

THE NETHERLANDS



PREFACE

During the past three years the Ministry of Transport, Public Works and Water Management of The Netherlands has prepared the 'Fourth National Policy Document on Water Management in The Netherlands'. The document was published in March 1999. During its preparation intensive studies were conducted on various important issues to prepare a vision on the future of water management in The Netherlands. In parallel, a wide range of consultations were held with all the stakeholders, associations and the general public. Based on this information a policy document has been prepared. The document has been approved by Parliament.

While this work was recently done, the Netherlands National Committee for Irrigation and Drainage (NETHCID) requested the Ministry if, for the preparation of our country position paper, we could use the policy document. It agreed. Therefore the core of this paper is composed of the parts of the policy document that are directly, or indirectly, related to the role of water for agriculture and rural development. In addition, some information has been added on agriculture and rural development in The Netherlands as well as on the longer term perspective for The Netherlands as a low lying country in the deltas of the rivers Rhine, Meuse and Scheldt and bordering the North Sea.

EXECUTIVE SUMMARY

The Netherlands is a low lying, densely populated country bordering the North Sea. The major part of the country consists of lagoon and delta type areas, originating from the deltas of the

Rhine, Meuse and Scheldt rivers. The Dutch have made this area inhabitable by reclamation and protection against water. But to create their country the Dutch had to fight for centuries against water coming from the North Sea, the rivers, rainfall, or from waves on the lakes during storm surges.

The present land area comprises 3.4×10^6 ha, of which about one third is situated below mean sea level, whereas about 60% of the land is protected against flooding. The Netherlands is a very densely populated country, varying from 190 inhabitants per km² in the northern part to 915 inhabitants per km² in the low lying western part. The cities and industrial areas are mainly located in the western part, whereas the agricultural lands are spread throughout the country. The forests and nature reserves are located predominantly on the relatively wet soils in the western and northern part and on the sandy soils in the dunes and in the eastern part.

The major part of this country position paper is devoted to the National Policy on Water Management in The Netherlands which recently has been formulated in the Fourth National Policy Document on Water Management. The policies contained in the Fourth National Policy Document on Water Management encompass the period 1998 - 2006, with occasional glimpses into the more distant future. In addition a 'philosophic' view has been given on the long-term future scenarios and aims, resulting in the challenges for the future.

'A safe and habitable country with a healthy and sustainable water systems': this is the aim which Dutch water management faces the future in 1998, the year which marks the two-hundredth anniversary of the Netherlands Directorate-General for Public Works and Water Management ('Rijkswaterstaat'). The first part, to ensure a safe and habitable country, has existed for centuries and is in fact what gave rise to the establishment of 'Rijkswaterstaat' in 1798. After all, the nature of The Netherlands as a water-logged country is such that it must constantly be protected against flooding from the sea and rivers. At the same time, a constant effort has had to be invested in the consolidation of the soft subsurface in order to keep the country habitable and cultivable. The second part, to ensure 'healthy and sustainable water systems', has a much shorter history. It was not until the late 1960s that the problem of surface water pollution led to systematic action to tackle the main sources of pollution. By that time, the poor quality of the surface water presented a threat not only to public health but also to wildlife habitats. The two halves of the aim were initially addressed via a two-track policy approach, but during the 1980s there was a growing realisation that the aim of public safety and habitability could not be viewed in isolation from that of a healthy and sustainable water system. Moreover, it became clear that water management could achieve these aims much more effectively and efficiently if the policies directed at them were not only closely interrelated but also carefully co-ordinated with other relevant areas of policy. In the 1980s, this became known as integrated water management.

This philosophy was developed further in the Third National Policy Document on Water Management (NW3), published in 1989. Integrated water management and the water systems approach have become key concepts in the water management of the 1990s. Thanks to the support the NW3 attracted from the various authorities concerned with water management in The Netherlands, much of it has now been translated into concrete measures and the combined aim is now somewhat closer to realization. However, despite the success of this policy and management based on it, it has still proved necessary to conduct a new review of water management policies and to modify them where necessary in light of new social trends, continuing subsidence, expected climate change and other factors. The results of this process are formulated in the policy directions mapped out in the Fourth National Policy Document on Water Management (NW4). NW4 focuses on the development of an integrated approach to water systems at various levels, starting close to home and moving gradually outward to the great oceans. The advantage of this approach is that it reveals the interrelationship between the various levels of scale and it makes it easier for users and managers to identify with the issues. Because the subjects of flood protection, water depletion, emissions and aquatic soils have been regularly in the limelight over the last few years as major policy issues on which NW4 would

produce decisions, these themes have been given their own separate section in the policy document alongside consideration of the water systems as a whole.

Directly related to water for food and rural development is the fact that new farming methods have impaired nature and landscape, whereas increasing urbanization and expanding highway and railroad infrastructures have put the rural area of The Netherlands under great pressure. Additional factors are the growing interest in nature and landscape development and conservation, the ecological awareness, and the increasing need for outdoor recreation. In other words, the rural area of The Netherlands needed to be assigned other functions in addition to agriculture. Therefore the general objective of land development in The Netherlands is to improve the layout and infrastructure of the rural area in accordance with the functions of the area that are indicated within the framework of physical planning. Measures can be taken for improving the socio-economic conditions in the agricultural sector (agriculture, horticulture, forestry) and the conditions of other sectors (like development, conservation nature, and outdoor recreation). These measures refer to construction and improvement of rural roads, the water management system, exchange of agricultural land between farmers (in order to come to a more economic ownership) and improvement of field drainage, as well as delineating lands for other public uses with the related physical works.

Regarding challenges for the future it is important that the processes and trends be observed - the rise of the sea level, subsidence, higher requirements for safety, water quality and environment - will continue in the next century and will make the delta area of the Rhine, Meuse and Scheldt rivers even more vulnerable. A new picture of the future is taking shape in which water management will have to be adjusted because of the accelerated rise of the sea level, the additional intervention in the regime of surface and ground water due to the continuing urbanization and a large-scale use of underground construction.

1. INTRODUCTION

The Netherlands is a low lying, densely populated country bordering the North Sea. The major part consists of lagoon and delta type areas, originating from the deltas of the Rhine, Meuse and Scheldt rivers. The Dutch have made this area inhabitable by reclamation and protection against the water. But for this creation of their country the Dutch had to fight for centuries against water coming from the North Sea, the rivers, rainfall, or from waves on the lakes during storm surges.

The present land area of The Netherlands comprises 3.4×10^6 ha. As a result of land reclamation and subsidence about 30% is situated below mean sea level, whereas about 60% of the land is protected against flooding.

The Netherlands is a very densely populated country, varying from 190 inhabitants per km² in the northern part to 915 inhabitants per km² in the low lying western part. The cities and industrial areas (8%) are mainly located in the western part, whereas the agricultural lands (71%) are spread all over the country. The forests and nature reserves (9%) are located predominantly on the relatively wet soils in the western and northern part and on the sandy soils in the dunes and in the eastern part.

This country position paper starts with a brief description of the history of water management in The Netherlands. The major part of the paper is devoted to the National policy on water management which recently has been formulated in the Fourth National Policy Document on Water Management. The policies contained in NE4 encompass the 1998 - 2006 period, with occasional glimpses into the more distant future. In addition attention is paid to the present status of food and rural development. At the end a 'philosophic' view gives long term future scenarios and aims, resulting in the challenges for the future.

2 WATER MANAGEMENT IN THE NETHERLANDS

2.1 INTRODUCTION

History

The history of water management shows how the original natural landscape was transformed into a man-made landscape in a never-ending struggle with water. At present 'Laag-Nederland' (the low part of The Netherlands) in particular, virtually constitutes one hydraulic work, mainly created by man: a patchwork of lands gained from the sea, polders, lakes and meres, crossed by innumerable ditches and canals. Characteristic of water management throughout the centuries has been its small scale, great attention to the maintenance of existing works and its careful management. Although large-scale hydraulic works were accomplished at regular intervals, specific local conditions have always been taken into account. Inhabitants of the coastal areas settled on the levees and creek ridges along the rivers and salt marshes, on the sandy grounds and the strips of clay behind the dunes long before the Christian era. There is evidence that around 100 BC the first small hydraulic works were carried out in the western part of The Netherlands. However, the fight against water that resulted in the present situation of The Netherlands started in the 9th century on a minor scale involving a small number of inhabitants with modest demands. People were faced with technical problems that required solutions, if they were to survive. However, these provisions entailed new problems. A clear example is provided in structures to protect the land from the floods of rivers and the sea.

In the 9th century people started to move into the adjacent, huge peat areas. They lowered the groundwater level of these waste lands, which were situated a few metres above mean sea level, by digging a system of ditches to the lower adjacent waters. This cultivation process was completed in the 14th century. It has left its ineradicable mark on the landscape of the west The Netherlands. The expansion of these, at first massive, interventions in the hydrological situation repeatedly stagnated in the 12th and 13th centuries as a result of a series of severe storm surges, swallowing up large parts of the cultivated land gained and allowing the present IJsselmeer to be transformed from a small inland sea into a large estuary, called the Zuiderzee.

In this period local communities that were located in the first danger zone started to connect their local dikes. This was the start of collective dike construction. This second radical intervention in the hydrological system caused a chain reaction that is still going on. The immediate hydraulic effect of impoldering and the accompanying upheaval of the water storage and flooding across the land was a rise in flood levels. Impoldering of a certain area also affects the flood levels in other areas and so the rise spread further and further. The more people wanted to protect themselves against higher floods, the more the flood levels rose. In the longer term, impoldering has a morphological effect as well. According to the local situation a drop or a rise in the river bed may occur, mainly caused by accretion. This, again, leads to a further rise of flood levels. As the river sediments can no longer be deposited on the flood plains after impoldering, there is no further gain of land.

The protection against floods naturally improved the living conditions of the inhabitants and resulted in higher crop yields and more diversification. The cultivation of the peat lands caused a considerable drop of the surface level due to subsidence and oxidation. The subsidence of the deeper sub-soil layers, due to natural causes, continued as well. These processes resulted in a drop of the ground level, amounting to two to three metres in the course of the centuries. This made it necessary, sooner here and later there, to impolder the old cultivated grounds, initially by means of small sluices that could be opened at low outside water. During the 15th century windmills brought help. During the 19th century these windmills, in their turn, were replaced by steam engines and in the 20th century by electric and diesel engines.

Thus, one simple intervention in the natural condition of the deltas has had far-reaching consequences. Suggestions have been made to surrender certain parts in 'Laag-Nederland' to

water in order to partly restore the natural processes, but this has only been done on a very small scale because of opposition from inhabitants.

Present day and future water management

'A safe and habitable country with healthy and sustainable water systems' this is the aim with which Dutch water management faces the future in 1998, the year which marks the 200th anniversary of The Netherlands Directorate-General for Public Works and Water Management ('Rijkswaterstaat'). The first part of this aim, to ensure a safe and habitable country, has existed for centuries and is in fact what gave rise to the establishment of 'Rijkswaterstaat' in 1798. After all, the nature of our low-lying, water-logged country is such that it must constantly be protected against flooding from the sea and the rivers. At the same time, a constant effort must be invested in the consolidation of the soft subsurface in order to keep the country habitable and cultivable.

Water systems approach

The second part of the aim, to ensure 'healthy and sustainable water systems', has a much shorter history. It was not until the late 1960s that the problem of surface water pollution led to systematic action to tackle the main sources of pollution. By that time, the poor quality of surface waters was presenting a threat not only to public health but also to wildlife habitats. The two halves of the aim were initially addressed via a two-track policy approach, but during the 1980s there was realized that the aim of public safety and habitability could not be viewed in isolation from that of healthy and sustainable water systems. Moreover, it became clear that water management could achieve these aims much more effectively and efficiently if the policies directed at them were not only closely interrelated with each other but also carefully co-ordinated with other relevant areas of policy. In the mid-1980s, this realization became known as integrated water management.

Integrated water management

This philosophy was developed further in the Third National Policy Document on Water Management (NW3), published in 1989, and integrated water management and the water systems approach have become key concepts in the water management of the 1990s. Thanks to the support the NW3 attracted from various authorities concerned with water management in The Netherlands, much of it has now been translated into concrete measures and the combined aim is now somewhat closer to achievement. However, despite the success of this policy and management based on it, it has still proved necessary to conduct a new review of water management policies and to modify them where necessary in the light of new social trends, continuing subsidence, expected climate change and other factors. The results of this process were formulated in the policy directions mapped out in the Fourth National Policy Document on Water Management (NW4) which focuses on the development of an integrated approach to water systems at various levels of scale, starting close to home and moving gradually outward to the great oceans. The advantage of this approach is not only that it reveals the interrelationship between the various levels of scale, but also that it makes it easier for users and managers to identify with the issues.

Themes

Because the subjects of flood protection, water depletion, emissions and aquatic soils have been regularly in the limelight over the last few years as major policy issues on which NW4 would produce decisions, these themes have been given their own separate section in the policy document, alongside the consideration of the water systems as a whole.

2.2 STRATEGY, KEY POLICIES AND PROSPECTS

Integrated water management

NW3 set out a new strategy under the name of integrated water management. This was based on the view that the aims of water management could only be achieved via an integrated approach. Integrated water management has been a success and NW4 wholeheartedly pursues the same approach. The process of public consultation revealed the need both for more vigorous implementation and for a broader and deeper integrated water management approach. The Dutch Aquatic Outlook project has demonstrated that a number of NW3 objectives cannot be achieved within the time-limits set for them in the policy document unless policies are modified. In recent years the threat of flooding along the various branches of the Rhine and the floods in the Meuse basin have made it clear that measures to prevent repetition of these events will involve more than simply raising the dikes. A strategy directed at a sustainable solution demands measures relating to the wider situation, and not just to the dikes or the river system itself. For this reason, NW4 advocates improved co-ordination between policies on water management, physical planning and the environment. It argues that the co-ordinated policies should take account of all the various interests involved, including flood protection, agriculture, ecology, public water supplies, transport, recreation and the fishing industry. At the same time, they should provide scope for tailor-made local solutions, leading to a combination of an integrated generic approach aimed at achieving common countrywide targets and a specific regional elaboration of policies which takes account of local circumstances and opportunities.

Major economic interests

Water is of great economic significance to The Netherlands: it is a means of transport, a production factor in agriculture and industry, the raw material of public water supplies, a cooling agent and an intrinsic feature in the landscape, ecology, culture and history. Investing in effective water management (protection and exploitation) will lay the basis for the development of a high-quality industrialised society. The replacement value of the investments protected by the flood defences is estimated at over NLG 4×10^{10} (2×10^{10} US\$). Constant consideration and care of the country's water systems is an absolute precondition for the development and preservation of The Netherlands.

Responding to events

Water presents a threat whenever there is too much or too little, or when it is too warm or too polluted. For centuries, people in The Netherlands have been constructing and adding to an astonishing infrastructure, from drainage ditch to river system, designed to control the country's water resources and protect it against flooding. The decisions underlying their various contributions reflected the priorities of their day: agriculture, shipping and flood protection, or more recently the environment, landscape and ecology. In the future, such decisions will have to take account of the expected climatic changes, rises in sea-level and continuing subsidence.

Main aim of NW4

The main aim of NW4 is to have and maintain a safe and habitable country and to develop and maintain healthy and resilient water systems which will continue to guarantee sustained use.

Increase integration and involvement

Over the last 25 years, there have been rapid advances in The Netherlands not only in water management policies but also in policies on the environment, physical planning and ecology. These have helped to guide the development of society. Problems have been identified in a wide variety of sectors and many of them have been solved. Unfortunately, there has not always been sufficient recognition of the logical interrelationships between the various policy fields. Greater

integration is needed. The future water management policy represents a change: a switch from addressing problems as they arise to looking ahead and encouraging positive development. The water systems need to be flexible and resilient. Instead of constantly correcting what has gone wrong, it is preferable to prevent damage occurring in the first place, to conserve what is good and if possible to create scope for the exploitation of new opportunities. Policy has moved further in some areas than in others. Some areas are currently making the transition from one stage to another.

Increasing resilience

An important principle for future water management is to base measures on natural processes and to restore the resilience of water systems. This can be achieved by encouraging water conservation and buffering to make areas more self-sufficient. This will have the additional advantage of alleviating current water depletion problems and contamination by non-indigenous water. It can also help to expand wetland areas and prevent flooding. It will help to ensure that problems are resolved within river basins rather than transferred to adjacent areas.

In terms of reducing pollution, much has already been achieved, but that is no reason to sit back and rest. Use functions are still being restricted and necessary modifications of the hydrological system complicated by continuing diffuse pollution and the legacy of past pollution in the form of contaminated aquatic soils. Water managers will not be able to relax their attention with regard to pollution. On the contrary, they must tackle these problems with renewed vigour.

Area-specific policies

The water management policies can only succeed if they are pursued in co-operation with those directly involved and therefore through measures in their direct vicinity. This means that local and regional problems must be addressed wherever possible at that level. Accordingly, national objectives and standards must provide scope for area-specific policies at a local or regional level. This requires a new approach and the modification of norms and targets set in the water evaluation policy document.

Framework for some area-specific water system policies

The main features of the national framework for area-specific water system policies are dictated by:

- the functions assigned to the main water system, as shown in NW3, combined with the course set for rural areas;
- the basic principles of integrated water management as laid down in NW3:
- stand-still principle, precautionary principle, 'polluter pays' principle and the water systems approach. In addition, other policy fields must also recognise the need to concern themselves with water systems. Water is not only a factor in the economy, ecology, and social and administrative structure of the country, but also a basic factor on which to structure
- physical planning;
- policies for the rural areas as laid down in the Green Space Structure Plan and the policies for the major rivers as laid down in the 'Room for the Rivers' policy approach;
- countrywide norms for water, soil and air, as laid down in past or future national policy documents; and
- the policies outlined in NW4 and National Environment Protection Program (NEPP3).

Prospects

The policies in the NW4 are expected to produce a further improvement in the functioning of water systems. The government proposes to make an extra NLG 3×10^9 available up to the end of

2015 to protect the country against flooding. This sum is intended (in this order of priority) to restore revetments of the dikes around the coast and the IJsselmeer, to ensure the safety of areas protected by river dikes and to protect against flooding in the undiked sections of the Meuse. This financial injection will be sufficient to fund most of the new approaches to flood prevention along the major rivers - an approach that will provide lasting protection for the areas themselves and have a positive impact on the ecological and recreational value of the river flood plains.

This approach, aimed at increasing the resilience of water systems by basing measures as far as possible on natural processes, can also be translated to other areas. The prime example is the coast, but the approach is also relevant to water management in urban areas. In the latter case, closer co-operation between municipalities and water-boards will provide opportunities to enhance the various functions of water in the urban areas and reduce adverse effects on the surrounding area.

The new policy of strengthening the relationship between water management and other policy fields - the environment, physical planning and ecology - should prove beneficial to all the policy fields involved. In physical planning, the new approach will mean that water is regarded as a basic factor on which to structure planning.

Further progress in combating water depletion seems to be achievable through a combination of function modification, water management measures and - in some cases - restricting or reallocating licences for groundwater abstraction. It is still thought feasible to achieve the objective of rehabilitating 40% of the area affected by 2010, although to do so will require considerable effort by provincial authorities and water-boards.

There is particular concern at present about the contamination of aquatic soils by surface water pollution from diffuse sources. The Action Plan on Diffuse Sources represents a major move in the right direction, but must still be regarded as merely the first step towards the achievement of longer-term water and soil quality goals. Contaminated sediments increase the cost of management and maintenance. On the basis of current budgets, measures to clean up severely contaminated sites and restore functions in various localities will take a long time to complete (between 25 and 40 years).

2.3 WATER SYSTEMS

This section focuses on water systems, starting locally and working outwards. It looks first at the regional waters, beginning with the water in built-up areas. Then it turns to the major rivers, the Blue Heart and the southern delta.

Urban water

Waters in urban areas are an integral part of regional water systems and cannot be viewed in isolation. Nevertheless, there are reasons for devoting a separate part to urban water management. The problems of flooding and groundwater seepage, waste water and water consumption are different from those in rural areas. The ecological potential of the urban water system is under-exploited. Urban water is a hitherto forgotten part of regional water systems. A new appreciation and upgrading can have extremely positive results both for the urban water bodies themselves and for the regional systems.

Recently there have been a number of promising schemes directed at more sustainable management of urban water. Major elements in these are domestic measures to save water, the separation of urban run-off from the sewage system, the retention of rainwater in ponds and in the ground, and a new appreciation of the value of water systems in relation to the lay-out of new or established residential areas.

Regional waters

Management of the usually small-scale regional water systems will be heavily influenced by the close interaction between land and water. Water management cannot be viewed in isolation from land use. Success will be wholly dependent on the adoption of an integrated approach on a regional scale. There will be a close relationship between subsidence and the assignment of functions. An integrated approach will be adopted to water management, physical planning and ecological and environmental policies for the region. Local groundwater situations will become the basis for regional planning. Water as a basic principle underlying planning will be the linchpin in regional water management.

Eutrophication of lakes will be reduced. The natural resilience of water systems will be restored or enhanced. Pollution problems will no longer be passed on from one water system to another. Since aquatic soils will be of good quality, dredging spoil can once again be dispersed on land. The water depletion objectives will be achieved and maintained. Policies on water management, physical planning, ecology, the environment and agriculture will all be fully harmonised. Progress will be made in reducing/delaying subsidence by changing functions and taking measures, particularly in parts of The Netherlands below sea-level.

The major rivers

With regard to the major rivers, the main challenge over the coming decades will be to maintain flood protection in the face of larger design discharges, while at the same time conserving landscape, ecological and historical features, promoting navigational use and creating new wildlife areas. In other words, integrated river management. Sustainable flood protection along the rivers will be achieved through a combination of measures: retaining the water, giving the rivers more room to expand and taking precautionary measures. Integrated river management calls for an approach encompassing the entire river basin. Close co-operation with the other riparian states along the Rhine, Meuse and Scheldt will be vital. Water management, physical planning and habitat creation will go hand in hand.

Over the coming decades, the winter beds of the major rivers will undergo dramatic changes. Fifteen years from now, the rivers should be flowing over beds designed to optimise the safe discharge of water and ice. Barges will make their way easily between seaports and the hinterland. The major rivers will form blue ribbons connecting the North Sea and areas upstream and the winter beds will be closely related in ecological and landscape terms to adjacent areas outside the dikes and beyond. A few polders will be reserved for temporary storage of water during times of exceptional peak discharges.

The achievement of this scenario will be associated with a radical reassignment of functions and large-scale engineering works. Rivers will be given room to expand as they did in the past, primarily by making their winter beds broader and deeper. Here and there, a main dike may be moved landward, but landscape, ecological and historical features will be respected and integrated wherever possible. The river landscape will change, but will remain typically Dutch: small-scale landscapes will open out occasionally into wide panoramas and riverside towns and villages will not be allowed to expand at the expense of the river, but will retain their links with it. The area around major rivers will be a splendid place for people to spend their leisure time. Therefore the Government will :

- allow the rivers more room to expand. The government will pursue policies based on the philosophy underlying the 'Room for the Rivers' approach. Wherever possible, unnatural obstacles will be removed, side-channels will be restored and winter beds will be deepened;
- draft a plan for the expansion of the flow area of the Rhine and the Meuse, to be completed by the year 2000 and implemented in 2000 - 2015 (central and local governments). This will create opportunities for enhancing the National Ecological Network of protected areas. Dike strengthening will become the flood protection measure of last resort;

- increase co-ordination between water management, physical planning and habitat creation. The long-term strategy for the major rivers will be rooted in a national physical planning policy;
- encourage the rapid establishment of international action programmes for the protection and exploitation of the major rivers and the achievement of sustainable river flood protection. A high priority will be given to implement these programmes;
- during discussions on the EU framework directive on water, advocate integrated management of the (transborder) major rivers as an interpretation of the concept of 'river basin management';
- promote efficient navigation by dealing with deficiencies in the inland waterway infrastructure;
- give a high priority within regional and urban water management to retaining water longer within river basins.

The Blue Heart

The IJsselmeer, the Markermeer, the chain of inland lakes between Kampen and Almere known as the Randmeren, the Amsterdam-Rhine Canal and the North Sea Canal are all man-made water systems and all part of the same storage basin: the vital Blue Heart of The Netherlands. Fed by the various branches of the Rhine, the Blue Heart plays a crucial role in the water management of the northern half of The Netherlands. The Heart is engineered in accordance with current ideas, but is not completely up to date. Its present infrastructure takes no account of the wish to meet the rapidly increasing demand for water by eventually abstracting more surface water. Nor does it take account of rises in sea-level. The management of water levels is unnatural, but cannot be changed without modifying the infrastructure of the surrounding areas. Where the rivers flow out into the sea, there is a sharp division between fresh water and salt. Demand for recreational uses is increasing and will have to be controlled. At the same time, commercial shipping is also of growing importance. More and more claims are being made on the limited space available. It is time to draw up an integrated scenario for the future development of the IJsselmeer area.

Consensus needs to be reached about the hydrological design of the Blue Heart. Its scale and openness offer scope for almost every conceivable water-related function and its ecological features and potential for water-based recreation will make it an area of international importance. Flood protection will continue to be guaranteed.

The southern delta

The southern delta, originally an area of interconnected estuaries, has changed considerably over recent decades. Over the years taken to implement the Delta Project (designed to protect against flooding), policy came increasingly to be directed at maximising the conservation of the area's valuable ecological features. This led to parallel investments in conservation and, where necessary, restoration of healthy water systems in the Eastern Scheldt, Grevelingen, Veerse Meer, Western Scheldt, Volkerak-Zoommeer and Haringvliet-Hollandsch Diep. Despite the frequently valuable ecological features of these systems, the compartmentalisation required for greater flood protection produced sharp divisions which can also make an area vulnerable from the hydrological and ecological points of view. Partial restoration of the links between the systems would not only increase their resilience but also restore saline gradients and so provide opportunities for further enhancement of the ecology.

The natural processes in the Delta should be restored and enhanced. There should be a greater exchange of water between the various compartments. Natural, gradual transitions will be restored and water levels will fluctuate in a natural way. Flood protection will be maintained.

2.4 THEMES

Apart from defining the water systems and the policies to be developed for them, this section addresses some specific topics on which policy decisions have been widely expected.

Flood protection

Without the dikes and dunes, more than half of The Netherlands would be regularly inundated. So the extensive system of dikes and dunes is essential to the safety and habitability of the country and an absolute precondition for healthy economic development. The Dikes Act is the statutory basis for flood protection. For centuries, flood protection has been synonymous with dike-building and maintenance. However, the floods of recent years have taught us that sustainable protection means more than periodic dike strengthening. It can best be achieved by working hand in hand with natural processes. We need to step back and give the rivers, estuaries and coast more room to evolve.

In a country like The Netherlands, flood protection must never be neglected. The management and maintenance of flood defences must always be a top priority. Climate changes may soon lead to higher design water levels. Our water systems need room to evolve if they are to cope with uncertain and unforeseen future developments. For the rivers, this means water conservation throughout the entire river basin and enlarging the flow area of the river rather than embarking on a further round of dike strengthening. Where the coast is concerned, it means extensive sand nourishment instead of 'hard' engineering structures. Room for water also means that we may sometimes need to take a step back and, for instance, stop building in the flood plains of the rivers, on the beaches and in the dunes facing the sea, and reserve land for possible future use to maintain flood protection.

Where flood defences are concerned, measures relating to the sea defences have the highest priority followed by those in the diked sections of the rivers. Both situations have risks to human life and little advance warning. Measures along the undiked sections of the rivers have a lower priority because they present no risk to human life. But there is no such thing as absolute safety. Whatever we do, we may at some time face a water level which our flood defences are simply not designed to withstand. We must learn to live with the awareness of that residual risk and be prepared to cope with such circumstances if they occur.

Related to flood protection the following actions will be undertaken :

- completing of the Delta Plan for the Great Rivers;
- assessment of the safety of the primary defences (dike authorities; first round: now to 2001; second round: 2001 - 2006). Development of safety standards for non-primary flood defences (provinces and water-boards);
- preparation to change to an approach based on flood risk for areas within ring dikes;
- initiation of a debate about residual risks. Co-operation with municipalities and water-boards to develop plans to deal with the threat of any real flood emergency.

Water depletion

A total of 6.2×10^3 km² of Dutch countryside is regarded as suffering from water depletion. The figures belie The Netherlands' watery reputation. Water depletion is in fact one of the main causes of deterioration in habitat quality in The Netherlands. NW3 recognised the problem and since its publication there has been a widespread effort to combat it. The rehabilitation of the affected land calls for measures both within the areas and outside them. Surrounding areas may have a broad range of uses, from residential to agricultural. For this reason, many areas suffering from water depletion may require an integrated approach extending far beyond the borders of the area itself - an integrated approach which brings together the necessary quality and quantity

standards from wetlands to regional water systems. This kind of approach is necessary but complicated. Central government will continue to encourage and support that approach throughout the plan period.

The objective for 2010 is a 40% reduction in the area of countryside suffering from water depletion as compared with the 1985 figure. In order to achieve this, an integrated approach will be developed to deal with water depletion in relation to other water management issues. Eventually, target groundwater levels will be achieved throughout the country.

Aquatic soils

The quality of recently formed aquatic soils shows distinct improvement compared with that of earlier sediments, but even so there is still widespread pollution. This substantially increases the cost of maintenance dredging to ensure adequate river discharge and navigational depth. In addition, the restoration of water systems requires not only clean water but also uncontaminated aquatic soils. The main solution is to tackle the sources of pollution, but there is also a need to remove severely contaminated aquatic soils. Over the next few years consideration will be given to replacing the rigid classification of dredging spoil with a more flexible approach by which spoil will be dispersed where this would do no harm to the recipient system, treated (separation, purification, use) where financially feasible, and dumped only as a still indispensable, but environmentally and cost-effective, last resort.

Eventually it must be possible once again to use dredging spoil from maintenance work on shipping channels, ports, canals, ditches, etc. as a valuable raw material for a variety of uses. This will reduce the need for treatment and make dumping a thing of the past. The following actions are planned :

- to explore the potential for storing dredged spoil in deep pits located, for example, in the river flood plains;
- to build a large spoil storage depot in the Hollandsch Diep;
- to use simple sand-separation techniques at large storage sites;
- to give further encouragement for re-use of dredging spoil, either immediately or following treatment;
- to draft a 10-year scenario for the remediation of aquatic soils;
- to promote active management of aquatic and other soils; and
- to continue for the time being - subject to conditions - with the dispersion of slightly contaminated spoil both on land and in surface waters.

2.5 ADMINISTRATIVE STRUCTURE

NW3 introduced the concept of integrated water management. To put this concept into practice, it was necessary to create water-boards able to apply a fully integrated approach to manage the quantity and quality of water. The creation of such water control bodies required mergers between existing boards. This has considerably reduced the number of water-boards (from 2,300 to less than 60). The basic principles of NW3 still apply. The modifications proposed here are a question of 'fine-tuning': shifting the emphasis from a debate on structure to the optimization of implementation. This may mean that some operational duties relating to the management of groundwater and waterways have to be delegated from the provinces to the water-boards.

2.6 INSTRUMENTS

Social trends have become more complex, faster changing and often larger in scale. Policy on the physical environment, of which water management policy is a part, cannot escape the consequences of these developments. At the provincial level, various moves have been made in the direction of a more integrated planning process. This good example deserves to be followed.

Research on the introduction of a levy on various diffuse sources has been shown to be limited. To combat water depletion, the area-specific (GEBEVE) scheme will be extended for another two years. For the time being, no activities will be developed in the direction of integrated legislation. Developments concerning the financing of water management and European legislation may eventually produce a further integration of the present national legislation. The process of public consultation will be used in the preparation of various plans for major water systems.

2.7 INTERNATIONAL WATER POLICIES

States sharing river basins have a joint responsibility for the quality and functioning of those systems and for organizing and supervising their use. This includes responsibility for flood protection and for the seas into which the rivers discharge. This responsibility should be expressed at the most appropriate level within the framework established by international covenants. Public accountability is an important aspect of this responsibility. There is a need for rationalisation of international consultations in order to increase consistency and prevent duplication of effort.

For each water system/level of scale there should be a single forum, pursuing an integrated approach. The division of responsibilities between the different forums should be consistent, there should be close co-operation between them, and processes of consultation should be clear and transparent.

The basic terms of international water management policies should be established in general forums such as the EU and the UN. But the identification and, where possible, resolution of problems should take place at the level of regional seas or river basins and parts of them, with action programmes serving as frameworks for integration. Particular problems can be tackled at the EU or UN level where desirable. There should be effective feedback mechanisms for this, as well as between the various area-specific organisations. There also needs to be regular bilateral co-operation (between neighbouring countries and other strategically important partners) and national co-operation (between lower tiers of government and interest groups). The international forums should themselves maintain an open attitude towards the outside world. Dutch water management expertise should be systematically deployed in other countries, with a particular focus on the sustainable development of water systems.

This results in the following activities :

- to merge different international forums dealing with the same water system, especially the Rhine, the Meuse and the Scheldt, with the aim of improving integration;
- to establish an EU directive on water, placing the key emphasis on co-ordination, subsidiarity, transparency and the reduction of bureaucracy;
- to systematize the lower tiers of government and international non-governmental organisations in the work of international river basin commissions;
- to present to parliament an action plan setting out the priorities for Dutch efforts in the field of water management elsewhere in the world.

2.8 FINANCIAL AND ECONOMIC CONSEQUENCES

The last few years have seen considerable financial boosts to the implementation of integrated water management work, both in areas of central government responsibility and in the those of regional water management by water-boards, provinces and municipalities. The NW4 builds on the pointers provided by NW3 and on the efforts made so far. In addition, water management has been given a substantial additional financial injection to fund the new approach to deal with flood protection along the major rivers.

In estimating the financial consequences, a distinction is drawn between the maintenance of current practices and the introduction of supplementary measures. Maintenance of current practices is taken as the reference point for calculating the consequences of implementing supplementary measures. Supplementary measures can be based on either existing or new policies.

New policy, as far as the central government is concerned, means measures directed at the achievement of new objectives. In the case of this policy, the objectives relating to the expansion of rivers, a new approach marks the prevention of river flooding. Here too, however, the policy sets no new safety objective but opts for a new and more sustainable approach to the achievement of the existing safety standards. The estimates of the costs involved in maintaining current practices and introducing supplementary measures are based on the measures already described.

Estimates of public expenditure on current practices

Municipalities

The cost estimates for urban water management relate to the management of sewage systems in urban and surrounding rural areas to be connected to the system. Total annual costs are currently in the region of NLG 1.5×10^9 . Maintenance of current practices, as laid down in the Sewerage Memorandum, demands an overall investment of NLG 7×10^9 guilders: around 5×10^9 to catch up on overdue maintenance work and 2×10^9 to reduce storm overflows from sewage systems. The total annual costs to municipalities as a result of this investment (totalling around NLG 9×10^9) are expected to amount to almost NLG 2×10^9 in 2005: an average annual increase of 3.6% over the 1998 - 2006 plan period. This is entirely due to policies already agreed upon.

Water-boards

Water quality management is the largest category of expenditure relating to the duties of water-boards. Over the 1995 - 2001 period, a total of NLG 7.4×10^9 will be invested, most of it in sewage treatment plants. The nitrogen removal programme for sewage treatment is due to be completed in 2005. Annual expenditure on water quality management is expected to rise over the plan period (1998 - 2006) by approximately 2.2% towards the end of the period.

Over the 1995 - 2001 period, water-boards will invest almost NLG 2×10^9 in flood defences including contributions from other tiers of government and third parties. The greater part of the investment will be in the primary flood defences. This will consist both of routine work and dike strengthening under the Delta Plan for the Great Rivers. Total annual expenditure on flood defences is expected to rise by only 0.4% a year over the 1998 - 2006 plan period. Over the 1995 - 2001 period, water-boards will also invest almost NLG 2×10^9 in water quantity management. Relatively small proportions of this sum will take the form of specific investments relating to aquatic soils, water depletion and urban water management. Total annual expenditure on the management of water quantity is expected to rise by 0.2% a year over the 1998 - 2006 plan period.

Provinces

The function of provinces regarding water management is primarily strategic. This is expressed chiefly through the planning process (provincial water management plan). They also have a number of executive responsibilities in the field of groundwater management (under the Groundwater Act) and the management of inland waterways. Lastly, they subsidise dike strengthening work along the major rivers. Maintenance of current practices will have the following financial consequences.

The resources available for investment in improving flood defences are given by the provinces to the water-boards as their contribution to the improvement works. In total, the provinces will contribute around NLG 1.3×10^9 towards the implementation of the Delta Plan for the Great Rivers averaging approximately NLG 2.5×10^8 a year, an annual contribution of over NLG 2×10^7 will also be given to the water-boards for the maintenance of flood defences.

Expenditure on waterway management and related quantitative management of surface water will total approximately NLG 1.8×10^8 a year. The part for the Fries-Groningen canals will be funded by the central government since these canals function as national waterways.

Expenditure on strategic and operational groundwater management totals about NLG 2.6×10^7 a year and is partially funded by income from groundwater charges. The increase in groundwater charges means that administrative costs and the costs of projects to combat water depletion can in some cases be met by groundwater charges over the next few years. In the course of the plan period, this may produce an increase in annual expenditure amounting to around NLG 2×10^7 .

Central government

Maintenance of current central government practices will have the following financial consequences. Central government expenditure on water management currently totals around NLG 1.8×10^9 a year. Some 20% of this is general expenditure on staff and equipment which cannot be ascribed to specific areas of water management.

About 47% of spending on water management is for central government maintenance and restoration of water systems, investments in and maintenance of waterways and harbours, monitoring and research. In 1996, around NLG 9.3×10^7 was spent on infrastructure and restoration. The multi-year estimates show spending declining to around NLG 7.3×10^7 by 2001.

Some NLG 3×10^8 a year is currently available for central government work on flood defences. The policy of dynamic coastal management will demand additional resources, particularly to compensate for sand deficits in deep waters. The present budget includes financial provision for spending on this within the plan period.

More than NLG 2×10^8 a year will be required to manage aquatic soils, to dredge approach channels, waterways and harbours to maintain navigational depth, to construct and manage disposal sites for dredging spoil (including treatment of dredgings containing sand), and to remedy aquatic soils. The central government will make available around NLG 2×10^7 a year to remove contaminated sediment from regional waters.

In addition to carrying out its own management responsibilities, central government currently contributes NLG 1.5×10^6 a year to regional water management. This contribution relates primarily to the costs of maintaining waterways where such maintenance has been devolved by central government to provinces, water-boards and municipalities as part of the general policy of decentralisation, and to the costs of changing land use related to water management.

Estimates of public expenditure on supplementary measures

The policy described in NW4 will lead to the maintenance of current practices based on existing policy and also to a new approach and an intensification of current activities.

3. PRESENT STATUS OF FOOD AND RURAL DEVELOPMENT

Agriculture in The Netherlands has significantly changed during the past decades. For example the cultivation of a traditional crop like wheat has been reduced due to its low price. In the past decennia there has been a significant increase in greenhouse cultivation and in the number of cows, pigs and chicken raised. At present The Netherlands is still a large exporter of agricultural

products. However the export products mainly refer to flowers, vegetables and dairy products. Basic food products are largely imported.

The economic boom of the 1950s and 1960s produced drastic changes in all social sectors and also dramatically influenced the Dutch agricultural sector. Modern production techniques realized an enormous advance in agriculture, and mechanisation enabled farmers to cultivate significant larger areas with less manual input. Through land consolidation projects, parcel sizes were enlarged, field drainage was improved, and the farm road network modernized. In combination with the use of fertilisers and pesticides, these measures played a significant role in making the agricultural output of The Netherlands one of the highest in the world.

Advances also have their drawbacks, and the above developments are no exception to this rule. The new farming methods have impaired nature and landscape, whereas the increasing urbanization and expanding highway and railroad infrastructure have put the rural area under great pressure. Additional factors are the growing interest in nature, landscape development and conservation, ecological awareness, and the increasing need for outdoor recreation. In other words, the rural area needed to be assigned other functions in addition to agriculture.

The general objective of land development in The Netherlands is 'to improve the layout and infrastructure of the rural area in accordance with the functions of the area that are indicated within the framework of physical planning'. Measures can be taken for improving the socio-economic conditions in the agricultural sector and the conditions of other sectors such as the conservation of landscape, nature and outdoor recreation. These measures refer to construction and improvement of rural roads, water management systems, exchange of agricultural land between farmers and improvement of field drainage, as well as delineation of lands for other public uses.

4. CHALLENGES FOR THE FUTURE

In a delta area there is no final solution or permanent situation. The history of water management in The Netherlands shows how the original natural landscape was transformed into a man-made landscape in a never-ending struggle with water. Because of a great susceptibility of delta areas to intervention in the given physiographic condition, chain reactions also occur in other areas where economic development has led to certain activities. A few examples:

- mining of natural gas, resulting in subsidence and consequences for water management;
- deepening of approaches and harbours, resulting in an increased intrusion of sea water;
- expansion of green-houses with consequences for drainage and water quality requirements.

There are no grounds to suppose that in the future such activities will come to an end, and new developments will have to be reckoned with. There is no prospect of a permanent situation. Therefore a 'philosophic' longer term outlook of water management in The Netherlands will conclude this paper.

Analysis of the history of water management and its future prospects

An insight in the history of water management is essential to identify trends in existing developments and to be prepared for the consequences of possible future developments. The execution of works in water management and land reclamation depends on factors from one of three groups :

- incentives for the acceptance of a change;
- technical and other factors that make a change feasible;
- social conditions.

Together they form necessary conditions, but they are not enough to explain the historical developments. For the Dutch delta, it appears that the chance factor of disasters, threats and storm surges at sea are involved. Also characteristic of the Dutch delta area is that situations occurred that constituted a real threat to the country's survival, This was cause for great concern. Sometimes the technical solution was known, sometimes people did not see a way out but then a technical innovation was introduced and saved the day.

Possible developments in water management in The Netherlands

The processes and trends observed in the Netherlands - rise of the sea level, subsidence, higher requirements for safety, water quality and environment - will continue in the long term and will make the deltas of the Rhine and Meuse even more vulnerable. In addition, some factors, partly deterministic partly stochastic, are becoming apparent. They are :

- a change in the local climate, the hydrology of the Rhine and Meuse and the regime of storm surges;
- an accelerated rise of the sea level;
- increasing urbanization;
- large-scale underground works for traffic, industry and habitation;
- the occurrence of a 'super storm surge', surpassing by far the normative storm surges, with the chance of such a super storm surge occurring being 1% in a hundred years (return period 10,000 years);
- the occurrence of a 'super river surge', also much higher than the normal high water;
- the lack of a major storm surge for one or two generations;
- other events that are unknown so far, or are considered beyond the bounds of the possible (wars, earthquakes, loss of faith in the future and so on).

Of all these deterministic factors and chance hits, most attention is, of course, centred on the consequences of the greenhouse effect and the subsequent accelerated rise of the sea level, for this constitutes the most direct threat. Comprehensive international research has been conducted into the magnitude of this rise and the time span in which it will take place, using models of the hydrological cycle of water, the GCMs (Global Circulation Models). Although these models are based on the laws of physics, they produce rather divergent results according to the presuppositions that are to be entered. There are models predicting an additional rise of a few decimetres over a period of around 100 years and then there are models with a predicted rise of some metres over a period of around 300 years. A lowering of the sea level may also be possible. Under these circumstances it seems preferable to work out a few different scenarios of rises in sea level, namely what works should be undertaken to compensate for these rises, in what time span could the works be executed and in what order? As reliable predictions concerning the rate of the rise in sea level cannot be expected for another few decades, a strategy will have to be outlined that can be constantly adjusted to the actual developments. However, determining this rise, or the relative subsidence, is turning out to be less simple than one might think, mainly due to local differences and the lack of fixed measuring points. Everything seems to subside or, sometimes, to rise temporarily. That is why a network of stations throughout The Netherlands has been established, where, by measuring the differences in gravity of a certain level mark over a certain period, the change in absolute height

None the less, an accelerated rise in the average sea level need not be a disaster for the Dutch delta. The necessary technological equipment is present and experience with the strategy to be pursued has been gained during the past eight to ten centuries. Our land has subsided two to three metres due to natural and anthropogenic causes and, during the first centuries, people only had primitive technology at their disposal.

Financially, an accelerated rise in the sea level means a setback, but not so acute as generally assumed. If a rise of 0.7 m over of 100 years is taken, instead of the current 0.18 m, which is

regarded by many to be the average or the most probable figure, the necessary provisions with regard to safety, drainage and urban areas would cost circa 3.5×10^{10} guilders. This amounts to not more than 0.5% of the Gross National Product, provided the expenditure can be spread over 100 years. Even with a 'maximum scenario' of 5 m in 300 years, expenditure for hydraulic and other works will be minor if compared to the expenditure for social services, education and defence. It should be kept in mind that these estimates are based on existing technology, whereas it may be assumed that in future it will be feasible to build more cheaply, thanks to the availability of such things as cheap acceptable nuclear energy, light building materials and synthetics for facing dikes and banks.

A new picture of the future is taking shape, in which water management in The Netherlands will have to be adjusted as a result of the accelerated rise of the sea level, the additional intervention of surface and ground water due to the continuing urbanization and a large-scale use of underground construction. Several scenarios of a new infrastructure for water management in the Dutch coastal area, if the sea level rises by a few metres, have been developed. In one of these essential elements are the construction of a vanguard dike between the cities Den Helder and Hoek van Holland about 15 to 25 km in front of the present dike coastline and the creation of a lagoon and large-scale drainage of discharge from the great rivers. Another version entails the construction of a vanguard dike parallel to the present coastline contiguous to the Belgian and German coastal areas. From a technological point of view, no special problems are expected, but from an organisational and administrative point of view, it cannot yet be foreseen how measures can be taken in the framework of integrated water management.

Perhaps the biggest setback will be caused by sea storm surges that have been misjudged in Dutch history from 1134 and 1421 until 1953. Among the present inhabitants of the low part of The Netherlands the feeling prevails, just as it did 40 years ago, that the problem of safety from floods has been solved now that the normative storm surge has been determined at 1.15 m higher than the 1953 storm surge at Hoek van Holland. The recurrence of this normative storm surge is 1×10^4 years. However, it can be concluded from the delta report that a storm surge 2 to 3 m above the 1953 storm surge and so 1 to 2 m higher than the storm surge that determines the height and strength of the primary defence line could occur.

The non-occurrence of critical storm surges may lead to misjudgments. Experiences with rare events seem not to be passed on and after one or two generations people tend to forget a disaster or ignore reality when other urgent problems present themselves.