River
2003	• Partial catchment area visions adopted • 2003-2007 action programme started	• Legislation finalised • List of competent authorities completed		• Disaster management strategy for the flooding of the River Rhine and River Meuse adopted	
2004	• EUR 100 million subsidy scheme • Designation of blue nodes[1]	• Report on current status and underlying analyses completed • Completion of register of Protected Areas	• Discussions on responsibilities regarding flood protection and coastal towns concluded	• Research programme carried out	• Administrative draft decision • Publication of Land Use Planning Memo • Key planning decision part 1
2005	• Report on standardisation assessment • Provinces adopt GGOR[2] frameworks	• Process of formulating river catchment area management plans started	• Coastal policy line	• Discussion of 'options' with administrative partners • Social cost/benefit analyses • Draft decision of the Dutch government	• Key planning decision part 2 • Key planning decision part 3: Memorandum of reply following official participation
2006	Evaluation of National Administrative Agreement on Water				
	• Urban water management plans ready • Definitive decision on regional water systems standards • Evaluation of Water Impact Assessment	• Monitoring operational • Completion of timetable and formulation of work programme for catchment area management plans	• Report to EU on integrated coastal management recommendation • Provincial study on weak links complete	• Definitive decision by Cabinet and Lower House on Disaster management strategy for the flooding of the Rhine and Meuse	• Key planning decision part 4: government decision
2007	• Integral consideration of spatial requirements of provincial policy and regional plans and municipal zoning plans	• Overview of principal water management subjects		• Follow-up steps (depending on decision in 2006)	
2008	• Completion of initial draft of catchment area management plans (including goals en measures)		• Start of work on weak spots		
2009	• Completion of definitive catchment area management plans				
2010	• 2nd evaluation of the National Administrative Agreement on Water				
2015	• Water system in order (goals achieved)				
2021	• End of 1st phase of Water Framework Directive and drafting of next catchment area management plans				
2027	• End of 2nd phase of Water Framework Directive				

1 Blue nodes are the principal connections between the main and regional water systems.
2 GGOR = Dutch abbreviation for target ground and surface water regime

Colophon

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Surf to **www.nederlandleeftmetwater.nl** (in Dutch)
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