The Netherlands in the Future

Second Sustainability Outlook

The physical living environment in the Netherlands

Policy Studies

Netherlands Environmental Assessment Agency

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Preface

The First Sustainability Outlook (Netherlands Environmental Assessment Agency, 2004) defined the concept of sustainability as the distribution of a certain quality of life and the possibilities for maintaining this in the future. This quality of life is determined by the availability of the resources needed to achieve the goals set. The range of possible underlying objectives to choose from makes sustainability a heavily value-laden concept. The First Sustainability Outlook, therefore, analysed the possibilities for maintaining a certain quality of life from a global perspective. It noted that sustainability problems often arise from partial approaches, in which the situation is viewed from the perspective of a single world view, objectives are one-dimensional and the relations between goals and means are lost.

One of the main challenges of the Dutch Government's new Coalition Agreement (2007) is to bring about social cohesion, while creating the conditions for more sustainable development. The primary focus is on integrating the social (people), ecological (planet) and economic (profit) dimensions. Elsewhere, too, there is insistence on a more coherent spatial policy. The Dutch Upper House, under the motions proposed by Wolter Lemstra, has asked the Minister of Housing, Spatial Planning and the Environment to prepare an integrated, long-term investment strategy. This should not only incorporate the effects of climate change, but also make provision for the further development of the Randstad conurbation and Schiphol Amsterdam Airport.

This Second Sustainability Outlook initially endeavoured not only to examine the physical (planet) side of the problem, but also, in collaboration with other policy assessments, to study the long-term viability of the economic situation and the stability of social relations. However, this proved unsuccessful, because it is not yet possible to turn the concept of sustainability into workable principles for the economic (profit) and social (people) dimensions. The desire for insight into the practical implications of sustainability, therefore, can only be answered for the physical (planet) dimension, in other words, the physical living environment. To make the problem more manageable, it was looked at from two separate perspectives:

1. a spatial perspective, analysing the relationship between the Netherlands and rest of the world (*The Netherlands in a Sustainable World*);
2. a time perspective, analysing the relationship between the Netherlands of today and the Netherlands in the future (*The Netherlands in the Future*).

This study deals with the second (temporal) perspective and addresses the question of the sustainability of the physical living environment in the Netherlands. Here, too, sustainability is all about the integral picture. The planning of housing and employment areas, nature, landscape, infrastructure and energy supply are clearly related. These often conflicting activities can be accommodated much more effectively – while delivering the maximum possible quality of life to future generations – if they are looked at together. Current policies fail to adequately address a number of short-term issues. For example, it is not clear how the Netherlands will be able to meet its international obligations to protect biodiversity, how the Randstad can remain accessible, how the quality of the landscape can be prevented from declining further, and how the urban living environment can be improved.

Dividing up the demand for all these facilities, amenities and services into various sub-problems, would solve nothing, because it is then not clear how much these different activities strengthen or constrain each other. The obvious alternative is to address a whole series of choices which, in principle, have to be made at the same time. The final result has provided a map with the best possible arrangement of land uses. However, this map is not necessarily the only appropriate 'blueprint' for a sustainable Netherlands. It is only a preliminary proposal, although the best one at the moment. The remaining challenge is to produce a map that integrates housing, employment, infrastructure, green space and water management more effectively. This study should therefore be regarded as a 'work in progress'.

Contents

Summary and conclusions

- The Netherlands has to fit all of its housing, employment and transport onto a relative small land surface area, while maintaining the quality of the living environment and the landscape. The way to use the available space as effectively as possible is to view these functions and features as an integral whole, including the additional demands made on water management, caused by the effects of climate change. This study shows how optimising the spatial allocation of activities can maximise the sustainability of the Netherlands.

- Sustainability means that the Netherlands will remain attractive, safe and dynamic for future generations. It is important that central government better coordinates the implementation of existing policies on concentrating housing and employment provision, urban restructuring, National Landscapes, international protected areas and adaptation of hydrological systems (climate change). The new Spatial Planning Act contains specific provisions for this.

- Achieving the objectives of all these policies, simultaneously, will only be possible if their land use claims are considered together and the spatial implications mapped out.

The previous government asked the Netherlands Environmental Assessment Agency to produce a Sustainability Outlook. To reveal and describe the results to policymakers in the clearest possible way, the study was divided into two parts: the interrelations between the Netherlands and the world as a whole and the sustainability of the Netherlands itself. The second part – this study – shows that the pursuit of a sustainable Netherlands requires a more far-reaching integration of current policies. This is in line with the terms of the Dutch Government's Coalition Agreement, which greatly stresses the importance of 'cohesion'. Cohesion is at the heart of sustainability. When it is lost, part of the quality of our living environment is also irretrievably lost to future generations.

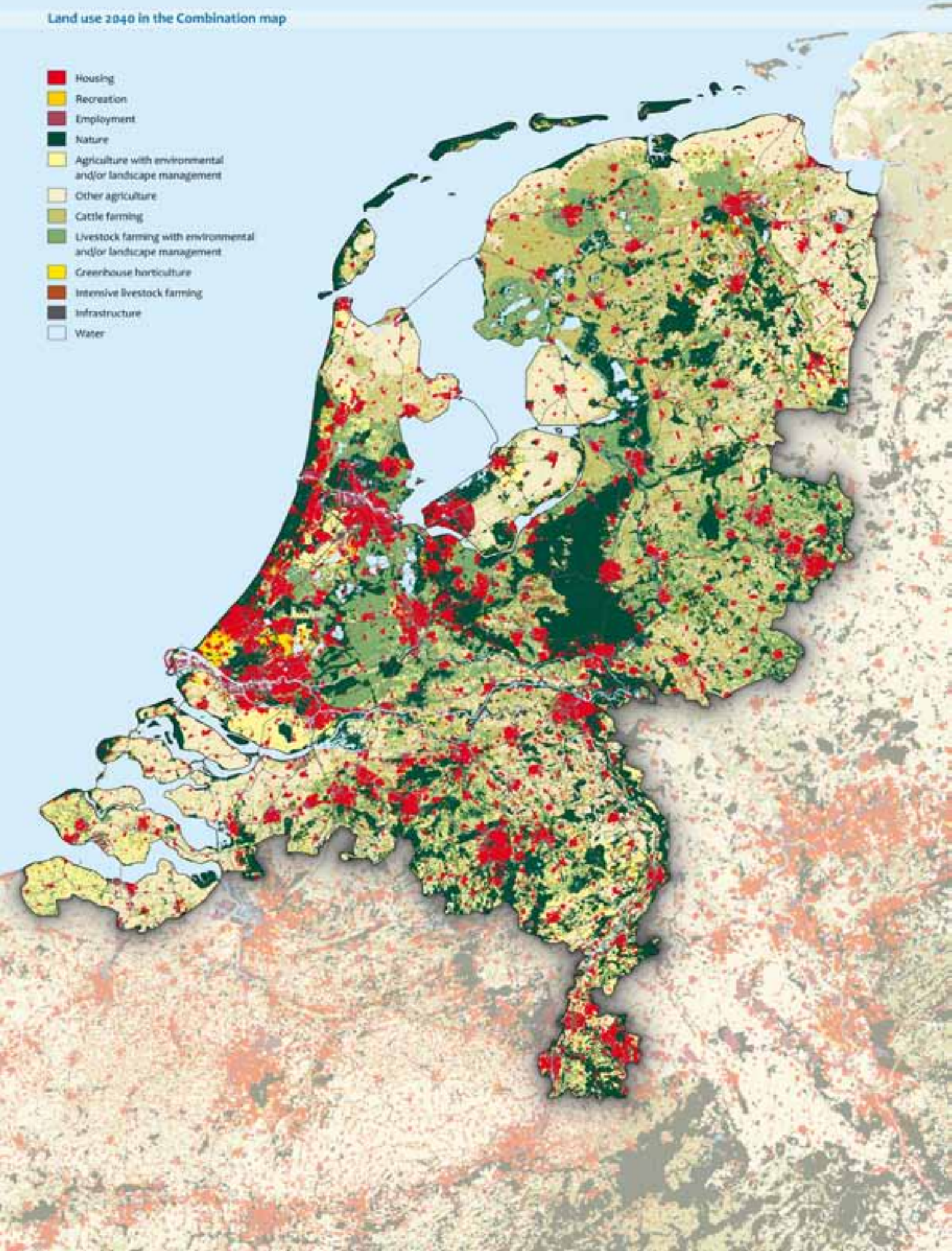
In the present system, political and administrative decisions on the various social issues are almost invariably taken from a sectoral, and thus partial, viewpoint. This leads to partial solutions and compartmentalisation. To accommodate the current demand for land, while ensuring that future generations inherit a high-quality living environment, we need a more coherent, long-term vision. The sustainability of the physical environment can be broken down into the following main themes:

1. *climate change*: flood risks and water damage, water shortages and salt-water intrusion;
2. *biodiversity* (diversity of plant and animal life): connectivity and quality of the National Ecological Network and Natura 2000 areas;
3. *traffic and transport*: accessibility of cities, congestion on roads, unequal distribution of environmental impacts between different population groups;
4. *attractive living environments*: shortage of quantitative and qualitative housing (particularly location: green space in urban areas, rural living), and affordability;
5. *international business location*: availability of easily accessible business parks, presence of prime office sites, international hubs (particularly Schiphol), and attractive residential areas;
6. *cluttering of the landscape*.This study endeavoured to find the most favourable combination of objectives from all the themes (policy fields), resulting in a map of the Netherlands for 2040. The map provides a development perspective that integrates the many different policy goals within a single spatial framework. Integrated maps that provide an even better combination of objectives may be conceivable, but these still have to be found. The map is not a 'blueprint' but the best conceivable option at the moment. Of course, the challenge of devising better combinations, again, by carefully consideration of all policy areas, still stands.

Appendix 1 provides an overview of all geographical names in this report.

Figures 1 and 2 depict the Netherlands in 2040. Figure 1 presents the Combination map, showing the optimum spatial configuration, taking account of the constraints and requirements of all the themes (perspectives) and based on current trends in development pressure; Figure 2 is based on

Land use 2040 in the Combination map



a high development pressure. The trend-based projection reflects modest economic growth (1.7%) and population growth (to just over 17 million in 2040). The map based on high development pressure reflects an economic growth of 2.1% and a population of almost 20 million by 2040.

Flood defences

The 'climate and safety' theme indicates that the Netherlands will probably remain climate-proof and protected against sea level rise for some centuries to come, and that structural spatial measures, such as a shift in investment to the upland areas of the Netherlands or to a much wider coastal zone, are not urgently required. The *Combination Map,* therefore, assumes further investment in the low-lying Netherlands, particularly in the Randstad conurbation, and is limited to a specific differentiation of protection levels aimed at reducing the risks of damage and human casualties, and establishing a more robust protection system in the river areas. Areas where safety standards are lowest will be kept free of new urban development as far as possible. The use of overflow dykes is expected to make it easier to predict floods and further reduce the risk of human casualties, in particular.

Adaptation to climate change

Although there are still many uncertainties surrounding the rate and extent of climate change and the rise in sea levels over the long term, the diminishing probability of gravity discharge from the rivers is a determining factor in the long-term sustainability of the Netherlands. Should sea levels rise by about two metres, other structural solutions may have to be found for dealing with peak discharges from the rivers Rhine and Meuse. A rise in sea level as high as this, at the upper end of estimates by the KNMI (Royal Netherlands Meteorological Institute), could occur within two or three centuries. The heavily populated lower reaches of the major rivers, which include the cities of Rotterdam and Dordrecht, are especially vulnerable. In the *Combination Map,* land has been reserved in the south-west delta region, the river areas and the IJsselmeer area to keep longer-term options open for changing the discharge regimes and water storage capacity of the rivers and lakes. These designated inundation areas also make the Netherlands more resilient to any unexpected increases in the rate of sea level rise this century. Areas for extra water storage are most needed in the low-lying Netherlands, the deeper areas of some of the land reclaimed from lakes being the prime candidates. These areas are most suitable, because this would also help counter salt-water intrusion, combating desiccation in surrounding nature conservation areas and would be of additional benefit to recreation and green residential areas. A separate salt-water drainage system could support the development of water-based recreational facilities. It is assumed that any new urban areas will be designed with extra space for water storage, given the limited options and high cost of later modification (sewerage, water storage space). This is also an important ingredient in the restructuring of existing urban areas.

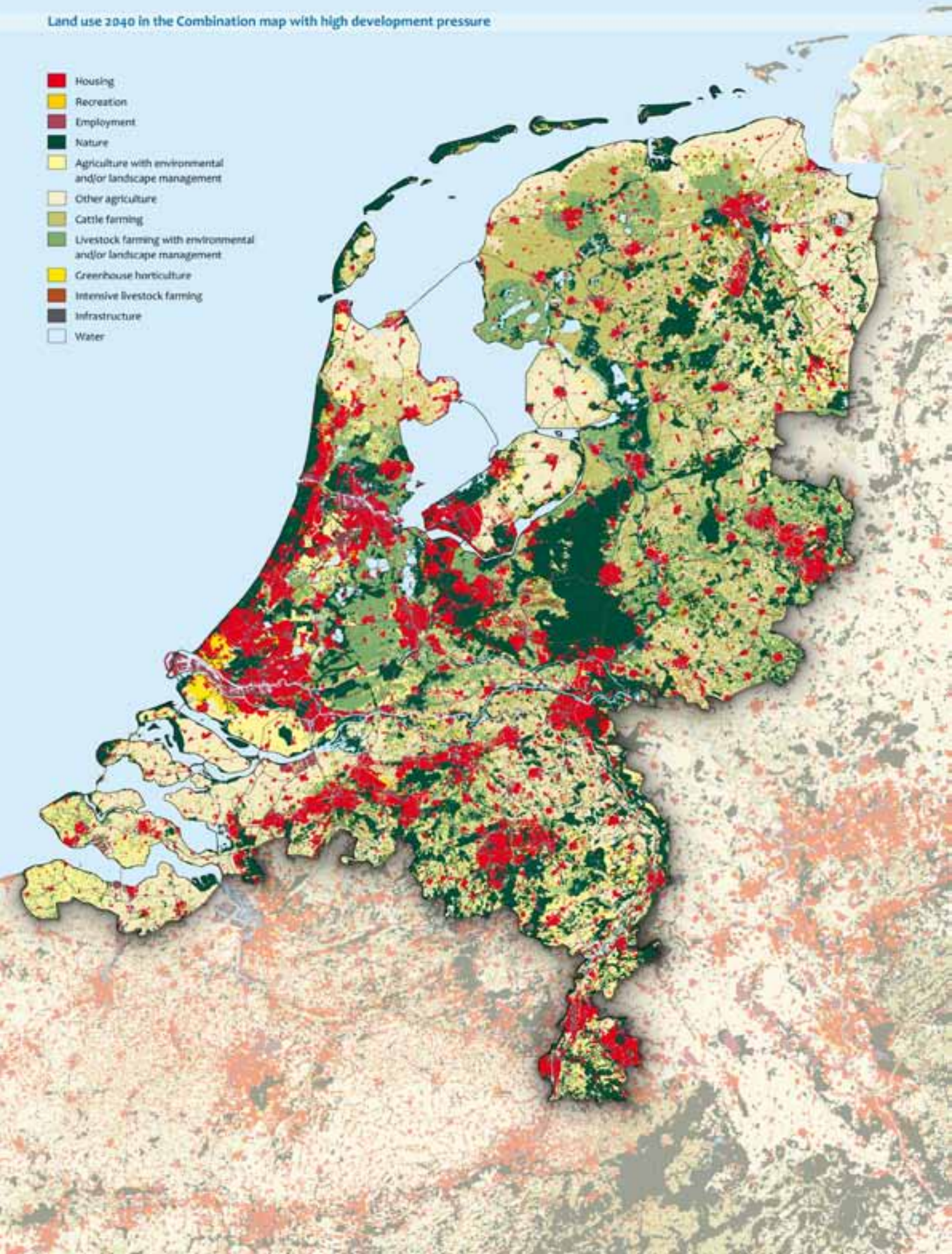
Biodiversity

To comply with EU policy on the sustainable protection of certain internationally important habitats and species (Natura 2000 network), the Netherlands needs to expand several protected areas and reduce environmental pressures from surrounding areas. These extensions to Natura 2000 areas are included in the *Combination Map*. Wetland habitats figure prominently, including areas of peat mire, river and stream systems, large bodies of water and the river floodplains, as

Figure 1

Combination map of the Netherlands in 2040, under baseline growth in economy and population. The map presents an optimisation of spatial developments, also based on criteria in the various perspectives.

Land use 2040 in the Combination map with high development pressure



well as the dunes and the fringes of the Veluwe and Utrechtse Heuvelrug regions.

Accessibility

Concentrated and compact urban development provides considerable accessibility benefits. Another advantage of concentrated and compact development is that it requires less space. It retains the flexibility in the spatial development of the Netherlands, makes it easier to reserve land for flood protection (ability to adapt to climate change) and limits damage to the landscape. Concentrated urban development is therefore an important element of the *Combination Map*.

Concentrated and compact urban development also has negative effects, mainly those of the (relative) decrease in green space in and around the cities (recreational facilities) and increase in noise nuisance. To compensate for these, space is reserved in the *Combination Map* for the creation of additional bodies of water and recreational green space around the cities to support landscape, tourism and recreation policy. Road pricing and improved public transport deliver considerable accessibility benefits. Both instruments are therefore incorporated in the *Combination Map*.

The public cost of maintaining and managing the existing built environment (including infrastructure) is much higher than the cost of a change in use (including restructuring costs). A new model has been used for calculating the investment and maintenance costs of three perspectives. The method is still experimental, so the results should be seen as indicative only. It indicates that, in the long term, compact (intensified) land use is cheaper than greenfield development only. In the latter case, the built-up area would continue to expand and so management and maintenance costs increase as well. With no compact development, investment costs are lower in the short term, but annual management costs rise in the longer term. In other words, the costs would have to be borne by future generations.

Quality of the living environment

Considering people's desire to live in spacious and green surroundings, it is clear that the greater land use and urban development in attractive landscapes score lower on many indicators than the structural trend. Building in much lower densities than reflect current housing preferences, combined with a less restrictive policy on housing and employment land use, creates many conflicts with other sustainability issues. There is more government control over urban growth in the *Combination Map* than in the *Baseline* scenario, and no new development is permitted in attractive areas, such as National Landscapes, and in urban buffer zones. There is space in and around the Randstad to develop new green residential areas in the direct vicinity of the cities. To improve the quality of the living environment – not only for new housing, but also for the existing housing stock – the *Combination Map* includes

Figure 2

Combination map of the Netherlands in 2040, under high economic and population growth. The map presents an optimisation of spatial developments, also based on criteria in the various perspectives.

Effects of the Combination Map (development pressure on land in line with trend) compared with the structural trend Table 1

Indicator	Combination map	Effects
Flood Defences		Differentiation in safety levels, use of overflow dykes, concentration of urban development in the low-lying Netherlands in areas with the highest safety levels, and limited urban expansion in the river areas.
Adaptation to Climate Change		Retention of reserved areas for future designation within flood-risk areas and more water bodies in and around the cities provide more options for water storage.
Biodiversity		Expansion of Natura 2000, additional green around the cities, and agricultural environment and landscape management of buffer zones and National Landscapes.
Accessibility		Accessibility benefits resulting from urban compaction policy brings homes and employment closer to each other.
Quality of the Living Environment		More green and water around the cities, and an improvement in the quality of agricultural landscapes; less noise nuisance from Schiphol Urban intensification increases pressure on the quality of living environment. Airport.
Residential Housing in Spacious and Green Surroundings		In and around the Randstad there is some scope to develop new green living environments in the direct vicinity of the cities.
International Businesses Establishment		More green and water around the cities, and improvements in the quality of agricultural landscapes; less noise nuisance from Schiphol Airport.
Landscape Quality		Areas of high landscape quality kept free of urban development and agricultural intensification; more green and water around the cities, more agricultural landscape management and reorganising of dispersed greenhouse horticulture and intensive livestock farming.
Spatial Segregation		Effect barely differs from structural trend.

additional areas of open water and extra recreational green space around the cities.

International business location

The business location perspective assumes that only the northern wing of the Randstad is an international business location that can match the European second tier (Barcelona, Munich). This is why a great deal of the urban development in western Netherlands is concentrated around Amsterdam. However, it has an adverse effect on other city regions and on nature, landscape and water resources around Amsterdam. As such a bias towards Amsterdam is an unlikely option, given the political and administrative context, it has not been incorporated into the *Combination Map*.

The rerouting of some flights in and out of Schiphol to Lelystad Airport (relocated slightly to the north-east) will improve environmental quality around Amsterdam and, on balance, in the Netherlands as a whole. This rerouting is incorporated into the *Combination Map*.

Landscape quality

The landscape, tourism and recreation perspective requires a restrictive policy on development in the National Landscapes and urban buffer zones. These have been incorporated into the *Combination Map*, along with the provision of additional recreational green space and bodies of water around the urban areas to counter the adverse effects of concentrated and compact urban development strategies.

The *Combination Map* includes the additional investment in landscape stewardship schemes from the perspectives of landscape, tourism and recreation. These investments are made in the National Landscapes, peat meadow areas, a five-kilometre zone around the urban buffer zones. They are based on the fact that the imminent reform of the EU's Common Agricultural Policy will enable a major shift away from the current system of agricultural subsidies to a system of rewards for farmers who work to maintain and improve the quality of nature and the landscape. This opens up opportunities to finance landscape maintenance in these areas, as well as additional environmental measures in the buffer zones around Natura 2000 sites. In the *Combination Map,* intensive forms of agriculture (greenhouse horticulture, intensive livestock farming) are more concentrated in specific areas.

The effects of the *Combination Map* score better on many indicators than the structural trend does (Table 1). Under increased development pressure on land (accompanying higher economic growth) the indicator scores will be lower.

Conclusions

These maps and underlying analysis of synergies and conflicts have led to the following (main) conclusions:

- To accommodate all our needs regarding housing, employment, transport and green space, while maintaining the quality of the physical environment for present and future generations, requires an integrated approach. Only then will it be possible to pursue all the objectives of the different policy fields simultaneously, and achieve more sustainable land-use patterns.
- More coordination between urban development and infrastructure and integration of flood protection measures with nature and landscape conservation offer most benefits. There are also important synergies between farming and nature and landscape quality, and even between flood protection and the climate for new business establishment.

Additional policy actions

Table 2

	Short term (before 2010)	Long term (after 2010)
Links between urban development, climate (safety) and biodiversity	• Reserved land (water storage) in IJssel Valley, IJsselmeer, Volkerak-Zoommeer, Grevelingenmeer • Criteria for urban expansion (e.g. Almere, Kampen, Deventer, Zutphen, Dordrecht) • Robust design for restructuring and new urban development (sewerage, water storage) • Differentiation in safety standards + criteria for new urban developments • International agreements on managing river discharges • Planning protection for the National Ecological Network and Natura 2000 • Expansion of Natura 2000 and revision of the land acquisition policy for the National Ecological Network • International promotion of the Netherlands as the world's safest delta	• Strengthen spatial coherence of development in the delta – river areas – IJssel valley and IJsselmeer area • Adapt urban development to differentiated set of safety standards • Accelerating dyke reinforcement + building of overflow dykes and flood retention basins • Payment for agri-environmental buffer zones • Improve water quality of large water bodies
Links between urban development, infrastructure and quality of the living environment	• Introduce a national road pricing scheme (a kilometre charge differentiated by time, place and vehicle characteristics) • Operationalise goal for intensification of existing housing areas • More ambitious concentration policy • More greenery around the cities; integration with water management • Amelioration of noise nuisance along urban and provincial road network • Promote multiple land use • Retain green areas in and between cities	• Creating new water bodies
Links between agriculture, nature and landscape	• Planning protection for National Landscapes, urban buffer zones, peat meadows • Concentration of greenhouse horticulture, intensive livestock farming, tree nurseries, bulb cultivation • More control over planning of new business parks	• Payments for agricultural landscape management
Links between policy, implementation and enforcement	• Clear land-use planning and enforcement • Provisions in new Spatial Planning Act for matters of national importance • Converting Economic Structure Enhancing Fund into Sustainable Structure Enhancing Fund	• Use reformed Common Agricultural Policy to support agri-environmental and landscape stewardship schemes

- Existing policy aims offer sufficient opportunities to move towards more sustainable land use in the Netherlands. But such a move would rely on decisive implementation of these policies at local government level and proper recognition of EU policy. Clear plans and the enforcement of existing land-use designations are important prerequisites for a sustainable living environment. Under the new Spatial Planning Act, local structuring plans (*structuurvisies*) may be used to decide matters of national importance ('decentralise what you can, centralise what you must') and must be accompanied by a detailed implementation agenda. From a sustainability perspective, benefits that will accrue in the more distant future should weigh more heavily in political decision making.
- Compact and concentrated new development delivers considerable accessibility gains. These gains are greater under moderate growth in mobility and congestion than from the investments in the road network proposed in the Mobility Policy Document. Investments in infrastructure are more efficient when made in the following order: spatial policy (clustering and intensification) – road pricing – expansions of infrastructure.
- The Randstad shows definite signs of expansion, particularly in the *High Development Pressure* scenario. New urban areas run as a larger Randstad ring from the coastal zone to Rotterdam, the Brabant city ring, Nijmegen, and Arnhem, on through Amersfoort to Almere and Amsterdam.
- More compact land use works out cheaper, in the long run, than continuing the development of greenfield sites, because management and maintenance costs (e.g. infrastructure, sewerage) rise less. The higher costs of 'non-compact' building patterns are passed on to government and future generations.
- In the *Combination Map,* some of the greenhouse horticulture in the western Netherlands has been moved to the periphery of the Randstad. To alleviate the pressure on space in the west of the country, consideration may be given to creating greenhouse clusters elsewhere in the Netherlands.
- There are many opportunities for synergies with natural habitat development in the river areas (land reserved for widening the river IJssel and for 'bypasses' at Kampen and Dordrecht), in the IJsselmeer area and the eastern half of the Green Heart: inundation of the lowest lying land in areas reclaimed from lakes, limit flushing of the polder water system with fresh water from elsewhere (to remove intruding salt water) and development of peat mires.
- A clear land-use planning framework that can bring agricultural land prices under control is a necessary condition for the maintenance and continued development of land-based agriculture as steward of

the landscape (National Landscapes) and for effective buffer zones around Natura 2000 areas. Within these areas, financial compensation should be awarded in agri-environmental and landscape stewardship schemes. These may be financed from EU agricultural subsidies, National Landscapes policy and Natura 2000 policy. The reform of the EU Common Agricultural Policy (CAP) in 2013 is an essential, although uncertain, factor here. Co-funding from the Netherlands will also be required.

Policy actions for the short and long term

Specific policy actions are necessary to increase the harmonisation of sectoral policy themes and, thus, provide sustainability gains in the shorter and longer term. Table 2 summarises the potential policy actions described above.

No completely new policy vision is needed to carry out these actions. The National Spatial Strategy and various other policy documents already point largely in this direction. However, the National Spatial Strategy Monitor shows that in some cases there is no guarantee that goals will be achieved. Moreover, the underlying study indicates that more radical policies are needed, particularly for flood protection in the longer term and for international nature conservation commitments.

1 Introduction

1.1 Remit from the government

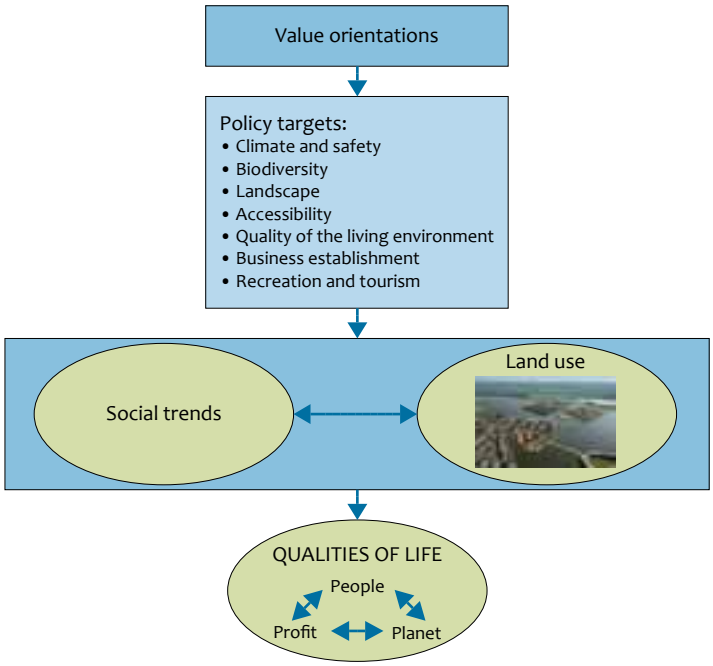
The Netherlands Environmental Assessment Agency (PBL, formerly MNP) published its first Sustainability Outlook in 2004. Although the method developed by the agency for studying the harmonisation of policy was valuable, it nevertheless excluded many specific leads. The government of the day therefore requested that the second Sustainability Outlook would analyse the connections between current policy goals, and propose concrete action strategies or policy options to further their harmonisation. These action strategies and policy options should provide a firm basis for current and future governments to develop more detailed policies towards 'sustainability'.

1.2 Objective

The objective of the second Sustainability Outlook is to show how policy decisions made *here and now* for *elsewhere and later* are connected, and to derive specific policy options and action strategies. To facilitate linkage with specific policy portfolios, the sustainability issues were clustered along two axes:

1. Spatial axis: some sustainability factors mainly concern the relationship between *here and elsewhere*, primarily these are global issues, such as energy and climate, poverty, and biodiversity.
2. Temporal axis: other factors concern the relationship between *nowand later*. These involve the sustainability of the Netherlands itself, particularly of the physical living environment, and therefore concern spatial development

Sustainability is about the quality of life and how to maintain that quality in the future.



and land use in the Netherlands. The key question to be answered is the degree to which spatial planning could contribute to sustainability; in other words, to maintaining the quality of the limited available physical space, as much as possible, for future generations. In practice, this means maximum coordination of national policies to create a more cohesive overall package. Similar to the global level, a balance must also be found between the economic, ecological and sociocultural dimensions.

1.3 Analytical framework

An analytical framework was used to determine how much spatial planning can contribute to sustainability, the dilemmas that may arise and the strategic actions that can be taken (Figure 1.1).

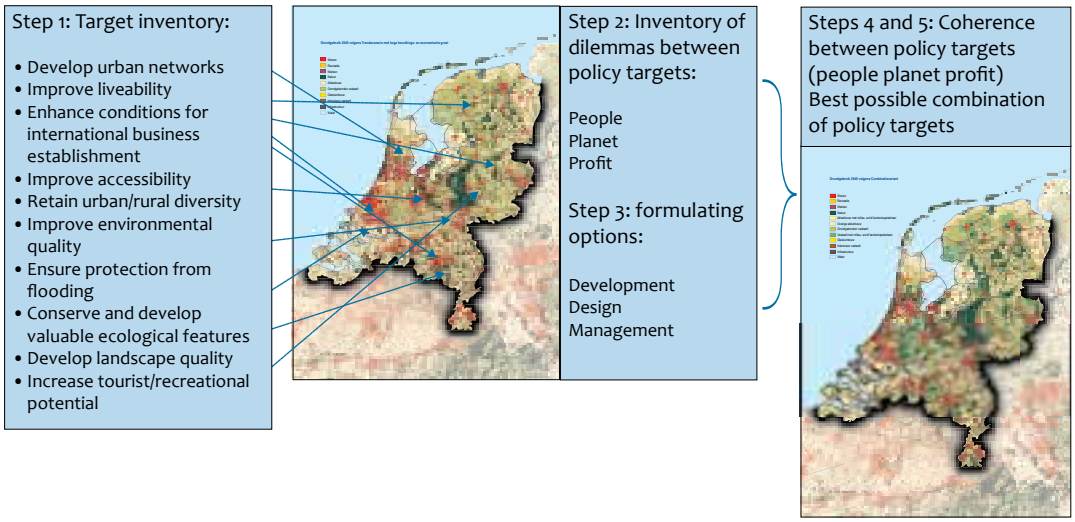
Sustainability is about quality of life and ways of maintaining that quality in the future. There are three basic qualities of life, or dimensions of sustainability: social, ecological and economic. The first Sustainability Outlook considered the relationship between value orientations, the qualities of life and policy goals. It described how the valuation and content of the qualities of life are influenced by the value orientations prevailing in society. It focused on the normative aspects of sustainability.

This second Sustainability Outlook interprets policy goals as the outcomes of decision-making processes which have been influenced by various value orientations. Value orientations are thus considered 'exogenous' variables and have not been investigated further. The end/means relationship was studied, with spatial planning being treated as a means to achieving a more sustainable society. Other means besides 'planning' are 'design' and 'management' (examples include nature conservation, urban restructuring and the introduction of road pricing).

In response to demand for the formulation of specific action strategies for sustainable (spatial) development, a study was made of the possible effects of sectoral and spatial planning policy on land use and thus on sustainable development. Spatial development in the Netherlands is determined partly by government policy, but decision-making on policy issues is fragmented, involving different departments and government authorities. Besides spatial planning policy, various sectoral policies are also an important factor in spatial development. Sectoral policies influence spatial development directly and indirectly via interventions in social trends. Examples of a direct and an indirect influence are the Multi-annual Programme for Infrastructure and Transport and immigration policy. Indirect influences are beyond the scope of this study.

Given the specific expertise at the Netherlands Environmental Assessment Agency, the main emphasis is on the 'planet' dimension. However, 'profit' policy (e.g. strengthening the Netherlands' international competitive position and improving accessibility) and 'people' policy (e.g. creating attractive residential areas) are included too. The issues at stake are:

People (sociocultural)
- quality of the living environment
- accessibility
- landscape
- vulnerability, protecting people and property against flooding
-



Steps towards robust spatial development for the long term, based on the policy tasks linked with a long-term time horizon.

Planet (ecological)
- biodiversity
- landscape
- adaptation to climate change

Profit (economic)
- accessibility
- condition for international business establishment
- maintenance costs and investment expenditure

1.4 Rationale

Effective sustainability policy begins with the restoration of coherence between time and space and a revaluation of ends and means. To tackle the major environmental issues such as climate change and biodiversity loss it is vital to take the long-term view – realising that certain impacts on nature and the environment are irreversible. Moreover, sustainable development has various spatial dimensions, each of which has its own set of problems and solutions.

Better overall solutions can be found if the problems are tackled together. It is important to establish coherence between:
- different scales;
- time horizons;
- the three Ps: people, planet and profit;
- ends and means;
- public and private;
- value orientations in policy.

This study seeks to identify opportunities to achieve this coherence by identifying the consequences of spatial development for sustainability under a baseline (structural trend) policy scenario and under alternative policy scenarios. The alternative scenarios are based on existing policy plus additional policy for achieving one aspect of sustainable development. By pinpointing the synergies (positive interaction between scenarios), the measures for one policy field can reinforce the measures for another. By highlighting spatial conflicts (negative interaction between scenarios), apparently 'clear cut' measures can be called into question. That could be seen as a problem, but the positive side is that possible alternative measures are often available that deliver more synergies and are therefore worth (further) consideration.

Robust long-term spatial development

The objectives of spatial development policy in the Netherlands have a varied time horizon and are more or less linked to specific physical features (altitude, type of soil, water system). Climate change and sea level rise operate on a time scale of centuries as does the conservation of internationally important habitats and the conservation and development of National Landscapes. Vulnerable areas from the perspective of long-term climate change and the development and conservation of internationally important habitats and ecosystems are determined largely by their physical locations in the Netherlands. Goals for accessibility, urban development and restructuring, improvement in the quality of the living environment and development of recreational amenities have a shorter time horizon and are also less dependent on topography. Moreover, the spatial structure of land use in the Netherlands cannot be reorganised; by far the largest part of the built-up area, for example, either already exists or is already planned (until 2010). The possibilities for restructuring land use in the Netherlands are therefore limited. History also has a major hand in determining the future spatial structure of the country.

Against the background of the layer approach to physical planning (National Spatial Strategy), the following long-term policy fields were chosen to ensure robust long-term spatial development: climate change, international nature and

nationally and internationally important landscapes. These concern those parts of the Netherlands that are of special importance in the long term. The existing land uses and the situation expected for 2040 can be compared, in order to identify opportunities to ensure the spatial development is more compatible with long-term sustainability issues. Lastly, a picture is given of the chances of achieving the goals for accessibility, urban development and the quality of the living environment (see Figure 1.2) while meeting the challenges presented by these long-term trends.

The following analyses were conducted to identify specific action strategies and policy options for sustainable development:

1. *Inventory of problems and goals*
   The starting point was current, adopted national policy. After researching the literature on the subject, an inventory was made of all problems related to land use and the associated policy goals that are connected with 'sustainability'. A choice was then made between solving the problems and achieving goals related to land use. Examples are climate change, nature quality and accessibility.
2. *Draw up a baseline scenario*
   Current social trends were tracked to see whether existing goals were being achieved and what policy objectives remained for the future. This is referred to as the *Baseline* scenario. This takes into account only policies that have been adopted by the Dutch or European Parliament and is therefore a policy neutral scenario. From this low-policy perspective, past trends and patterns of spatial development are translated into maps depicting future spatial structures.
3. *Develop spatial focuses*
   Future spatial developments were adjusted to obtain optimal land-use patterns for resolving one persistent (policy) problem. This new picture of the desired use of space per sector is referred to as a 'focus'. A focus thus reflects the (partial) orientation from the perspective of one social (departmental) issue, for example, housing, employment or transport. A focus is thus a spatial interpretation of a policy line. Each focus not only analyses the spatial consequences of policy but also the effects of the land use pattern and land management. Estimates of maintenance and management costs and of investment expenditure are necessary.
4. *Compare focuses with the Baseline scenario*
   Comparison of all combinations of the *Baseline* scenario with the focuses highlights the potential (spatial) conflicts and (spatial) synergies (opportunities). These insights form the starting point for investigating alternative action strategies and policy options.
5. *Optimisation*
   Lastly, the positive elements of the various focuses are combined as favourably as possible, so that ultimately a map is created in which the different focuses, and their land-use functions, are optimised for each of the three domains of *people, planet* and *profit*. This map gives a picture of the Netherlands that is more sustainable and future-proof, and provides starting points for designing specific strategic options.

1.5 Selection of policy themes and sustainability indicators

What policy goals have been formulated for sustainable (spatial) development? The answer contains a selection of existing policy goals that contribute to the sustainable development of the Netherlands. These goals are then used to devise a set of indicators that can be used to assess possible future changes in the physical environment.

Stress on more internal policy coherence

The previous government placed great emphasis on collaboration between departments and more coherence between different policy fields. Spatial and environmental policy in particular, as 'facet policies', cut across sectoral policies (e.g. agriculture, mobility, nature, housing). This is expressed in the strategic visions published by the previous government. National Spatial Strategy, for example, represents the policies of four government departments. It forms the basis for other policy documents, such as the Agenda for a Living Countryside, the Mobility Policy Document, the Room for the River programme, and the Peaks in the Delta economic strategy.

National Spatial Strategy interprets spatial policy along two lines. The first line involves the concept of basic quality. This is the minimum standard for the physical characteristics of the way in which 'quality of life' is interpreted in the Netherlands. This minimum standard is based on international agreements that apply to the Netherlands (e.g. EU environmental directives) and on the objectives laid down in environmental and sectoral policies. The National Spatial Strategy contains a 'goals tree'; a diagram showing the hierarchy of policy objectives, cause-effect relationships and the situation resulting from solving the stated problems. The first National Spatial Strategy Monitor (Snellen *et al.*, 2006) concluded that this goals tree is not yet complete. There appear to be no objectives in some cases, particularly for economic aspects, such as international competitiveness. Moreover, some aspects of basic quality conflict with others. It is, for example, difficult to reconcile an improvement in accessibility with the achievement of the EU's air quality targets. It is impossible to say whether the policies of provincial and municipal authorities comply with the concept of a basic quality standard, as this concept is not explicitly explained.

The second line taken by National Spatial Strategy concerns objectives for the national spatial structure. Under the slogan 'decentralise where possible, centralise where necessary', efforts will be made to create a situation in which matters are considered at the most appropriate level. Based on the recommendations of the Scientific Council for Government Policy, the strategy defines a range of national priorities that are translated into a national spatial structure. Central government is responsible for delivering on these priorities and has set objectives based on a layer approach to physical planning.

Closer links between short- and long-term developments

When the Upper House of the Dutch Parliament debated the National Spatial Strategy in 2005, there was an exhaustive discussion on how spatial economic policy could take account

The conditions within the Netherlands for international business establishment is one of the themes of sustainable land use planning.

of long-term trends, such as climate change, sea level rise, biodiversity, the future of Schiphol and the competitive position of the Randstad (motion by Wolter Lemstra). It was clear from the letter sent to the Dutch Lower House that there was room for improvement in the long-term orientation of government policy and in the harmonisation of its various elements. In collaboration with government departments, a strategic Agenda 2040 was drawn up for the Randstad which coordinated long-term developments, such as population growth, climate change, macroeconomic trends and transport. Current topics such as business locations, visual cluttering of the landscape, knowledge infrastructure, transport infrastructure and the marketing strategy for the Netherlands were also dealt with.

The intention to make policy more consistent is also expressed in the new Coalition Agreement, which divides the objectives for the government's term of office into six pillars. The decompartmentalisation of existing policies will be boosted by projects that cut across the institutional structure. Sustainable development is a major policy goal in the new Coalition Agreement. Environment Minster Jacqueline Cramer set out her top priorities in a letter to the Lower House of Parliament (Ministry of VROM, 2007). She emphasised that in the interests of sustainability the integration of spatial planning, nature and landscape policy, infrastructure planning and energy consumption must be promoted. These topics will be looked at in unison in this part of the Second Sustainability Outlook (apart from energy consumption, which is examined in depth in Part 1).

Important themes in sustainable spatial development and choice of indicators

The discussion on sustainable land use in the Netherlands can be divided into six themes:

- the consequences of climate change, especially for the Netherlands those of rising sea levels,;
- declining biodiversity;
- the conditions for international business establishment in the Netherlands;
- the related accessibility issues;
- quality of the urban living environment;
- landscape quality.

A national policy has been formulated for each of these themes and an indicator set has been developed based on these goals, drawing on existing indicator sets for sustainable spatial development. The main selection criteria include long-term focus, the link between people, planet and profit, dependence on spatial structure and land-use pattern, and of course the availability of data. The use of these selection criteria excludes several important indicators. A lack of data on social trends in particular means that this dimension of sustainable development is only partly included in the study. No mention is made of social exclusion, inequality, trends in

Indicator set for sustainable land use Table 1.1

Indicator	Explanation
Flood Defences	Risk of damages and human casualties
Adaptation to Climate Change	Space in river areas
Biodiversity	Biodiversity in nature areas
Accessibility	Social (financial) accessibility gains
Quality of the Living Environment	Greenery around the city and noise pollution. This operationalisation puts the emphasis on collective qualities. Only the quality regarding the need for private space has been considered
Residential Housing in Spacious and Green Surroundings	Possibilities for new housing in low densities, in attractive areas
International Business Establishment	Congestion, risk perception, growth of northern wing
Landscape Quality	Quality National Landscapes, value of perception and of recreation
Spatial Segregation	Spatial distribution of income brackets
Management costs	Estimation of management costs of the use of space, based on historical regional and specific land-use data
Transformation costs	Estimation of the transformation costs of transforming one type of land use into another

educational levels and sociocultural trends (all of which are pertinent to the major cities).

It is assumed that some of today's environmental problems will be resolved in the next fifteen years. For example, this study foresees that air quality in North West Europe will no longer fail to meet EU quality standards in the long term. Thanks to technological advances and new regulations, the Netherlands will eventually meet the EU standards for particulates and NO_2 emissions. From 2009, all new diesel cars sold in the EU will have to comply with the Euro 5 standard and be fitted with particle filters. Risks of exceeding the standard remain, however, particularly in the *High Development Pressure* scenario, (CPB/MNP/RPB, 2006). In addition, particulates pose a danger to health even if the air quality standard is not exceeded. However, it is not expected that there will be any appreciable difference in the concentration of particulates and NO_2 between the *Baseline* scenario and the focuses examined in this study.

Structure of the book

Chapter 2 describes the policy objectives for the future. Chapter 3 defines the Baseline scenario. This is based on:

- *demographic and economic trends, such as those projected by the Organisation for Economic Co-operation and Development (OECD) and the Dutch policy assessment agencies: the Netherlands Bureau for Economic Policy Analysis (CPB), the Netherlands Environmental Assessment Agency, and Netherlands Institute for Spatial Research (RPB) (CPB/MNP/RPB, 2006);*
- *rate of spatial change, derived from statistics on housing, employment, agriculture, nature and infrastructure;*
- *interpretation of adopted policy.*

Chapter 4 lists the policy options per policy objective, based on six focuses. Chapter 5 summarises the interrelationship between sectoral policy strategies, analysing from a spatial perspective where in the Netherlands there are synergies between interests and where there are conflicts between existing policies and existing goals.

In the second part of Chapter 5 the results from the study are placed in an administrative context and possible means by which central government can deal with synergies and conflicts are explored, given a changing administrative landscape.

This study has been an ambitious undertaking. Not all the aims have been achieved because there are still many gaps in the available data. In particular, the 'new' theme of the consequences of climate change for spatial planning in the Netherlands requires further research. A research agenda has therefore been included in the last section of Chapter 5.

2

What is in store for the Netherlands?

2.1 Introduction

This chapter describes the possible consequences of climate change and the structural trends in population, economy and policy. Past trends are extrapolated into the future.

2.2 What can the Netherlands expect?

Climate change

Global warming could have drastic consequences for the Netherlands, including a multiplicity of impacts on health, agriculture, tourism, transport, energy, nature and water management (MNP, 2005). Climate change and sea level rise may have more serious consequences elsewhere in Europe – and elsewhere in the world – than in the Netherlands. The main regions at risk from sea level rise are the coastal zones and delta areas of North America, India, Bangladesh and China. Large parts of Southern Europe, Africa and Asia are also vulnerable to increased desiccation and declining food production (Intergovernmental Panel on Climate Change, 2007).

Climate change will have the following effects on water in the Netherlands (MNP, 2005; KNMI, 2006):

- rising sea levels and greater peak river discharges in the winter months;
- increased groundwater seepage and salt-water intrusion;
- flooding and water damage in rural and urban areas;
- water depletion in rural areas and low river discharge in summer;
- deterioration in water quality due to a combination of higher water temperatures (greater chance of blue-green algal blooms) and water shortages.

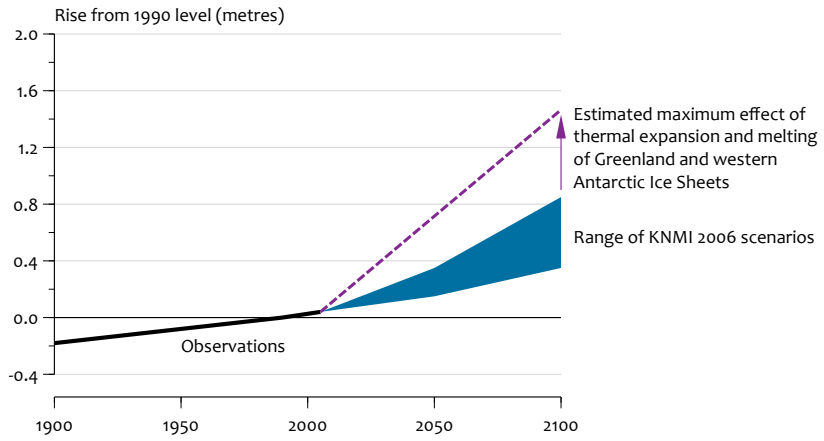
Climate change is expected to increase average precipitation and peak rainfall intensities in both summer and winter. Only in scenarios where a change in the pattern of north-west European airflows is predicted is a sharp decline in average precipitation in summer expected, leading to considerably drier summers than at present (KNMI, 2006). The climate in the Netherlands will therefore become both wetter (winter) and drier (summer) and because of the expected increase in peak rainfall intensities it will also become more unpredictable, with greater regional and local variation (KNMI, 2006). Current water management policy already takes account of the possible knock-on effects of climate change (see Section 2.3). A time horizon of around fifty years, or a hundred in the case of coastal defences, is generally used in these politics. Flooding from the sea and rivers will be most disruptive to the functioning of the Netherlands. In the long term, the sea level rise, and in this regard the potentially unrestricted run-off of river discharge, will determine the sustainability of the Netherlands.

Future sea level rise: wide margins of error

The rate at which sea levels rise depends on many different factors and is subject to many uncertainties. These uncertainties relate to the sensitivity of the climatic system as a whole, the melting ice sheets of Greenland and Western Antarctica, and future emissions of greenhouse gases.

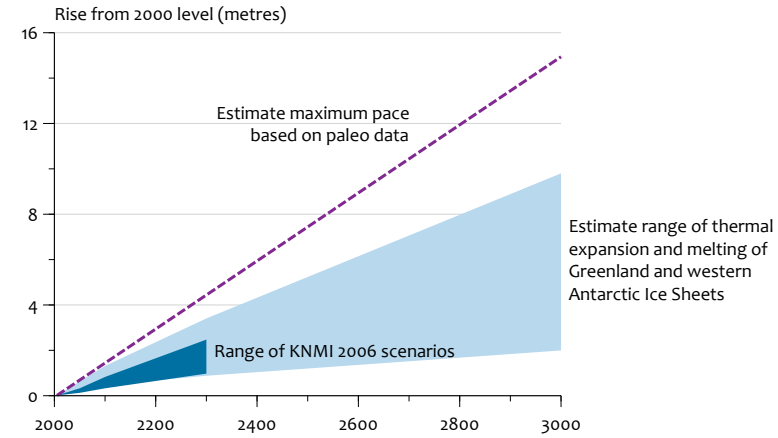
The sea level around the Dutch coast has risen by approximately 20 cm over the past century. Recently published scenarios (KNMI, 2006) predicted with 80% certainty a 35 to 85 cm rise in sea level in the 21st century (Figure 2.1). Because of the delayed effects inherent in the climate-ocean system, sea levels will continue to rise for a long time after 2100. The scenario by the Royal Netherlands Meteorological Institute projects a sea level rise of around 1 to 2.5 metres by 2300 (Figure 2.2). The estimate of the maximum contribution from Greenland and Western Antarctica to sea level rise, based on the Intergovernmental Panel on Climate Change (IPCC) 2007 reports, is somewhat higher than the extrapolation in the 2006 climate scenarios by the KNMI. In the scenario based on the IPCC, sea levels could rise by some 10 metres over many centuries. There are also geological discoveries that indicate that, in the past, a rise in temperature of more than 2 to 2.5 °C in the northern hemisphere coincided with a rise in sea level of some 4 to 6 metres. The rise in sea level per century then averages 1.5 metres. In Figure 2.2 this is taken to be the estimated maximum sea level rise. According to the climate scenarios, temperatures in the northern hemisphere could be 2 to 2.5 °C higher by around 2050. Recent scientific publications indicate that the ice sheets in Greenland and Western Antarctica may melt more rapidly than the current models suggest. Satellite photographs show that the rise in sea level has sped up since 1993 (IPCC, 2007).

Rise in sea level by 2100 **Figure 2.1**



The Royal Netherlands Meteorological Institute scenarios predict sea level rises of up to 85cm by 2100. There is an unknown but slight chance that the rise will accelerate in the second half of the century if the Greenland or Western Antarctic Ice Sheets melt more quickly or break up.

Rise in sea level by the year 3000 **Figure 2.2**



Depending on the melting ice sheets in Greenland and Western Antarctica, sea levels may rise by 2 to 10 metres in the longer term (KNMI/MNP calculation based on IPCC 2007). Extrapolating from the KNMI scenarios to 2300 provides a rise of 1 to 2.5 metres.

Assuming a six metre rise in the sea level is manageable for the Netherlands, a sharp acceleration in the rate of rise (1 to 1.5 metres per century) would put the future of the Netherlands at risk within four to six centuries.

Based on information currently available, the Netherlands Environmental Assessment Agency assumes the following:

- The KNMI's estimate of a 35 to 85cm rise in sea level per century is the most plausible margin for the expected rise this century. It takes account of a temperature-dependent acceleration in the melting of the ice caps and a relatively sharp rise in temperature in the northern hemisphere.
- It is still very uncertain whether it will be possible within the foreseeable future to realise the 50 to 60% global reduction in emissions required to stabilise the temperature rise at 2 °C. If this does prove impossible, then the potential sea level rise is more likely to be at the top end of the KNMI's range than at the bottom end.
- Given the great uncertainties and the unknown, but thought to be slight, chance of a sharp acceleration in the melting and disintegration of the ice sheets in Greenland and Antarctica over the next hundred years, a maximum rise in the sea level of 1.5 metres is regarded as the *worst-case* scenario.

Storm surges

Besides the gradual rise in sea level, the effects of changes in storm surges in the North Sea on the flood defences also have to be reckoned with. Each degree rise in temperature causes higher wind speeds and increases the destructive force of storms (IPCC, 2007). Existing defences in the provinces of North Holland and South Holland are based on a storm surge

Climate change results in higher peak discharges into the major rivers.

that is likely to occur once every 10,000 years, with a sea level of +5 metres Amsterdam Ordnance Datum (NAP). In the event of higher temperatures, such a storm surge could result in higher water levels than currently accounted for. As with the problem of the rapidly melting ice sheets, there are, however, still great uncertainties about what to expect regarding the frequency of storms, wind strength and direction. The number of storms in the North Sea has diminished over the past forty years, but it is not clear how much this drop has to do with the rise in temperature. Further research, therefore, is required into the effect of climate change on storms and the consequences for coastal defences (see also KNMI, 2006).

What problems lie ahead for the Netherlands?

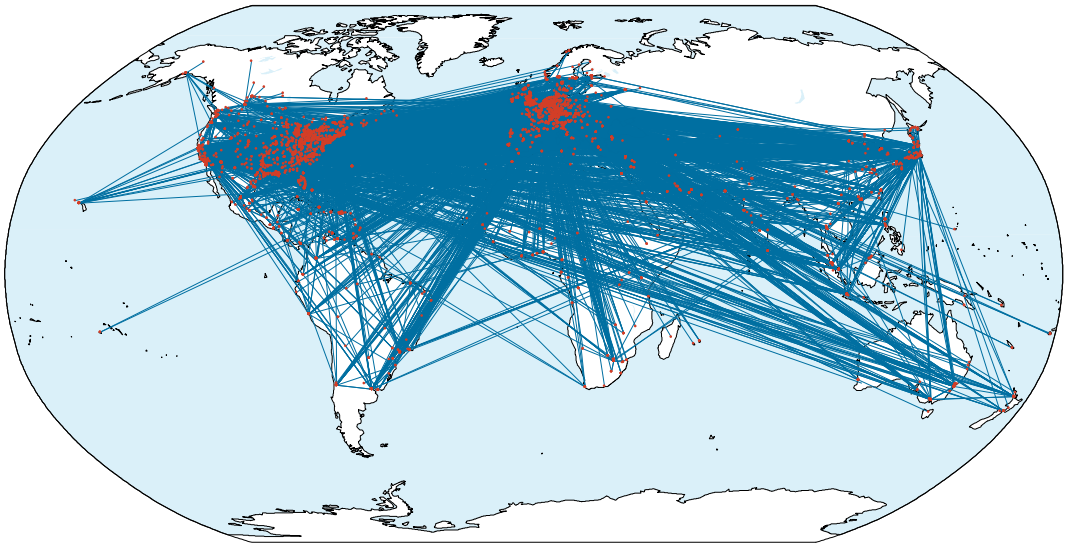
Sea flooding
The sea level rise indicated in the KNMI scenarios need not lead to severe flooding (Klijn *et al*., 2007; Stive, 2007). Current engineering techniques are effective enough to ensure good coastal defences (see also Adviescommissie Financiering Primaire Waterkeringen, 2006). If, however, the rate at which sea levels are rising should increase to 1.5 metres per century (owing to the accelerated melting of the ice sheets), considerable efforts will be needed to constantly adapt the dykes ('hard' defences) and dunes ('soft' defences). Additional reinforcement may be necessary if further research would show that – as a consequence of higher temperatures – heavier storms can be expected in the North Sea.

River discharges
As the sea level rises further, the free outflow from the rivers and the regional water systems will diminish, the water level in the lower reaches of the major rivers will rise, and tidal influence and salt-water intrusion will encroach further inland. Particularly, in the event of lower river discharges in the summer, salt-water intrusion from the sea could extend far inland. If the sea level rises by two metres, the tidal influence will reach Tiel, and if it rises by six metres it will almost reach Lobith, on the German border (Klijn *et al*., 2007). Higher water levels and the loss of gradient (gravity discharge) will require the dykes to be raised in an ever larger area in the south-west of the Netherlands, the main river floodplains and the IJsselmeer. The strategy of widening rivers and lowering river forelands is no solution to higher water levels in areas affected by the sea.

Rotterdam and Dordrecht will be particularly vulnerable in the event of further rises in the sea level. Eventually, other solutions may have to be found for main and peak discharges from the Rhine.

Significant options that provide scope for solutions are the rerouting of river discharges to the Zeeland delta and/or to the river IJssel and the IJsselmeer, and the opportunities for water storage in these areas.

Increasing groundwater seepage
In many areas in the western Netherlands and the river areas, the top strata are thick enough to withstand the upward pressure from groundwater. If this layer were not



Relations between the top 100 multinationals: the hubs are on the east coast of the United States, in Japan and western Europe (Wall and Van der Knaap, 2007).

present, groundwater seepage, spontaneous blow wells (upward flow of water under pressure) and cracks may appear on the surface. In the polders, the lowest lying parts of the Netherlands, the top strata are already fractured. The Haarlemmermeer is an example of this, where the digging of watercourses during new housing construction damaged the top stratum to such an extent that water welled up to the surface.

A rise in sea level does not seem to add much to the risk of a spontaneous fracture of the top strata in the low-lying polders. However, if the water table continues to rise along with the sea level, the risks will clearly intensify along the rivers and in the IJsselmeer area (Klijn *et al.,* 2007). Moreover, in the peat districts any further subsidence also will increase the chances of this happening (Ministry of VenW, 2006). Because there has been little or no systematic research, it is difficult to judge the actual risks.

Sea level rise will increase groundwater seepage, particularly along the landward edge of the coastal dunes, on the Wadden Islands, in the estuaries of the major rivers, in the IJsselmeer area and in Zeeland. But even in the event of very high rises in sea level, the expected increase in rainfall will probably be more important for the dimensioning of the drainage system of the polders than an increase in groundwater seepage would be (Klijn *et al.,* 2007). The main regions that will have to cope with considerably higher salinity are the province of Zeeland, some parts of province of North Holland, the Wadden Islands and the Friesian coast, and low-lying polders (Haarlemmermeer polder) near the west coast. Salt-sensitive crops and certain habitats will come under further pressure in those areas.

Social developments

Globalisation

The trends of globalisation and individualisation will continue for some decades. People and businesses will relocate to other countries with increasing ease. This is one reason why social and cultural changes are becoming increasingly difficult to predict. These changes are brought about by tastes, preferences and consumer behaviour. Consumers, to a large extent, govern the market, and producers respond by adapting their production techniques. Fashion companies, for instance, launch completely new lines of clothing several times each season in order to meet short-lived consumer demand, made possible by new technological developments in production and logistics. Goods are now often produced in low-wage countries (Asia) and this has significantly increased freight traffic. The consequences of globalisation are also evident in land use (see: Sassen, 1991, 1994; Castells, 1996; Van der Cammen and De Klerk, 2003; Nidi, 2006; Wall and Van der Knaap, 2007). The way cities develop is influenced not only by local and national developments, but especially by what is happening in other cities. The drivers of economic growth are to be found in specific places, each of which plays its own part in the global economy (Figure 2.3). The cities of the Netherlands are not on a par with global cities, such as London, New York and Tokyo, although Amsterdam does play a role in specific global economic sectors (international business services). This region of the Netherlands, therefore, experiences much higher economic growth than the rest of the country (CPB/MNP/RPB, 2006).

The major cities of the Netherlands have grown into urban agglomerations and polycentric networks on a much greater scale. The National Spatial Strategy mentions six national urban networks, of which the Randstad is by far the biggest. Each of these urban networks has its own specialisation.

Processes of social change in cities are one of the least understood elements of urban sociology. 'In the post-war years, it looked as if the city had had its day.... In the 1980s and 1990s, the influx of ethnic minorities brought the cities more problems than benefits.... Now the city is considered 'the place to be' for going out.' (RPB, 2006). It should be noted here that there are wide differences between urban agglomerations. Some cities are faced with a radical income shortfall compared with surrounding regions, but most are catching up.

Individualisation

Besides globalisation, ongoing individualisation influences trends in society. Schnabel (SCP, 2006) defines individualisation as the development that makes individuals more independent of their fellow citizens and institutions and provides them with ever more freedom of choice about their own actions. Individualisation is facilitated by factors such as increasing affluence, rising educational levels and the declining influence of traditional institutions and power structures. One of the consequences of individualisation is that not everybody shares in the increased affluence. The number of low-income households has grown from just under 580,000 in 2002 to an estimated 680,000 plus in 2005. That is equal to an increase from 8.8 to 10.5% of all households. Thanks to better pension provisions, the number of senior citizens that live below the poverty line has declined. According to the Poverty Monitor, spatial segregation increased in the period from 1994 to 2002: low-income households are concentrated in certain residential areas. This phenomenon is more evident in smaller than in larger municipalities. However, segregation also increased in Rotterdam, The Hague and Utrecht between 1994 and 2002 (it stayed virtually the same in Amsterdam). Selective migration was a major reason for this: better-off families left the poorer districts and were frequently replaced by low-income households (SCP, 2006).

The Netherlands Institute for Social Research (SCP) concluded that 'the concentration of poor households in a particular residential area can, in theory, perpetuate an unwelcome situation if a 'culture of poverty' is created, or where districts with an unbalanced composition (population and housing stock) offer little opportunity to escape the poverty trap (weak labour market, limited social networks, lack of good schools and childcare facilities).'

As a result of individualisation and globalisation:

- the composition of households has changed dramatically (more one-person households);
- participation of women on the labour market has increased;
- the role of institutions, such as church, district councils, clubs and societies, has become much less important;
- mobility has increased sharply;
- the spatial segregation of socio-economic groups has increased.

This study assumes that individualisation and globalisation will continue.

Demographic trends and economic growth

Global demographic trends and economic growth have been derived from the OECD baseline scenario (OECD, 2006a), as they have been for the study *The Netherlands in a Sustainable World*, by the Netherlands Environmental Assessment Agency. These trends have been used for compiling a *Baseline* scenario. The *Transatlantic Market* scenario of the study 'Welfare, Prosperity and Quality of the Living Environment' (CPB/MNP/RPB, 2006) was used for demographic trends and economic growth in the Netherlands. *Transatlantic Market* takes the middle road on demographic trends and economic growth and is therefore most in line with the OECD baseline scenario. This does not, however, mean that the *Baseline* scenario in this study and the *Transatlantic Market* scenario are exactly the same. The scenarios are not necessarily identical, particularly regarding the presumed international context national policies. The differences are mainly in economic policy, about which this study makes no explicit assumptions.

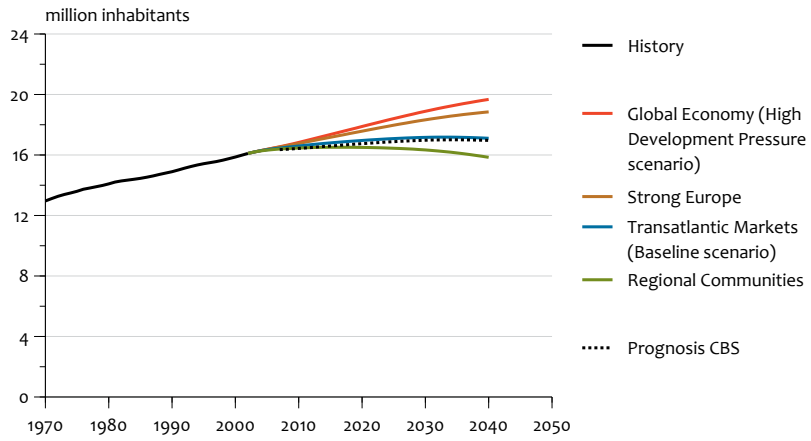
Of course, other developments than those reflected in the *Baseline* scenario are possible in the Netherlands, towards both greater and lower development pressures on land. In the OECD baseline scenario it is also possible that trends in the Netherlands may differ from average European trends. An upward deviation is the most logical, because in the last twenty years it has become evident that it is in the (dynamic) urbanised areas of Europe that economic and demographic growth occurs. A *High Development Pressure* scenario has therefore been formulated as well. The values for the demographic trends and economic growth in this *High Development Pressure* scenario are based on the *Global Economy* scenario in the study 'Welfare, Prosperity and Quality of the Living Environment'. This scenario assumes a large influx of economic migrants into the Netherlands. The decision to open the Dutch borders to economic migrants from the new Member States of the European Union earlier than the other Member States, makes the *High Development Pressure* scenario more plausible. Given these demographic trends, a housing market model (ABF, 2006) was used to simulate trends in the qualitative demand and the spatial characteristics of trends in the housing market (ABF, 2006). (The *High Development Pressure* scenario in this study is thus a different scenario from the one with the same name mentioned in the National Spatial Strategy.)

The *High Development Pressure* scenario factors in the same structural trends as the *Baseline* scenario for many drivers, such as technology and international relations. The following chapter takes an indepth look at the uncertainties and possible trend breaks.

Demographic trends and the housing market

Population growth is determined by migration, mortality and birth rates. The most uncertain demographic factor is migration. Figure 2.4 shows that the structural trend, as forecast by Statistics Netherlands (CBS), is reasonably in line with the *Transatlantic Market* scenario in the study 'Welfare, Prosperity and Quality of the Living Environment'. In the chosen scenario, the population grows by around one million, by 2040. Immigration accounts for 80% of this increase and natural growth for the remainder. The *Global Economy* scenario has the highest demographic growth – to almost 20

Population **Figure 2.4**



Population growth in the Netherlands according to the four scenarios in the study 'Welfare, Prosperity and Quality of the Living Environment' and the population projection by Statistics Netherlands.

Forecast growth in population and number of households from 2002 to 2040 (CPB/MNP/RPB, 2006) **Table 2.1**

	Baseline scenario			High Development Pressure scenario	
	2002	2020	2040	2020	2040
Population (number)	16,1	17,0	17,2	18,0	19,7
Number of households	7,0	8,0	8,5	8,6	10,0

Forecast demand for new housing in thousands per year (CPB/MNP/RPB, 2006). **Table 2.2**

	Baseline scenario		High Development Pressure scenario	
	02/20	20/40	02/20	20/40
Randstad	39	28	60	54
Transition zone	22	16	33	29
Rest of the Netherlands	17	12	28	23
Total the Netherlands	78	54	121	106

million – due mainly to increased migration both from within and outside the EU 27. This migration is both the cause and the consequence of higher economic growth.

The decrease in family sizes means that the number of households will continue to grow faster than the population (Table 2.1). The regional population forecast by Statistics Netherlands and the Netherlands Institute for Spatial Research (CBS and RPB, 2006) suggested that the number of one-person households will increase to 3.3 million over the next fifteen years. Half of this figure is due to ageing of the population: many of those aged over sixty-five will continue to live alone after their partner dies. Another reason for the growth in one-person households is divorce (or separation). Once divorced, people tend to live on their own, either temporarily or permanently. People increasingly live alone, particularly in the big cities

Therefore, there will be considerable demand for housing and for housing development sites in the years ahead (Table 2.2). This relates more to changes in the composition of households and changing housing requirements than to population growth. Assuming that migration flows slow down and second-home ownership does not increase, the need for expansion of the housing market will decline after 2020. In the *High Development Pressure* scenario the inflow of foreign migrants feeds the need for expansion.

Economic growth

The economic growth forecast in the *Baseline* scenario is somewhat lower than historical economic growth from 1971 to 2000, but in the *High Development Pressure* scenario it is actually slightly higher (Table 2.3). Although the difference in economic growth between the two scenarios seems small (1.7% against 2.1%), combined with the higher population the size of the Dutch economy in the *High Development Pressure* scenario is considerably larger. Gross domestic product (GDP) will be over 2.7 times larger in 2040 than it was in 2000. In the *Baseline* scenario it is 2.1 times larger.

The total area of industrial estates and business parks has increased sharply in recent decades. The structural trend also suggests a sharp increase from 2003 to 2020 (Figure 2.5). The spatial distribution of these sites is based on regional

Forecast economic growth (% change per year) Table 2.3

	Historic 1971-2001	Baseline scenario 2002-2040	High Development Pressure scenario 2002-2040
Population	0,7	0,2	0,5
Labour force	1,1	0,0	0,4
Employment	0,9	0,0	0,4
Labour productivity	1,9	1,9	2,1
GDP (market prices)	2,6	1,9	2,6
GDP per capita	1,9	1,7	2,1

population growth. It is assumed that in regions where the population is growing rapidly, demand for services, such as commerce and health care, will also rise. In addition, population growth adds to the labour market and that makes a region more attractive as a place to set up a new business. There are indications that after 2020 there will be surplus industrial and commercial land. Some of these sites will be redeveloped for housing, but such transformations will not be on a large scale.

2.3 Baseline policy

In order to construct spatial representations based on the trends in the *Baseline* scenario, assumptions also need to be made about spatial (and other) policy. Spatial policy consists on the one hand of outline strategies and plans, particularly, by central government, and on the other hand of many policy decisions on each land-use function, sectoral policy and local authority policies. Previous research shows that the gap between vision and implementation has widened (Hajer, 2006). The future success of existing policy, therefore, has been assessed by extrapolating structural trends.

Housing

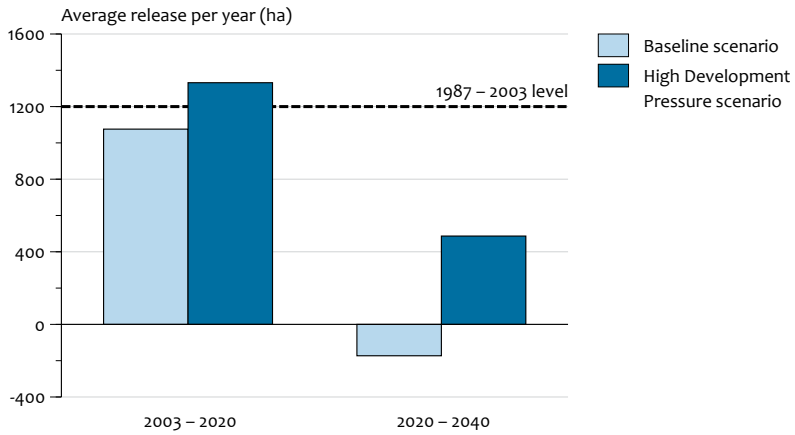
Spatial demand for housing has been divided into three categories 1) Central Urban and Inner City, 2) Green Urban and Urban Village and 3) Rural Living (Borsboom *et al.,* 2005). The underlying principle is 'freedom of choice within social limits', as described in the policy document entitled *What People Want, Where People Live*, which means that policy is geared to the creation of residential areas for which there is existing and future demand (based on the housing survey). When allocating land for housing, particular account is taken of people's housing preferences and the way in which local authorities and property developers respond to those preferences. National and provincial policies are also taken into account. Specifically, the following basic principles apply:

- Firm commitments in regional plans are implemented. Locations for housing, employment and greenhouse horticulture that are highly likely to have been developed by about 2010 were identified in consultation with all the provincial councils. Not all the provinces were able to take 2010 as the limit. For some it is 2015 and for others 2020.
- The urban compaction target in the National Spatial Strategy is achieved. This means that the 'concentration percentage' (the proportion of all homes in a province that are built in the designated 'concentration areas') remains at least the same in each province. The concentration percentage remained almost the same between 2000 and 2004 (Snellen *et al.*, 2006). It is no great challenge to maintain the same concentration percentage in the period to 2040 given the size of the concentration areas in relation to the existing urban area (a large part of the Randstad is designated a concentration area) and the house building targets.
- The aim of building 40% of all new homes on brownfield sites will not be achieved. In recent years (2000–2004), approximately half of the net additions to the housing stock (excluding demolition and replacement new housing) and approximately a third of the increase in the workforce were in the existing urban area. The housing target was therefore met in those years, mainly because all the major urban extensions were within the designated boundaries for the built-up area (Snellen *et al.*, 2006). The degree of concentration is expected to decline in the years ahead because new development will have to be allocated to the more difficult and more expensive sites. The historical trend in the period from 1995 to 2003 is extrapolated in the *Baseline* scenario and it is assumed that 13% of net additions to the housing stock between 2002 and 2030 will be in the existing built-up area, the majority before 2010 (Groenemeijer, 2006).
- The existing restrictive policy is partly successful. Little or no building is permitted in several areas: Natura 2000 sites, areas designated under the Nature Conservation Act, National Ecological Network buffer zones, Randstad Green Structure projects, National Landscapes, areas designated in the Room for the River programme, coastal foundations, groundwater protection areas, peat meadow areas and high-risk areas for external protection and noise contours. It is assumed that nature areas are the least likely to be developed, provided they are Natura 2000 sites.

It is evident that in practice, policy has not always been promptly and fully implemented in recent years:

- In recent years, the number of buildings in the reserved areas along the major rivers, such as the winter bed and possible water retention areas, still increased. Built-up areas in flood-prone areas, such as the lowest lying polders and peat meadows, are expanding at the same rate as in the rest of the Netherlands (Snellen *et al.,* 2006). Until recently, the assessment of the impact of building on water management had no effect on the choice of location for new development (Werkgroep Evaluatie Watertoets, 2006).
- In past years, there has been somewhat less building in the provisionally designated National Landscapes than in the rest of the Netherlands (Snellen *et al.*, 2006). This is why nature policy categories, buffer zones, and to a lesser

Net release of industrial, business and harbour land **Figure 2.5**



Average annual net release of industrial, business and harbour land in two scenarios.

extent the National Landscapes, have been included as a restrictive factor. Based on the assumption that water will be an increasingly important issue in the years ahead, it is also included as a restrictive factor, but weighing less heavily than in Natura 2000.

Employment

Roughly the same policy is assumed for employment as for housing.

- The industrial and business locations in 2010, included in the scenario, are those for which the provinces have firm plans, and which have been included in the New Map of the Netherlands.
- In line with the National Spatial Strategy, some large-scale industrial areas and business parks are under development: Maasvlakte 2, Venlo economic core area and Moerdijkse Hoek.
- As in the case of housing, the urban compaction policy for concentrating employment locations in the National Spatial Strategy is achieved; that is, the concentration percentages for jobs and employment locations remain the same. The concentration of jobs and businesses did not change appreciably between 2000 and 2004 (Snellen *et al.*, 2006).
- A quarter of all industrial areas and business parks, a third of this total land area, is currently obsolete. Restructuring is either underway or is planned for half of the industrial areas and business parks, but in just a small percentage of the total area, restructuring has been completed since 1990 (Snellen *et al.*, 2006). The allocations for new industrial areas and business parks in the National Spatial Strategy are an implicit choice for continuing this trend. Until 2020, the growth in new industrial and business locations will greatly exceed the actual increase in demand (demand that arises from growth in employment) (Olden Louw, 2005; Ministry of VROM, 2006).
- Snellen *et al.* (2006) show that, between 2000 and 2004, jobs and business parks at locations close to motorway slip roads increased, proportionally, while the proportion at locations with access to reliable public transport decreased. The *Baseline* scenario assumes that the factors that attracted businesses in the past (easy access to the main road network and proximity to urban areas) will also apply in future.

Agriculture

Land-based agriculture (crop and livestock farming) is the 'balancing item in the budget'. This land use is maintained until the land is needed for other uses, such as housing, employment, infrastructure or nature conservation. Changes in the EU's Common Agricultural Policy will probably have only a limited effect on the amount of land in agricultural use (Stolwijk and Westhoek, 2007). However, the liberalisation of the trade in agricultural products (combined with the abolition of milk quotas) may well lead to a sharper decline in crop farming and an increase in dairy farming in the Netherlands, increasing livestock density (CPB/MNP/RPB, 2006). The move towards bigger farms will also speed up (De Bont *et al.*, 2007), which may impair landscape quality. The *Baseline* scenario does not link income supplements to public amenities such as nature and landscape. Such a link may well benefit landscape quality and ease agricultural pressure on the environment, but it will have little effect on the size of the agricultural area.

The provinces have designated areas for the development of greenhouse horticulture in their regional plans. The *Baseline* scenario assumes that greenhouse horticulture will expand mainly in those areas, but that scattered development will continue outside those areas.

The plans to cluster intensive livestock farming have been realised to some extent in recent years (Snellen *et al.*, 2006). This trend is expected to continue, with intensive livestock farming in the sandy soil areas being concentrated in the agricultural development areas, with opportunities to develop in the mixed land-use areas, but not disappearing entirely from extensive farming areas.

Nature

It is assumed that the National Ecological Network will be largely realised by 2020. The policy goal is to complete the

Land reserved for the Randstad Green Structure **Table 2.4**

Ha	Targets	Completed 2004	Completed 2000	Outstanding in 2000
North Holland	6.506	3766	3.305	3.201
South Holland	7.968	2.365	2.076	5.892
Utrecht	1.282	181	159	1.123
Gelderland	512	0	0	512
North Brabant	115	0	0	115
Total	16.383	6.312	5.540	10.843

National Ecological Network by 2018 through acquisition of land and signing management agreements. Between 2000 and 2004, the built-up area within the National Ecological Network increased by a few per cent (Snellen *et al.*, 2006). It is, therefore, expected that some sites in the National Ecological Network and other nature conservation areas will be built on. The greatest degree of protection is assumed for areas that are both part of the National Ecological Network and Natura 2000 sites (see Housing). No additional land for nature conservation is foreseen beyond 2020.

The land requirement for nature conservation includes large recreational green areas around the major cities. This requirement is based on the targets in the Agenda for a Living Countryside – Multi-annual Programme. These combine the targets of Randstad Green Structure (RGS) in the National Structure Plan for the Rural Areas and the targets for strategic and regional green space referred to in the Update of the Supplement to the Fourth National Policy Document on Spatial Planning (Vinac). In total, these combined targets amount to 16,383 hectares to be achieved by 2010 (Vinac) and 2013 (RGS). These targets were reconfirmed at the end of 2004 in agreements between the government, the provincial councils and some large municipalities (Table 2.4).

The National Landscapes retain their character as much as possible. This means that (with the exception of existing plans), there will be no major building activities in these areas.

Mobility

The *Baseline* scenario assumes that the increases in the capacity of the road network and other efficiency measures in the Multi-annual Programme for Infrastructure and Transport (MIT 2005) will be taken, along with the construction programme in the Mobility Policy Document (see Figure 2.6). This package will lead to a 16% increase in road use. In the case of the main road network this principally means widening existing roads (an addition of about 2,900 km of new lanes), while in the remainder of the road system most increases are in the form of new connections (addition of approximately 800 km). Because the trend variant is a policy neutral variant, no further expansion of the road system is foreseen for 2020 to 2040. The study 'Welfare, Prosperity and Quality of the Living Environment', however, does assume capacity increases after 2020.

The package of qualitative improvements to public transport and additions to infrastructure contained in the Multi-annual Programme for Infrastructure and Transport and the Mobility Policy Document are expected to be implemented in the period up to 2020. This includes the building of two railway lines – the southern high-speed rail link and the Hanze line – and improvements to regional transport. No qualitative improvements are foreseen after 2020, but it is expected that public transport will be able to fully absorb any growth if existing levels of service and timetables are maintained.

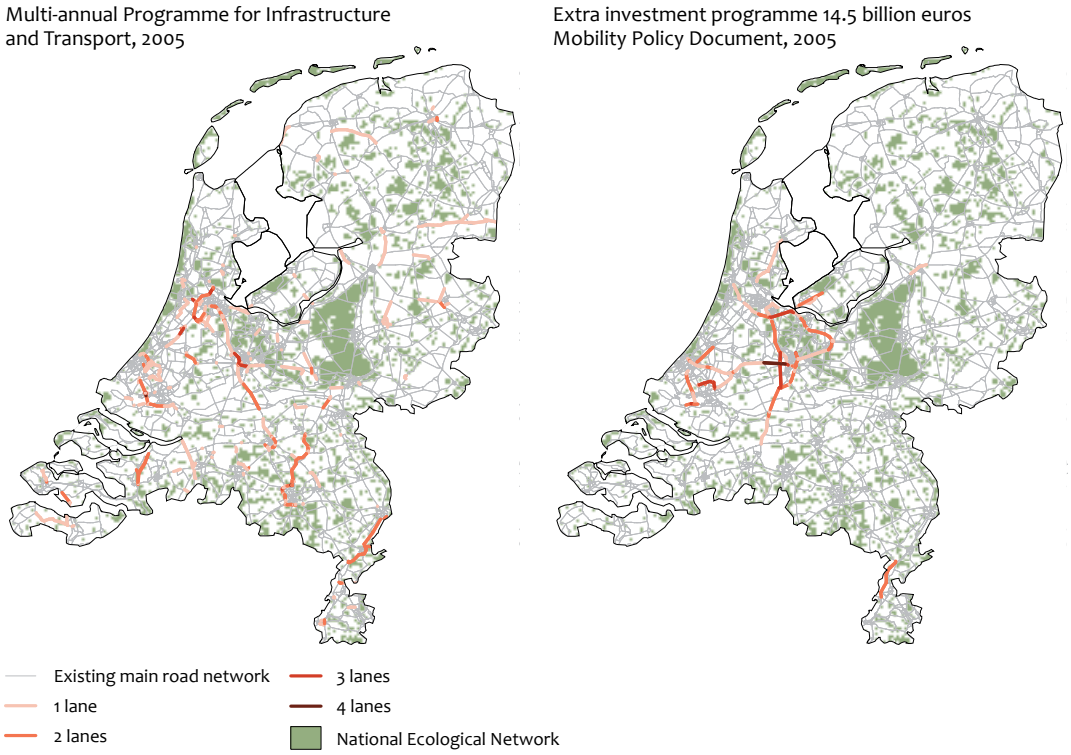
Water and safety

The basic principle of the *Baseline* scenario is that the protection levels provided by the primary flood defences are maintained, as laid down by the Flood Defence Act (Staatsblad, 1996). The primary flood defences run along the coast, in the IJsselmeer area and along the major rivers and have a total length of around 3,600 km. The safety standards have a long history and are based on recommendations made in 1960 by the Delta Commission (set up after the disastrous floods in 1953) and in 1977 (Commissie Rivierdijken, 1977). The results of the latest survey of flood defences indicate that 46% are up to standard, 19% are below standard and insufficient information is available to assess the remaining 35% (Ministry of VenW, 2006).

The government is planning to take several steps before 2020 to ensure that the primary flood defences comply with legal standards: 2.2 billion euros is budgeted for the implementation of the Room for the River programme in the period to 2015, 740 million euros for reinforcing the weak links along the coast, 1 billion euros for reinforcing the embankments along the river Meuse, 1 billion euros to improve the dykes in Zeeland and – following the survey of the dykes in 2006 – 1.6 billion euros to bring the dykes up to standard by 2020 (of which 420 million euros has been earmarked in the 2007 national budget). Assuming that a similar number of the dykes on which there is no information are also substandard, an extra 1 billion euros or so will be needed to bring these up to standard by 2020. In addition, some 40 million euros will be spent, annually, on sand replenishment along the coast. Total expenditure by 2020, therefore, is estimated at approximately 8 billion euros.

The *Baseline* scenario is based on investments and objectives to ensure compliance with the Flood Defence Act, by 2020, and to take into account anticipated consequences of climate change where necessary. In the *Baseline* scenario, safety standards under the Flood Defence Act will continue to be met between 2020 and 2040, as well.

Current water policy already takes account of the possible consequences of climate change. This involves not only technical measures, but also landscape and land-use measures to ensure a more secure and robust water system (Ministry of VenW, 2000a). Most policy documents and projects (e.g. Weak Links, Room for the River programme, National Administrative Agreement on Water, Flood



Investment locations in the Multi-annual Programme for Infrastructure and Transport (MIT) 2005 and the extrainvestment programme in the Mobility Policy Document.

Protection Programme) assume the KNMI's middle scenario, prepared for the study by the Advisory Committee on Water Management in the 21st Century (Commissie Waterbeheer 21e eeuw, 2000), which looks 50 to 100 years ahead. For the coast, a low sea level rise scenario (20 cm/century) is used for short-term decisions (5 years), a middle scenario (60 cm/century) for longer-term decisions (50–100 years), and a high scenario (85 cm/century) in the case of reserving land for measures in the very long term (time horizon of 200 years) (Ministry of VenW, 2000b).

Current developments in water policy are not included in the *baseline* scenario. In 2006, the Ministry of Transport, Public Works and Water Management launched the policy study 'Water Management in the 21st Century'. The approach is based on a risk management, looking both at how to control the flood risks and how to manage the consequences of flooding. Pertinent questions to be addressed are how to translate the social changes of the past decades into appropriate protection levels and what measures would be effective in limiting impacts (compartmentalisation, adapted buildings, location of development, protection of vital infrastructure). The process is intended to culminate in a new policy document on flood defences in 2008. In addition, international harmonisation of safety strategies and measures in river catchment areas are very important to the Netherlands. New development and other interventions in the landscape, as well as safety measures in the upper reaches of the rivers Ems, Rhine, Meuse and Westerschelde, have a major impact on the amount of water flowing through the Netherlands. The EU Floods Directive sets out the arrangements and procedures for coordination at catchment level. Negotiations on these issues ended in 2007 and plans for flood risk management have to be drawn up for each catchment area by 2015.

2.4 Spatial modelling

The planned land requirements, current land use and policies as described above, were used to compile a picture of the possible future spatial structure of the Netherlands, for various years. This was done with the aid of the Land Use Scanner, a model that uses historical data, the relationships between current land use and competition between different types of land use to allocate planned land requirements to specific locations (Scholten *et al.*, 2001, Koomen *et al.*, 2007). The consequences for mobility and transport were analysed using the TIGRIS XL model of the Netherlands Transport Research Centre (for more information see Zondag *et al.*, 2007).

Modelling future land use with the Land Use Scanner

The Land Use Scanner balances supply and demand for different land-use functions based on an economic balance principle (Hilferink and Rietveld, 2001; Koomen, 2002). The spatial unit generally consists of a square of 100 by 100 metres. Land use is usually divided into some 25 to 30 classes. The model has three main components for allocating future land use, each of which has its own data set (see Figure 2.7):

Present land use

The map of present land use is a composite of the Land Use Data set (Basis Bestand Grondgebruik) of Statistics Netherlands and the National Land Use Database (Landelijk Grondgebruiksbestand Nederland), a classified remote sensing image by Wageningen University. Present land use is the basis for the allocation, but is often also the determinant of suitability for a variety of uses.

Land requirements per use

The inputs here are figures on land-use requirements provided by sectoral models, such as housing market or business accommodation models. This data may be numbers of hectares or numbers of objects, such as houses, which are then translated into hectares with the aid of indices. If no quantitative data is available, land-use requirement are estimated by experts.

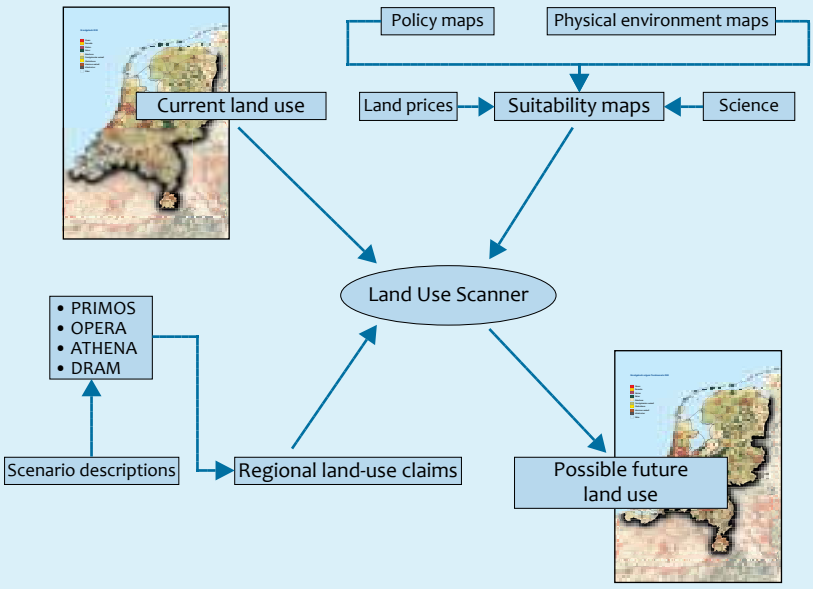
Suitability maps

Suitability maps are produced or collated for each type of land use. These consist of potential maps based on distance decay, policy maps and physical maps. Potential maps show attractiveness of a function by taking account of spatial relationships (distances) and the physical features that are relevant to a particular function. For example, the attractiveness for establishing business parks in a potential map is calculated from data on access to motorways and presence of urban functions at each location.

Policy maps are used to indicate sites for the implementation of policy, for example, designated to urban extensions, or to rule out certain areas, for example new housing and employment in water retention areas. They can also generate rough boundaries of reserved areas for future designation, such as new nature conservation areas within the contours of the National Ecological Network. Lastly, the physical maps contain information on soil and groundwater relevant for the location of agriculture and nature or for excluding certain types of land use.

During allocation, the chance of a certain type of land use appearing in a square is determined by comparing the suitability of that cell for that type of land use with its overall suitability for all other types of land use.

Allocation according to Land Use Scanner **Figure 2.7**



Allocation of future land use according to Land Use Scanner

3 Mapping trends

3.1 Introduction

This chapter draws a picture of the spatial structure of the Netherlands in 2040, in line with structural trends, and defines the consequences of this for adapting to climate change, flood defences, accessibility and the quality of the living environment, nature and landscape. It is assumed that current policy and social and technological trends will continue. Proposals in the Coalition Agreement – such as the introduction of road pricing – have not been included because the Dutch Lower House has not yet adopted them. The principles and assumptions on the amount of land required and the way this is allocated across the Netherlands in the *Baseline* scenario have already been described in the previous chapter.

In view of the uncertainties about the precise extent of the spatial requirement in the *Baseline* scenario, a *High Development Pressure* scenario was also drawn up. There are, however, many other uncertainties and possible trend breaks that could also effect spatial development in the Netherlands. This chapter, therefore, ends with a summary of those uncertainties and possible trend breaks.

3.2 Spatial developments

Land use in 2010

After all the provincial councils had been consulted, a summary was made of the locations for housing, employment and greenhouse horticulture that are most likely to be developed by 2010. Not all the provinces were able to adopt 2010 as their target year. For some it is 2015 and for others 2020. An adjustment was made for those provinces by modelling the actual spatial requirement for 2010 instead of taking it directly from the maps.

Figure 3.1 shows land use in 2000. The map of land use in 2010 (Figure 3.3) shows that most residential and employment locations are in the concentration areas described in the National Spatial Strategy. In the western part of the country these include Almere, IJburg, and Haarlemmermeer, The Hague/Delft/Zoetermeer area, and around Utrecht Leidsche Rijn and Rijnenburg.

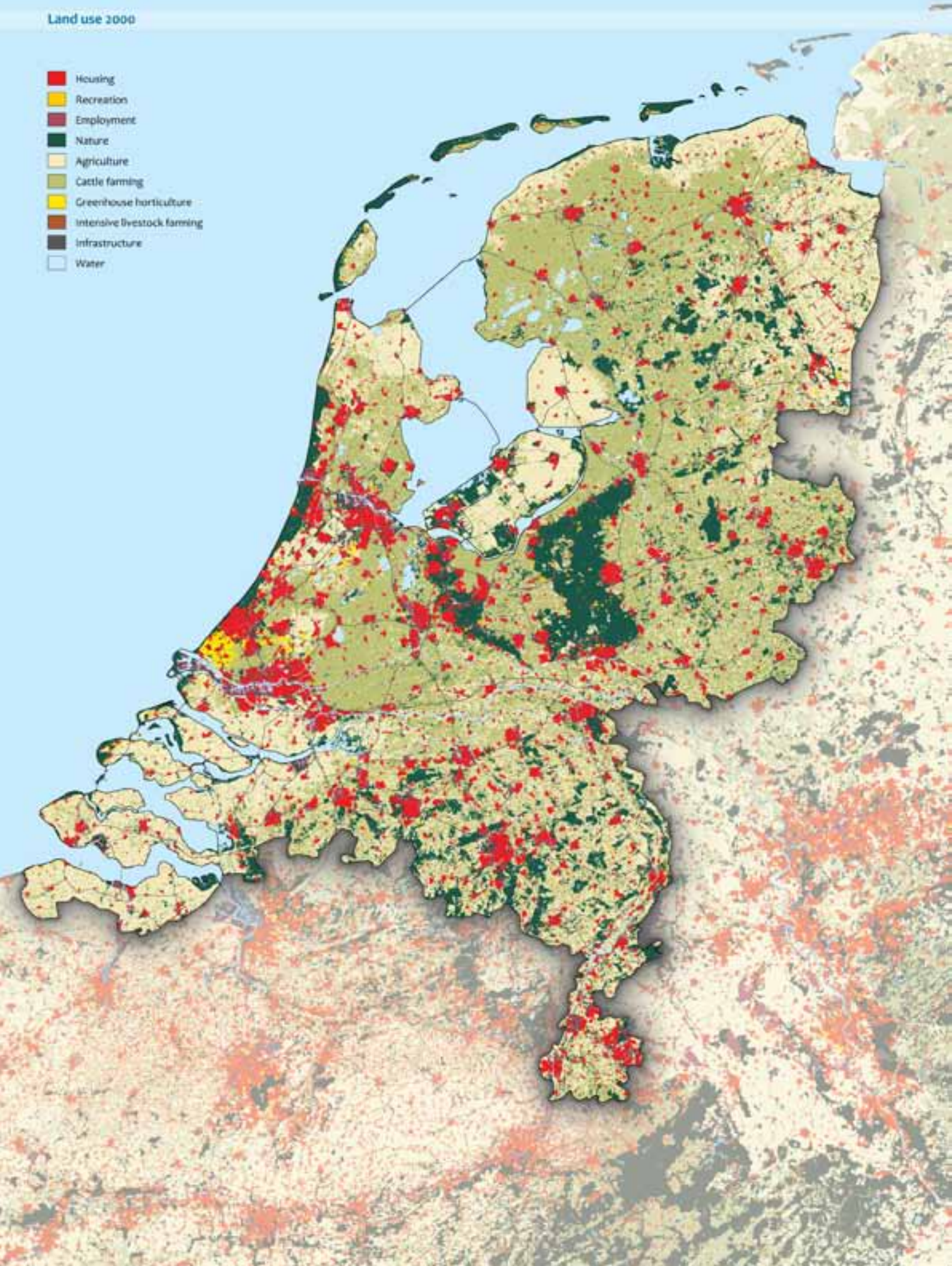
Land use 2040

Figures 3.4 and 3.7 show land use in 2040 under the *Baseline* scenario and the *High Development Pressure* scenario. Figure 3.10 shows the difference in the built-up area between the initial situation in 2010 and the two scenarios for 2040. The total built-up area increases by over 120,000 hectares between 2010 and 2040 in the *Baseline* scenario, and by as much as 190,000 hectares in the *High Development Pressure* scenario. The biggest increases are in the provinces of South Holland, North Brabant and North Holland. The completion of the National Ecological Network will also considerably expand the area devoted to nature conservation. In turn, these increases will result in a substantial decrease of between 200,000 and 260,000 hectares in the agricultural area (Figure 3.2).The extra land requirements for housing and employment sites tend to be met in the Randstad and to a lesser extent in the provinces of Flevoland, Gelderland and North Brabant. Demand elsewhere in the Netherlands is limited. Calculations of the extent of the land requirements for housing and employment take account of the qualitative characteristics of the demand. Structural trends in urban development do not take water-system locations into account.

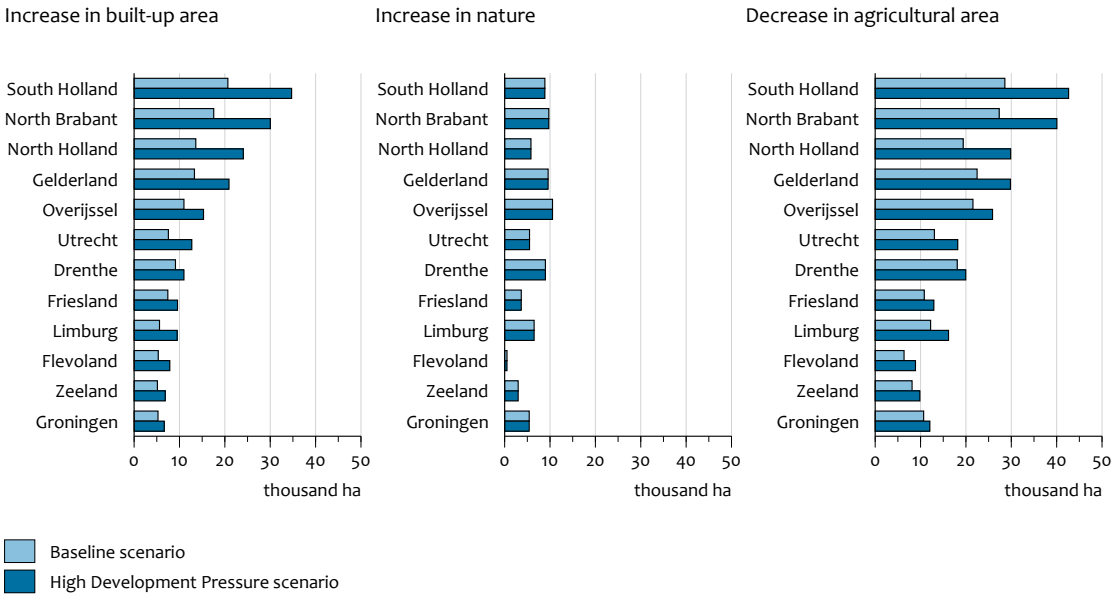
In the *Baseline* scenario, demand for multiple-unit housing rises sharply owing to progressive individualisation and the ageing of the population, which leads to more and smaller households. Demand for owner-occupied housing grows particularly strongly. The greatest demands for expansion are for the green-urban and urban village residential areas. This applies almost everywhere in the Netherlands, but there are also some considerable regional differences. In The Hague and surroundings, for example, there is great demand for rural housing because of the relative over-representation of high-income earners in that part of the Randstad. In Utrecht and North Brabant, demand for central-urban and inner-city housing is relatively high.

Table 3.1 gives the breakdown of new housing in existing built-up areas and greenfield areas from 1995 onwards. The figures given for the built-up area are for two years, 1996 and 2000. The table shows that the proportion of new housing in rural areas has soared in the past ten years. In urban areas, new housing has been mostly along the urban edge. Major urban extensions, such as the Leidsche Rijn, fall within existing built-up areas (2000). These sites will be further developed over the next ten years, after which there will be no more space for such large developments within existing built-up areas (2000). This means that the proportion of new housing in existing built-up areas will decline further after 2010, when about 8% of new housing will be within existing built-up areas (2000).

Land use 2000



Change in land use, 2010 – 2040 **Figure 3.2**



Increase in built-up area (including greenhouse horticulture and intensive livestock farming) and nature areas, and decrease in agricultural area, between 2010 and 2040.

The *Baseline* scenario assumes that the number of hectares taken up by business parks will increase by around 20% to 2040. The map depicting the *Baseline* scenario (Figure 3.4) indicates that this increase will be throughout the Netherlands. There is little difference with the present spatial distribution of industrial and business land: the dispersed pattern remains and additions are mainly near junctions with the major roads on the fringes of cities and villages. There is a noticeable increase in the number and size of business parks in the province of Overijssel. Given their attractive location on the edge of the cities and good accessibility, some business parks in areas where there is a surplus will be redeveloped after 2020, in part for housing.

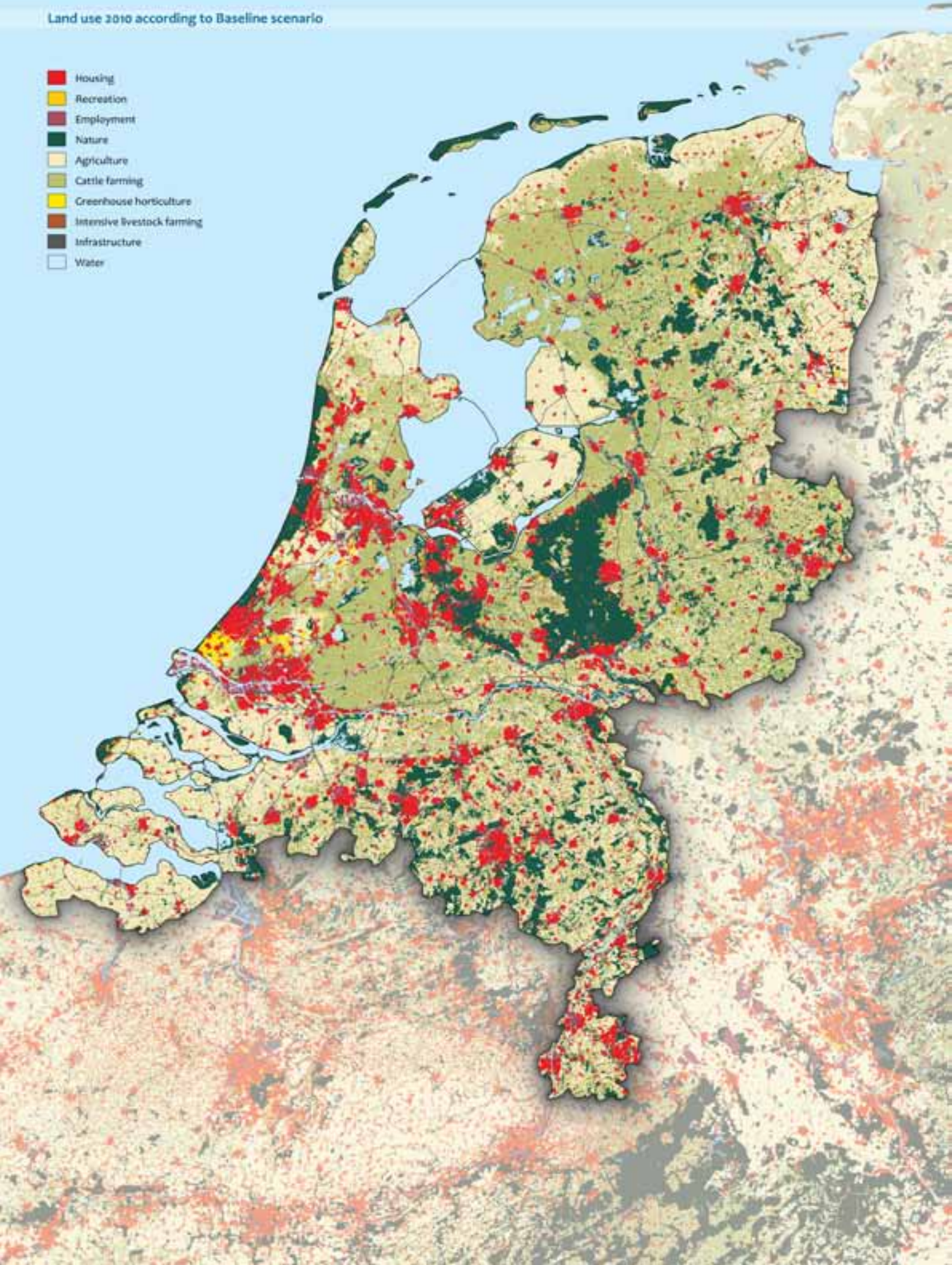
There are large new residential areas in Almere, Haarlemmermeer, Purmerend, between Delft and Zoetermeer, south of Rotterdam, in the Leiden-Alphen-Utrecht zone along the river Oude Rijn, between Utrecht and Amsterdam along the river Vecht, east of Utrecht, south of Leeuwarden, Meerstad near Groningen, and Blauwe Stad. There are more housing developments in the coastal strip behind the dunes along the west coast (The Hague/Leiden, bulb-growing region, Kennemerland), Zuidplaspolder, 't Gooi and the Utrechtse Heuvelrug, and around the Twente and Brabant cities (particularly Breda, Tilburg, Eindhoven). No decision has been taken on the expansion of Almere after 2010, so its growth remains relatively limited. It is also evident that there is little housing development in the Zuidplaspolder, although there is an increase in employment locations.In the southern wing of the Randstad, land requirements for housing and employment is so great that some buffer zones are rapidly being developed (The Hague–Leiden, south of Rotterdam). Scattered housing developments are seen in such areas as Waterland, along the IJsselmeer, in the west of the Green Heart, in the Hoeksche Waard, the Utrechtse Heuvelrug, in the area along the river Linge, around Staphorst and Meppel, around Deventer, in the province of North Brabant (near Etten-Leur, Vught, Drunen, Helmond), on the Zeeland island of Zuid-Beveland to the east of Goes, and in Limburg (Maasplassen, Eijsden). Some National Landscapes are also experiencing significant encroaching development: Waterland, the Green Heart, Hoeksche Waard and the river areas.

Larger employment locations are under development in the Haarlemmermeer polder, the bulb-growing region, the Amsterdam port area (but not for port-related activities), Zuidplaspolder, Maasvlakte (the Maasvlakte 2 project is partly complete), and also near Groningen, the Overbetuwe (Waalsprong Nijmegen), and around Enschede and Tilburg. Greenhouse horticulture continues in the west, with the Westland complex shrinking slightly in size, but existing greenhouse horticulture enterprises between Delft and Zoetermeer are replaced by housing developments and move towards Oostland (the so-called B triangle formed by Bleiswijk, Bleskensgraaf and Berkel-Rodenrijs). The Aalsmeer complex also gives way to housing. Scattered development of greenhouse horticulture enterprises increases in Voorne and around Katwijk. Intensive livestock farming tends to be concentrated in the agricultural development areas, such as those referred to in the reconstruction plans for the sandy soil regions in the eastern and southern regions of the country.

Figure 3.1

Land use in 2000.

Land use 2010 according to Baseline scenario



Breakdown of new housing between existing built-up areas and greenfield areas (1995-2003) in % **Table 3.1**

	Type	1995	1996	1997	1998	1999	2000	2001	2002	2003
New housing	Existing built-up area in 1996	91	86	63	53	50	44	45	45	46
	Existing built-up area in 2000	5	10	32	42	41	32	10	5	4
	Greenfield	4	4	5	5	9	24	45	50	50
	Totaal	100	100	100	100	100	100	100	100	100
Balance	Existing built-up area in 1996	91	85	59	48	42	35	34	31	29
	Existing built-up area in 2000	6	12	37	48	49	39	12	6	5
	Greenfield	3	3	4	4	9	26	54	62	66
	Total	100	100	100	100	100	100	100	100	100

The area of land-based livestock farming increases slightly compared with, and at the expense of, arable farming (east of the province of Groningen).

The total nature conservation area increases and the National Ecological Network is largely in place. This is not always evident from the map as an increase in area because it will be achieved partly through on-farm conservation/management in areas shown on the map as land-based livestock or arable farming.

3.3 Effects

This section describes the effects of the spatial developments under the *Baseline* scenario as outlined in the previous section.

Flood defences

The reinforcement of the dykes, which should be completed by 2020, reduces the casualty risk in the *Baseline* scenario by a factor of 3 compared with the situation in 2000 (Figure 3.5). The (economic) damage risk declines by a factor of 1.7. However, the much higher population and economic value in the *High Development Pressure* scenario mean the risks are around 25% higher than in the *Baseline* scenario.

Adaptation to climate change

In the *Baseline* scenario, population growth and increase in built-up area occur mainly in the flood-prone areas of the Randstad (Figure 3.6). This spatial trend is already decades old and the vulnerability of the Netherlands as a whole, in terms of percentage of population and economic value at risk, continues to increase to 2040, In the period to 2040, the potential damage in the flood-prone area increases by a factor of 2 (*Baseline* scenario) to 3 (*High Development Pressure* scenario), and the newly built-up area contains around 25 to 30% of this (see Section 4.2).

The *Baseline* scenario is based on finalising the reservation of the areas indicated in the Room for the River programme. However, more space may be required in the future for the discharge of extreme volumes of river water (see Section 2.2) The *Baseline* scenario shows a 10 to 30% increase in building in areas reserved for river discharge and a 20 to 50% increase in the low-lying polders

Current understanding suggests that no large-scale changes in the regional water system will be needed to contain flooding before 2050. Measures are largely based on fine-grained solutions that require only limited land use (UvW, 2006; MNP, 2006a). It is still uncertain whether more land will be required in the longer term. The maps of the *Baseline* scenario *and* the *High Development Pressure* scenario do not include the possible spatial consequences of these.

Biodiversity

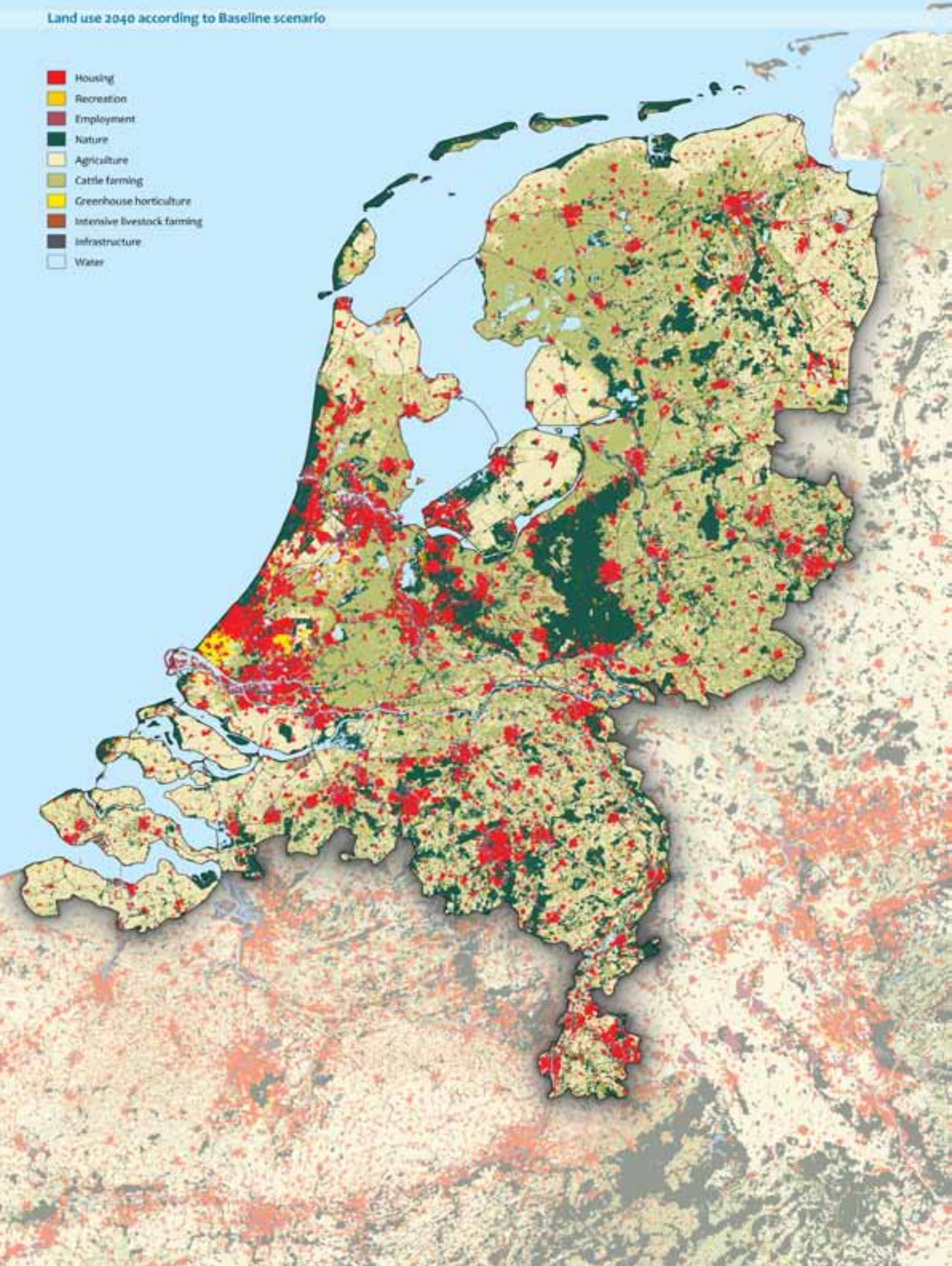
The area devoted to nature conservation increases between 2000 and 2040, owing to the completion of the National Ecological Network. In some cases, this leads to the expansion of existing core areas, but various small areas are added as well, so the National Ecological Network (NEN) remains somewhat fragmented. This fragmentation (Figure 3.8) is the result of the policy of assembling the National Ecological Network mainly on a voluntary basis. The intention is to build up the network by acquiring agricultural land that becomes available, but in competition with other uses, such as housing and employment. This effect is heightened because, according to the map attached to the National Spatial Strategy, the reserved areas for defining the exact boundaries of the National Ecological Network cover 80,000 hectares, or approximately ten per cent of the designated area. The target for agricultural conservation management (almost 100,000 hectares) is not included in the analyses because the sustainability of that type of management is limited. Contracts are concluded for a six-year term, and, if not renewed, the land loses its designation as part of the National Ecological Network.

Fragmentation continues, as a consequence of which the spatial connectivity for wildlife is little better than at present (Figure 3.9). This fragmentation is also responsible for the continuing high levels of environmental pressure on nature conservation areas.

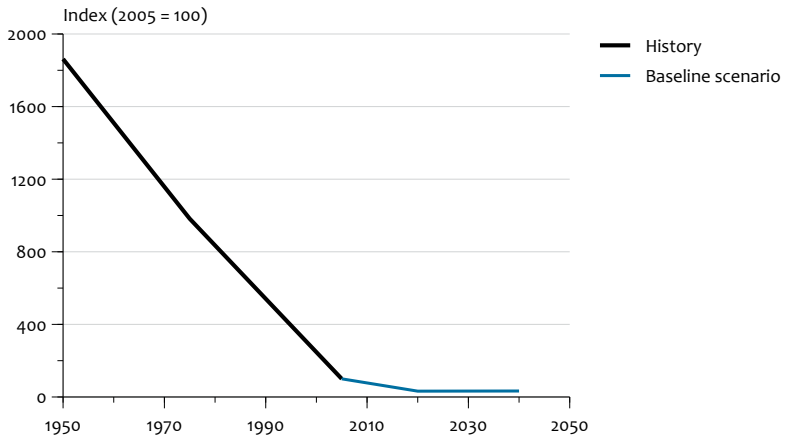
Figure 3.3

Land use in 2010 under the Baseline scenario.

Land use 2040 according to Baseline scenario

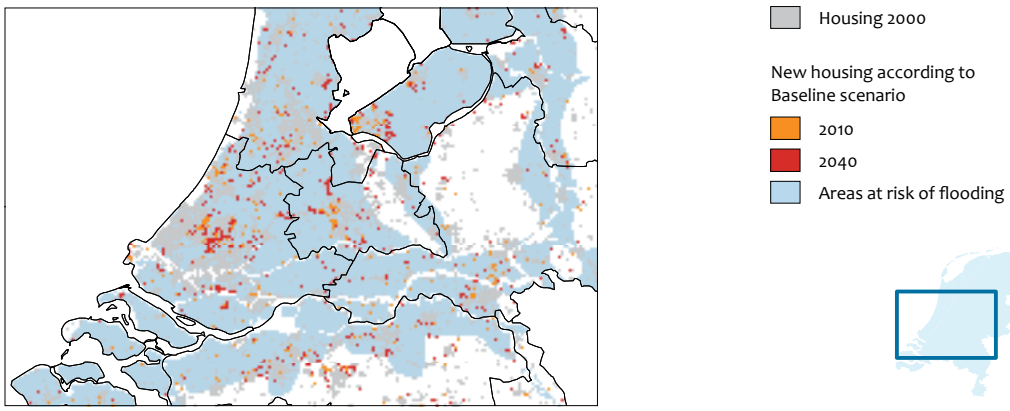


Human-casualty risk in case of flooding **Figure 3.5**



The proposed improvement and reinforcement of primary flood defences by 2020 further reduces the human-casualty risk under the Baseline scenario. The dykes will not meet safety standards until 2020 (Klijn et al., 2007).

Housing in areas at risk of flooding **Figure 3.6**



In the Baseline scenario a large proportion of new housing in the period to 2040 is in flood-prone areas, particularly in the Randstad.

Accessibility

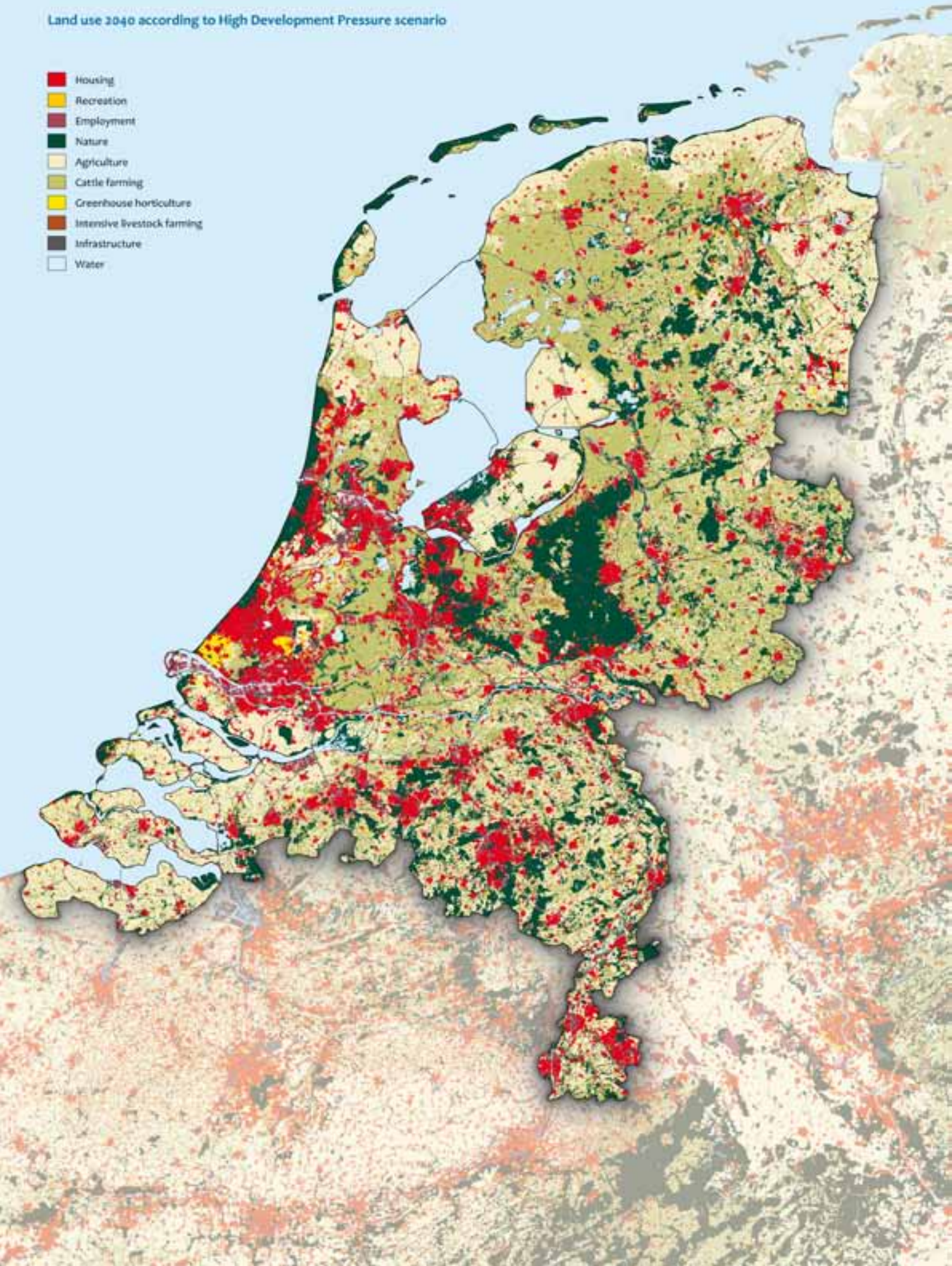
The pressure on the main road system escalates sharply in the *Baseline* scenario. Total 'traffic performance' increases by 75% from 2000 to 2040 in the *Baseline* scenario and by up to 95% in the *High Development Pressure* scenario. How does this affect accessibility? There are many different ways to define and express accessibility in practical terms and the choice of indicator often determines the conclusion (Geurs, 2006). In order to obtain a good representation of changes in accessibility this study adopts three different approaches, based on traffic, geography and economics.

The traffic engineering approach focuses on defining how well the road system functions. In this study, this is expressed this in the number of hours that are lost due to congestion on the roads. Because accessibility not only depends on how well the transport infrastructure functions, the geographic approach takes account of the spatial distribution of activities. For example, people travelling in Zeeland rarely get caught in traffic jams, but they have access to far fewer jobs, shops and amenities in the immediate vicinity. Accessibility in this study, therefore, is expressed as the number of employment locations that the working population can reach within 60 minutes by car (door to door) or within 90 minutes by public transport, with more distant destinations being less important. Lastly, the economic approach examines the social (financial) benefits of accessibility. This study applies a new method of calculating the monetary benefits of being able to get to different activities at different locations by different means of transport. The economic approach to accessibility

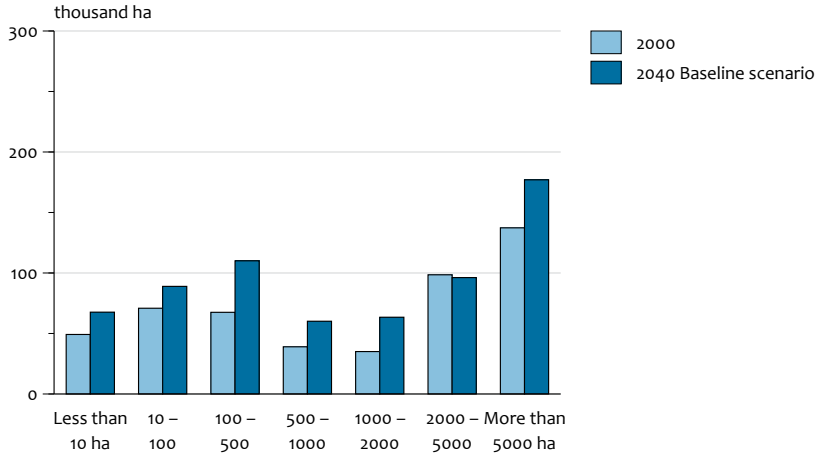
Figure 3.4

Land use in 2040 under the Baseline scenario.

Land use 2040 according to High Development Pressure scenario

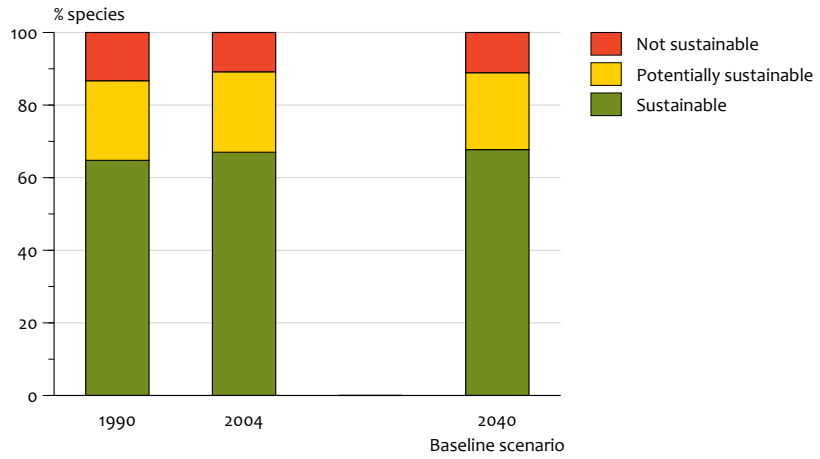


Nature surface area, per land surface area **Figure 3.8**



Completion of the National Ecological Network increases nature conservation areas. A considerable proportion of the overall area consists of relatively small sites.

Spatial conditions for animal target species **Figure 3.9**



The Baseline scenario, despite the increase in nature areas, leads to only a slight improvement in spatial connectivity for wildlife because of the fragmented nature of the National Ecological Network in this scenario.

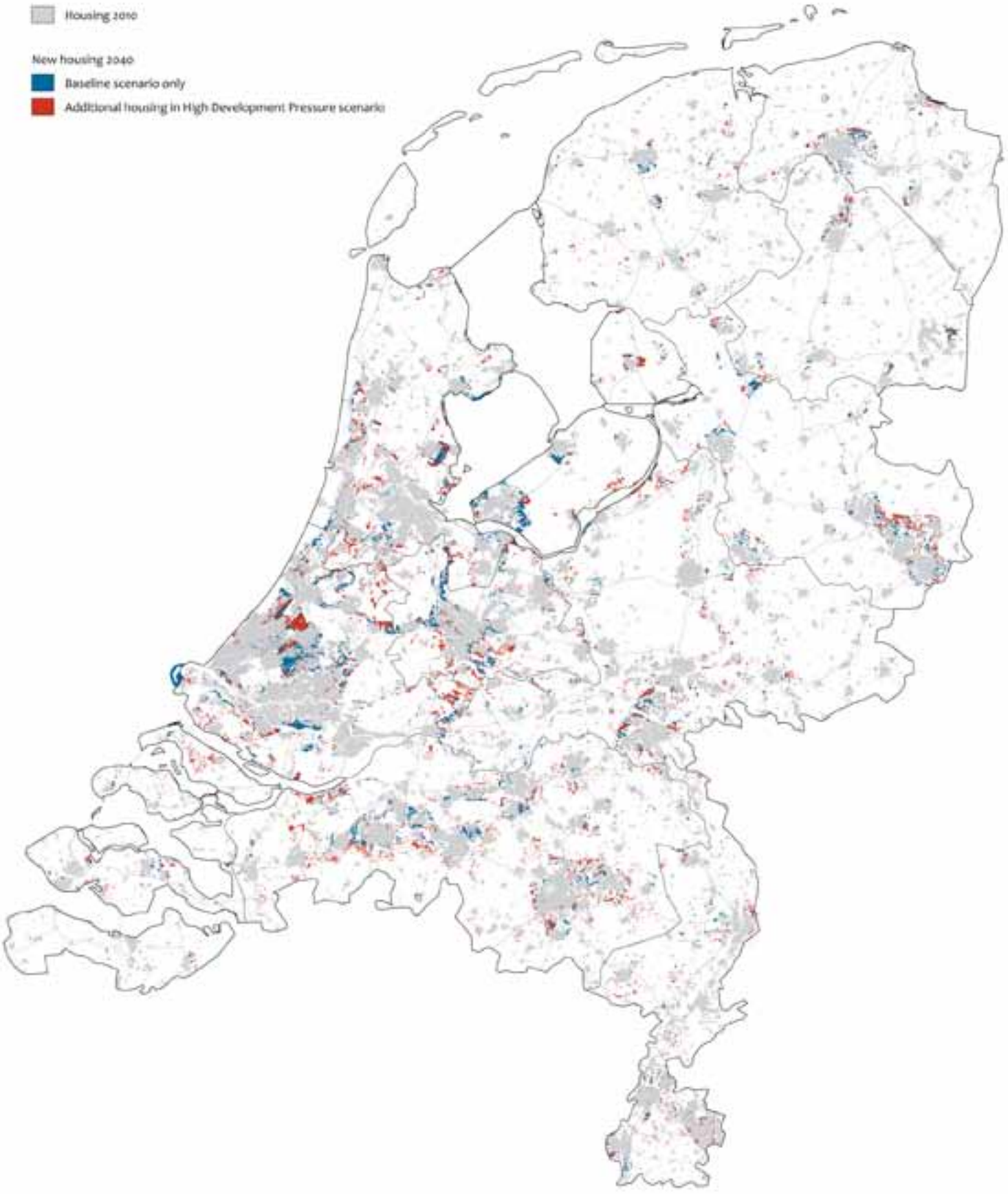
permits only the calculation of the relative prosperity gains (or consumer surplus) of measures or scenarios in comparison with a benchmark scenario without measures. The economic approach is used to map out the accessibility gains of the various focuses and variants (see Chapter 4 for more details). Figure 3.11 shows that congestion (number of hours lost) on the main road network has increased since the year 2000. The investment package of 14.5 billion euros to upgrade the road system allocated in the Mobility Policy Document decreases or stabilises the number of hours lost between 2010 and 2020, despite the increase in road traffic. In the *Baseline* scenario the number of hours lost – in the absence of extra investment or road pricing – increases after 2020. From 2000 to 2040, the number of hours lost increases by around 70% in the *Baseline* scenario and triples in the *High Development Pressure* scenario. The trend in accessibility of employment locations is different. Until 2020, accessibility of employment locations in the rush hours improves because of both investment in roads and job creation. In the *Baseline* scenario, the accessibility of employment locations decreases after 2020, due to more congestion and job losses. In the *High Development Pressure* scenario, the accessibility of employment locations more or less stabilises after 2020, despite increased congestion. This is roughly equal to the effect of a sharp growth in jobs after 2020.

In the *Baseline* scenario the accessibility of employment sites by public transport (not included in Figure 3.11) decreases

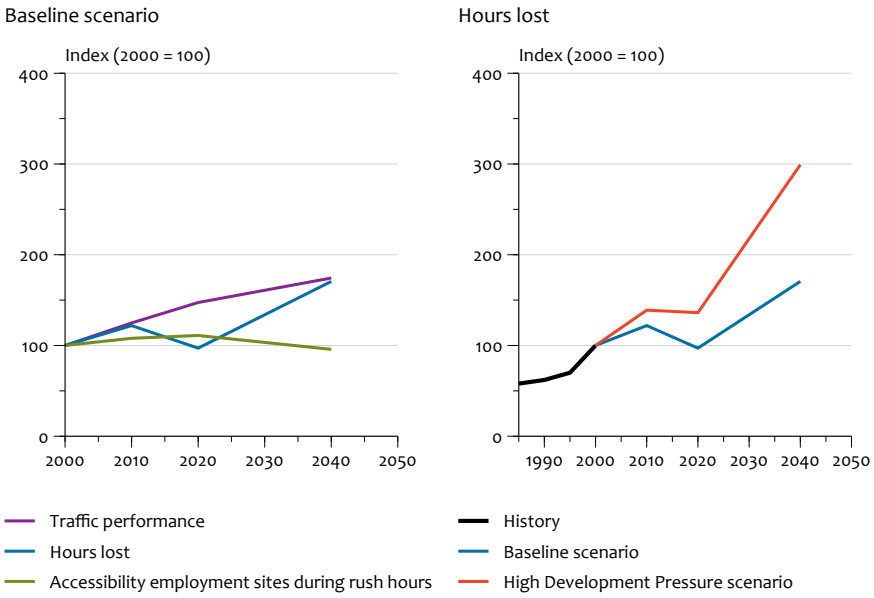
Figure 3.7

Land use in 2040 under the High Development Pressure scenario.

Development housing 2010 – 2040 according to Baseline scenario



Traffic projections **Figure 3.11**



Traffic performance, hours lost (congestion) on the main road network and accessibility of employment locations during rush hours under the Baseline scenario and the High Development Pressure scenario.

throughout the period from 2000 to 2040, despite the assumed qualitative improvements. Employment locations are expected to be approximately 15% less accessible by public transport in 2040, than they were in 2000. This is mainly because in the *Baseline* scenario businesses tend to be in locations that are not easy to reach by public transport. This is a continuation of the historical trend. Snellen *et al.* (2006) showed that, between 2000 and 2004, the number of employment locations with good public transport connections and the number of people with access to them decreased, while the number of locations close to junctions on the main road network increased.

Quality of the physical living environment

The number of homes experiencing noise levels in excess of 55dB L_{den} increases by 0.5 million in the *Baseline* scenario and by 1.3 million in the *High Development Pressure* scenario (Figure 3.12). This rise reflects the increase in road traffic and new housing in areas (particularly in the Randstad) where noise levels are already relatively high. The number of existing homes exposed to noise levels below 48dB L_{den} is declining. In the *Baseline* scenario the number of inhabitants experiencing noise levels above 55dB in 2040 is comparable with 2010, because, in 2000, the average household comprised of 2.3 people, while by 2040, this will be only 2.0. Existing housing stock exposed to noise levels lower than 48dB decreases in the *Baseline* scenario from 1.1 million homes in 2010 to 1.0 million in 2040. In the *High Development Pressure* scenario it falls to 0.9 million homes by 2040. The area in the Netherlands exposed to noise levels below 48dB L_{den} declines from around 57% to around 55% in the *Baseline* scenario (Figure 3.13) and to around 53% in the *High Development Pressure* scenario.

The computations assume that road surfaces on the road sections indicated in the Multi-annual Programme for Infrastructure and Transport comprise a double layer of very open-textured asphalt concrete. It is also assumed that noise barriers are constructed along the motorways in built-up areas exposed to noise levels above 65dB L_{den} in 2020. A double layer reduces noise by an additional 2 or 3dB, compared to a single layer. These measures mainly affect the number of homes along motorways. They cannot, however, prevent an increase in the number of homes experiencing noise levels above 55dB because this is mainly caused by provincial and inner city traffic.

Residential housing in spacious and green surroundings

There is considerable enthusiasm in the Netherlands for living in spacious and green surroundings. Any space allotted by government policy is utilised in full, which puts areas with an attractive landscape under considerable pressure. Formerly sporadic building activity is on the increase, in several National Landscapes, such as the Green Heart. The fringes of nature conservation areas are also under pressure, such as the edges of the Veluwe and the Utrechtse Heuvelrug.

Landscape quality

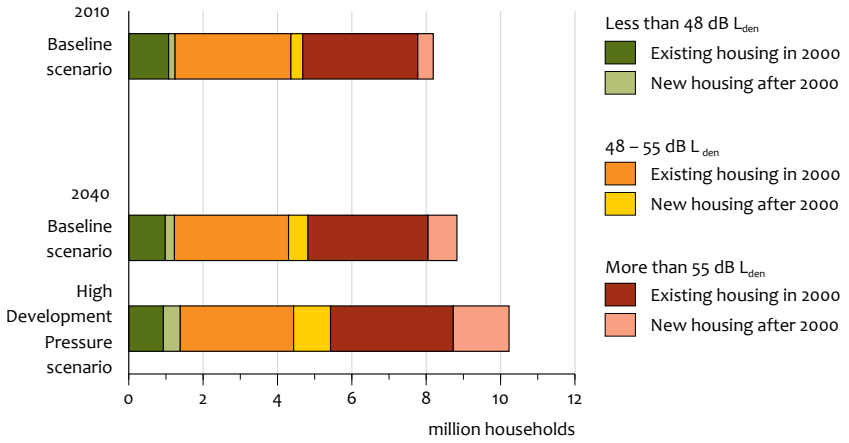
Between 2000 and 2040 the total agricultural area in the Netherlands will decline by 220,000 to 260,000 hectares. This is about the same rate of decline as in the period from 1970 to 2000. The decrease is mainly due to the expansion of residential, employment and recreational uses, and conversion of agricultural land into nature conservation areas. As many agricultural areas are open landscapes, this change of use will impair the quality of the landscape. Moreover,

Figure 3.10

Housing development 2010-2040 under the Baseline scenario and the High Development Pressure scenario.

Noise burden on households

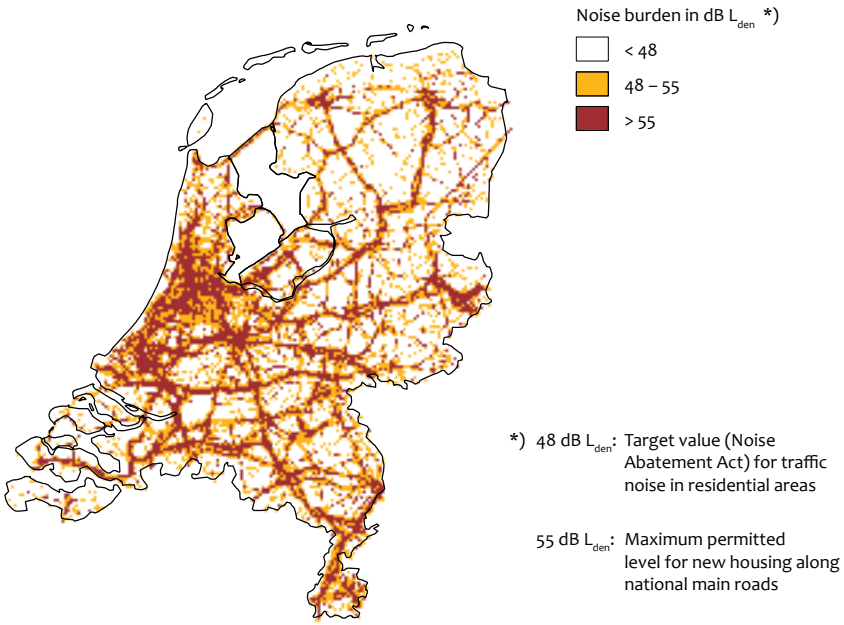
Figure 3.12



Noise burden on households increases between 2010 and 2040 in the Baseline scenario and the High Development Pressure scenario. The maximum permitted noise level is 55dB Lden for new housing along main roads; 48dB Lden is the long-term target for traffic noise in residential areas (Noise Abatement Act).

Noise burden under Baseline scenario, 2040

Figure 3.13



Noise burden in 2040 under the Baseline scenario.

unless there is a change in policy, the scale of agricultural activities will increase, which may also be to the detriment of the landscape (Figure 3.14).

The rate of urban development is relatively higher in most National Landscapes than it is in the Netherlands as a whole. Some of this development has adverse effects on the core qualities of the National Landscapes. The worst hit are the landscapes under greatest pressure from urban expansion, the Green Heart, the two water defence lines and the low-lying parts of the country in the west. These trends conflict with the policy advocated for National Landscapes.

The Baseline and High Development Pressure scenarios compared

Table 3.2 compares the effects of the *Baseline* scenario and the *High Development Pressure* scenario in 2040 with the situation of 2000. The table also shows whether existing policy targets are within reach.

Effects of the Baseline scenario and High Development Pressure scenario on several indicators in 2040 compared with 2000 Table 3.2

		Development			Effects
Indicator	**Explanation**	**Baseline scenario**	**High Development Pressure scenario**	**Policy target reached under Baseline scenario**	
Flood Defences	Risk of damages and human casualties				Maintenance backlog will be cleared up by 2020, through fortification of existing dykes
Adaptation to Climate Change	Space in river areas				Realisation 'Room for the River'
Biodiversity	Biodiversity in nature areas				Nature areas increase, but remain fragmented. Biodiversity targets are not achieved
Accessibility	Congestion, access to work locations, financial accessibility gains				Traffic congestion in the main road network increases. Access to work locations by car and public transport diminishes
Quality of the Living Environment	Greenery surrounding the city and noise pollution				Noise pollution within cities increases, while the amount of city greenery decreases
Spacious and Green Living	Space for personal living preferences within green surroundings				No explicit policy target
International Business Establishment	Congestion, risk perception, growth northern wing				No explicit policy target
Landscape Quality	Main qualities, perception and recreational values of the landscape				Openness of National Landscape decreases
Spatial Segregation	Spatial distribution of the various income brackets				No explicit policy target

3.4 Uncertainties and possible trend breaks

This chapter presents the main outcomes of the *Baseline* scenario. The *High Development Pressure* scenario depicts spatial developments in the event of higher population and economic growth within a certain range. Besides this range of population and economic growth, there are other uncertain factors that affect the sustainable growth of the Netherlands.

1. Population growth
Immigration and emigration are difficult processes to predict. Based on both academic research (Hooimeijer, 2007) and trend watchers, a conceivable future has been described in which migration patterns will change dramatically (Bakas, 2005). Examples of such changes are a sharp increase in re-migration, an increase in the outflow of enterprising, highly educated young people, and an outflow of wealthy and healthy senior citizens. Depending on social developments elsewhere, there may be a much bigger inflow of people into the urban areas of Europe, including the Netherlands (King, 1993).

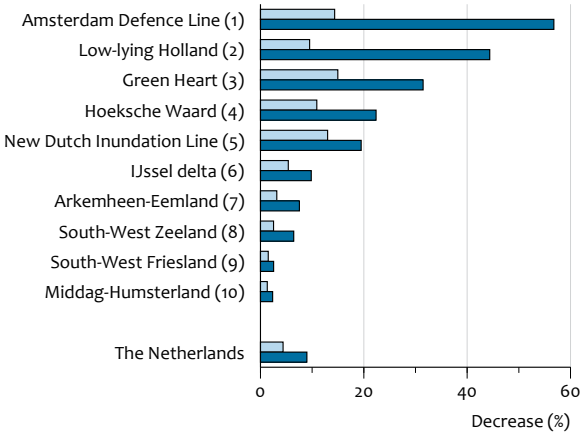
2. Individualisation
The scenarios assume implicitly that the trend of individualisation will continue to be expressed in consumer choice and land use. Trend watchers indicate that younger people are turning away from the entrenched individualism and related patterns of consumption. It is, however, unknown what consequences 'the new collectivism' will have for consumption patterns and related land use.

3. Housing preferences of socio-economic groups
The study assumes that housing preferences depend on socio-economic conditions. Hence, it is assumed that families with a high income will opt to live in green areas. Dutch households display a marked preference for single-family homes with a garden (the rural idyll; see, for example, Heins, 2002). Housing preferences in the Netherlands clearly differ from those in other countries. In Spain, for example, many high-income families live in luxury apartments, often surrounded by a garden with a swimming pool and other facilities. It is conceivable that the Dutch concept of the ideal home will shift, possibly in the direction of 'gated communities', more second home ownership and more urban residential areas.

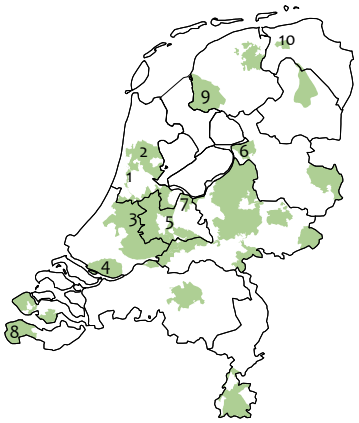
4. Economic growth
Oil prices and the position of the port of Rotterdam and of Schiphol Amsterdam Airport may change as the result of movements in the global economy. There is also much uncertainty about the effects of ICT developments on the economy. Both product processes and consumer behaviour may change because of this.

5. Climate change
Climate change is surrounded by many uncertainties (Section 2.2). Petersen listed these uncertainties in *Simulating Nature*

Decrease in very open areas, 2010 – 2040



Location of National Landscapes



The largest decrease in the 'very open area' core quality of National Landscapes is subject to the greatest development pressure.

(2006). Several very unfavourable potential developments cannot be ruled out, such as a rapid acceleration in the melting of the Greenland and Antarctic Ice Sheets, a change in the intensity of storms and hurricanes, and increased desiccation in some parts of the world due to much reduced precipitation or the disappearance of glaciers, (including in the Himalayas). Should such extreme developments occur (discontinuities), they would probably have a major impact on the global economy and migration patterns, and on the outlook for the future development of the Netherlands.

6. Technological breakthroughs

As mentioned above, this study does not pay explicit attention to the possible consequences of technological breakthroughs. It is certainly conceivable that technological advances will change transport infrastructure and mobility behaviour. Research shows that energy shortages will dramatically alter the transport behaviour and spatial organisation of human activities (Monzón and Nuijten, 2006).

3.5 Conclusions

The main conclusions based on the outcomes of the *Baseline* scenario are listed below.

- Land use in the Netherlands will change radically in the coming decades. The built-up area will have grown by 15 to 26% by 2040 (the range covers differences in population and economic growth). The existing built-up area is therefore expected to grow by about a quarter.
- The majority of new housing will be in flood-prone areas and the potential damage increases by 2 to 3 times by 2040. The new built-up area accounts for about 25 to 30% of the economic value of all property in 2040. In the *Baseline* scenario, the primary flood defences do not all meet the statutory standards up to 2020. The improvement in safety levels reduces the damage risk
- by a factor of 1.7 and the casualty risk by a factor of 3, compared with 2000.
- Given the assumptions made about social trends and the effectiveness of existing policy, new housing developments will be built near the major cities in the Randstad and the province of North Brabant. This is due to the high demand for housing in those regions and the urban compaction policy.
- Demand for new commercial sites will be concentrated mainly in the Randstad in the decades ahead. The northern wing of the Randstad, in particular, is part of a global network of cities. Many new commercial sites will be developed in this part of the Netherlands because job growth is highest here.
- Because it is assumed that existing provincial spatial plans are realised and that accessibility via the main road system is a significant business location incentive, new employment locations will be created and existing ones expanded, particularly in the centres of the large cities and in their vicinity, for example, in the Haarlemmermeer, the Zuidplaspolder, and the area to the south of Groningen.
- In the *Baseline* scenario, total mobility increases by approximately 15 to 30% and car use by 35 to 45%, between 2002 and 2040. The ranges allow for differences in population and economic growth. Accessibility of employment locations by car improves by about 10% during this period owing to investment in the road system and job creation. After 2020, the accessibility of employment sites – without additional investment and pricing policy – declines, owing to increased congestion and a decrease in the number of jobs.
- The proportion of homes experiencing noise levels of more than 55dB will have increased from 43 to 46% by 2040.

- In the *Baseline* scenario, the National Ecological Network will be realised by 2018 (approximately 730,000 hectares). The nature conservation areas remain fragmented, however. Environmental conditions do not improve sufficiently, either. Biodiversity goals, therefore, are not achieved.
- In the future, the open landscapes so characteristic of the Netherlands will largely disappear, because of ongoing urbanisation.

4 Focuses

4.1 Introduction

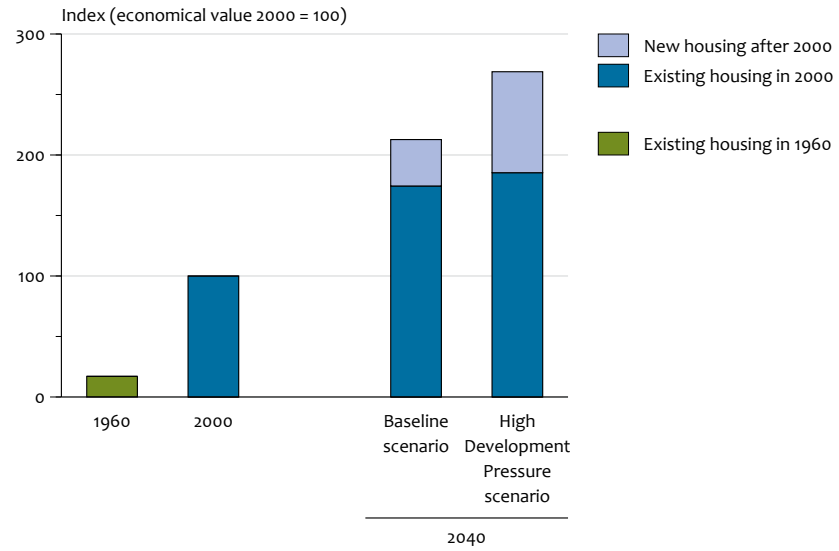
As discussed in the previous chapter, the *Baseline* scenario for 2040 shows that in the event of organic development (a continuation of current trends), several problems will not be resolved. These persistent problems form a major obstacle to sustainable spatial development. This chapter charts potential solutions to each persistent problem according to a particular 'focus' or topic area. These focuses correspond to the (partial) orientation of a specific social terrain or field covered by a government department, for example, of housing, employment or mobility. The effect of each focus is illustrated by a number of sustainability indicators (Table 4.1).

The six focuses are in themselves rather one-dimensional constructs. Together, however, they provide a range of possible solutions to the problems identified in the previous chapter. They also indicate where the solution to one set of problems may also resolve or aggravate other problems. The focuses vary in nature, from the more quantitative to the more design-oriented. The effects of the first three focuses have been expressed in quantitative terms; the last three have been assessed solely in qualitative terms.

Overview of problems, focuses and indicators **Table 4.1**

Persistent problem	Focus	Sustainability indicator
Climate change, leading to an increase in: • Flood risks (safety) • Flooding (material damage) • Water shortages (material damage and damage to nature) • Salinisation (material damage and damage to nature)	*Climate and Safety* Spatial development of the Netherlands is largely adapted to the consequences of climate change (rising sea levels, increased peak river discharges).	*Flood defences and adaptation to climate change*
Decrease in biodiversity, due to: • Lack of connectivity between nature areas • Inadequate environmental quality within nature areas (ammonia deposition, quality and quantity of groundwater and surface water)	*Robust Nature* The spatial development of the Netherlands is largely consistent with international agreements on habitats and wildlife, co-signed by the Netherlands.	*Biodiversity*
Poor accessibility of residential and employment locations and amenities due to: • Spatial distribution of functions and amenities • Congestion on the roads • Inefficient transport system	*Clustering and Intensification* New housing is very much concentrated in the designated urban concentration areas, particularly in the existing built-up areas, to make optimum use of (existing) infrastructure and to limit cluttering and visual intrusion in the landscape.	*Accessibility*
Poor quality of the living environment, due to: • Lack of space and green areas • Long distances to amenities • Noise and deposition of pollutants	*Residential Housing in Spacious and Green Surroundings* Lower density at new housing sites, preferably in attractive landscapes and close to cities with good urban facilities and amenities.	*Quality of the living environment and residential housing in spacious and green surroundings*
Declining competitiveness as an international business location, due to suboptimum (perception of): • Quality of business locations • Function / accessibility as international centre • Attractiveness of the living environment	*International Business Establishment* Urban development is highly concentrated in a few regions with the greatest potential (Amsterdam, Utrecht, and Eindhoven) and in the northern and eastern Netherlands (concentration areas).	*Conditions for international businesses establishment*
Decline in landscape quality as consequence of loss of local identity owing to: • Urbanisation • Agricultural changes	*Landscape, Tourism and Recreation* Urban development largely avoids damage to valued landscape features, combined with considerable investment in providing extra green space and water, and on-farm landscape management.	*Landscape quality*

Potential damage in areas at risk of flooding **Figure 4.1**



In the Baseline scenario economic growth and new housing greatly increase the potential economic damage in the flood-risk areas of the Netherlands in the period up to 2040.

4.2 Climate and flood defences

Problem outline

The main aim of water policy in the Netherlands is 'to have and to maintain a safe and habitable country and to maintain and strengthen sound and resilient water systems that guarantee sustainable use' (Ministry of VenW, 1998). Coastal and river floods are events that disrupt the functioning of the Netherlands, and the analysis in Chapter 2 shows that the sea level rise and associated reduction in options for guaranteeing the free discharge from the rivers are determining factors for the long-term future of the Netherlands. The need for protection is further intensified because, in the *Baseline* scenario, the majority of new urban development is in the flood-risk parts of the Netherlands (Chapter 3, Figure 3.8). This substantially increases the potential for economic damage in the event of flooding in the period to 2040. The new built-up area accounts for about 20 to 30% of this flood-risk areas (Figure 4.1).

Urban planning and infrastructure developments have long-term effects that will have consequences for several generations. Decisions taken in the coming decades, therefore, will partly determine the scope for future solutions with regard to adaptation to climate change.

In the shorter term, the effect of climate change on water systems also leads to problems with salt-water intrusion, flood control and desiccation (see, for example, MNP, 2005). The memorandum of December 2006 stated that these problems would be tackled through an investment of 2.5 billion euros in the regional water systems and 3 billion euros (indicative) in urban areas (Ministry of VenW, 2006). Further research on salt-water intrusion and desiccation is underway based on new climate scenarios produced by the Royal Netherlands Meteorological Institute in 2006. The following section only draws a relation between nature policy and the problem of desiccation, not that of salt-water intrusion.

Possible solutions to flood safety: defences, design and planning

The safety and long-term future of the Netherlands can, in principle, be controlled by:

- maintaining or enhancing the level of protection through engineering measures, such as strengthening coastal defences and dykes;
- reducing the effects of flooding by adapted building methods, compartmentalisation, awareness raising, risk and crisis communication and emergency evacuation plans;
- steering spatial development to minimise damage and casualties in the event of flooding and keeping options open for future spatial planning measures.

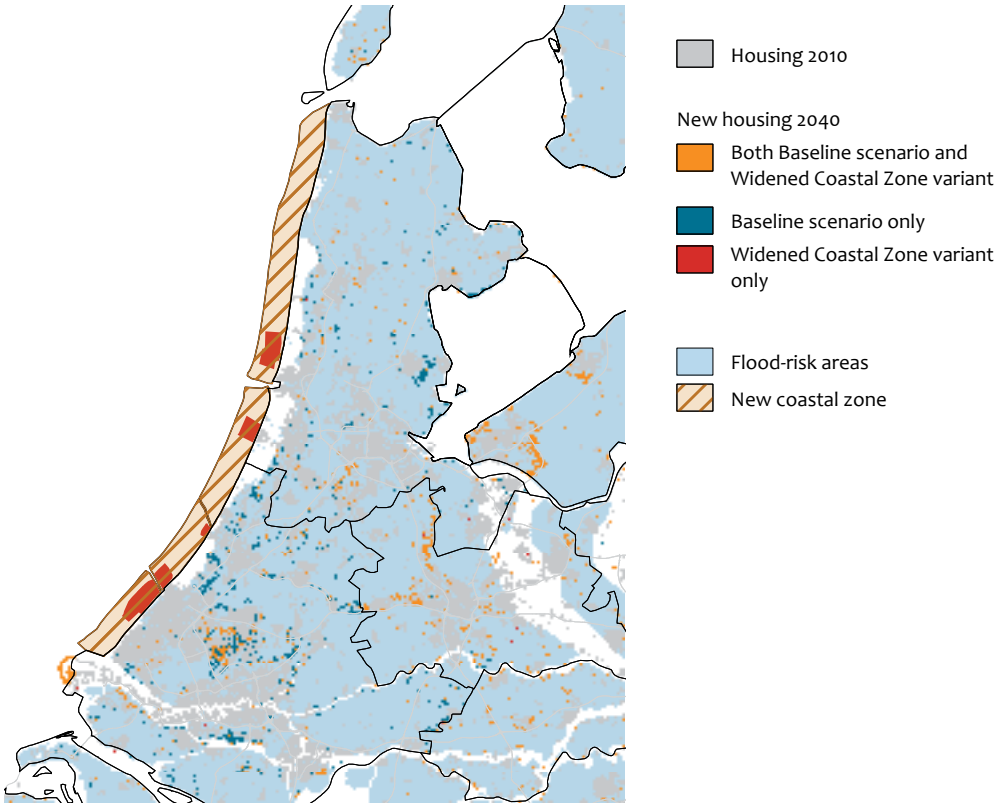
Increasing the level of protection, as proposed by the Advisory Committee on Financing

Primary Flood Defences (Adviescommissie Financiering Primaire Waterkeringen, 2006), or minimising the consequences of flooding by adapting building methods and compartmentalisation are expected to result in almost the same spatial development as under the *Baseline* scenario. This is because solutions of this kind impose no restrictions on land use and the siting of development does not depend on present or future flood risks. Adapted building methods (separating rainwater before it enters the waste-water sewerage system) could reduce the potential damage by up to 20 to 30% by 2040, with no additional rise in the safety level (see Figure 4.1).

Spatial options

The choice of time horizon and the extent to which potential events are anticipated very much determine the avenues for

Development housing area between 2010 and 2040, under the Widened Coastal Zone variant **Figure 4.2**



Growth in the built-up area under the Widened Coastal Zone variant compared with the Baseline scenario 2040.

possible solutions. The question to be answered with respect to climate change and rising sea levels is how to incorporate long-term trends into short-term decision making.

To give an idea of the possible spatial consequences of decisions that are to a greater or lesser degree prompted by expected climate change, three strategic variants have been formulated that closely reflect the current debate. The questions they address are whether it makes sense to continue to invest in the low-lying parts of the Netherlands, whether there is a need for large-scale and structurally different type of coastal defences, and whether more limited spatial options could reduce long-term vulnerability.

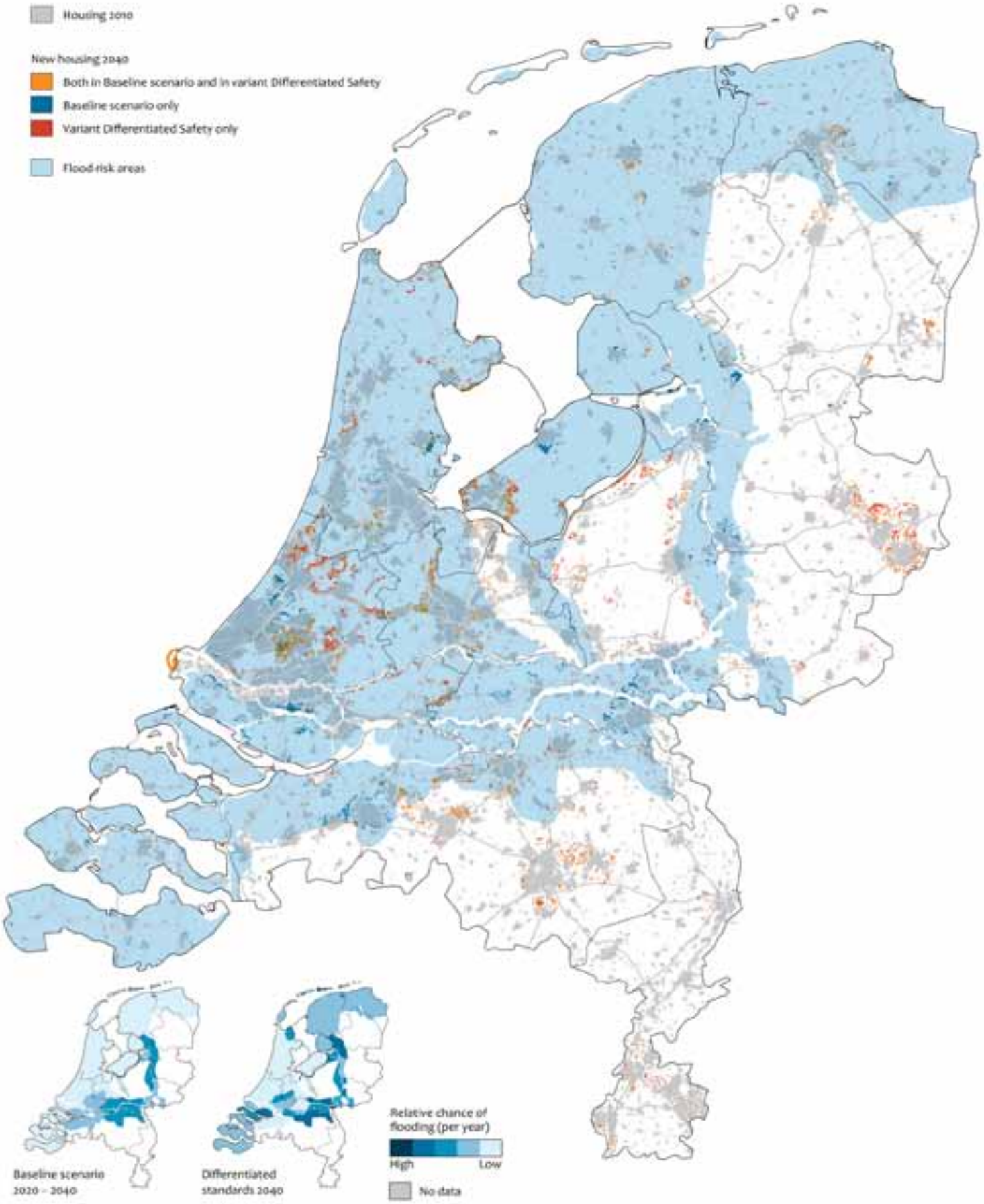
The strategic variants studied are characterised as follows:
1. Differentiation in safety levels / limited adaptation to climate change (*Differentiated Safety*).
2. Reduction in vulnerability: shift in investment to upland areas (*Uplands*).
3. Widened coastal zone: heavier investment in the low-lying Netherlands (*Widened Coastal Zone*)

Variant 1: Differentiation in safety levels / limited adaptation to climate change
In the *Differentiated Safety* variant, the Rhine-Meuse floodplain is more resilient than in the *Baseline* scenario, because the order in which the dyke rings flood can be arranged so as to cause the least possible damage. New developments can be located accordingly, which means that no new large-scale construction will take place in dyke rings where there is a relatively high chance of flooding. 'Overflow dykes' are built to make flooding as predictable and manageable as possible and thus reduce the risk of casualties.

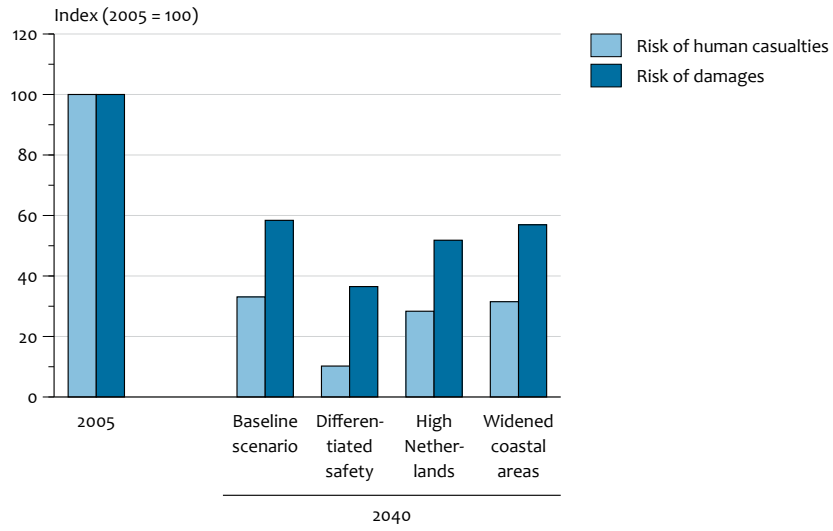
Variant 2: Shifting investment to the upland areas
The *Uplands* variant makes a radical break from the past trend in spatial development. From 2010 onwards, new housing and employment areas are located well away from the flood-risk area. This reduces the vulnerability of the Netherlands, and the remaining space then becomes available for future water management measures (keeping the main flood plains, the IJsselmeer area and south-western Netherlands free of new development).

Variant 3: Widened Coastal Zone – heavier investment in the low-lying Netherlands
In the *Widened Coastal Zone* variant the coastal zone is extended. The extent of this has not yet been decided and will depend on what society wants and on the funds available. It could take shape in different ways, varying from an archipelago similar to the Wadden Islands to an uninterrupted widening of the existing coastline. Here, we have opted for an uninterrupted (5km) widening of the coastal zone at a height of +5m Amsterdam Ordnance Datum (NAP) and, thus, the zone is capable of withstanding a substantial future sea level rise. Such a widening of the coastal zone is relatively easy to do and could potentially be used for important functions, such as housing and recreation. The extent to which these

Development housing 2010 – 2040 according to variant Differentiated Safety



Risk of damages and human casualties in case of flooding **Figure 4.4**



Compared with the Baseline scenario (expected economic damage 80 million euros per year), the damage and casualty risks decrease the most in the Differentiated Safety variant (Klijn et al., 2007).

functions could be developed, therefore, would be a significant option for recouping the costs (Syncera, 2007). The *WidenedCoastal Zone* variant is compatible with current discussions on such an option (see, for example, Holvoet *et al.*, 2005).

Spatial picture of the variants

Spatial development in the *Differentiated Safety* variant (Figure 4.3) differs from the *Baseline* scenario only in that there is less new development within the dyke rings that offer relatively little protection against flooding:

- less building activity in the upper reaches of the main rivers, with new development shifted to the Utrechtse Heuvelrug;
- a large proportion of new housing in the western Netherlands shifts away from the less safe dyke rings to the safest dyke ring (central Holland, generally referred to as dyke ring 14);
- in the Flevopolders, new housing is concentrated around Almere in southern Flevoland.

These shifts are accompanied by an alleviation of development pressure on the river landscape, but increased pressure on the landscapes of the Utrechtse Heuvelrug, the Veluwe and the Twente region in the east.

In the *Uplands* variant new employment and housing areas are located mainly in the Utrechtse Heuvelrug, on the fringes of the Veluwe and around the cities of North Brabant, Twente and South Limburg (Figure 4.5). This shift in housing and employment to the uplands largely reverses the trend of contraction and falling employment in some of these areas. As many amenities and jobs remain in the vicinity of the Randstad, this shift to the uplands will increase traffic.

However, pressure on the valued landscapes of the western Netherlands is alleviated and such a strategy offers good opportunities to strengthen the internationally important natural heritage in the low-lying Netherlands (e.g. peat districts, river areas).

The *Widened Coastal Zone* variant leads to considerable shifts in the development pattern in the western Netherlands compared with the *Baseline* scenario (Figure 4.2). Siting 50% of the housing needs of the provinces of South Holland and North Holland in the new coastal zone reduces the pressure on landscape in the western Netherlands and creates good opportunities to strengthen the internationally important natural heritage in the low-lying Netherlands (e.g. peat meadows). It adds to the options for developing attractive residential areas in the Randstad, and also increases the accessibility of recreational and nature conservation areas. This may be expected to increase the attractiveness of the region to businesses. Given the size of such a project and the need to keep house building on target in the next few decades, this option would appear highly ambitious – perhaps too ambitious. Ultimately, the available capacity and the possibilities for phased completion will largely determine its feasibility.

Qualitative assessment of effects

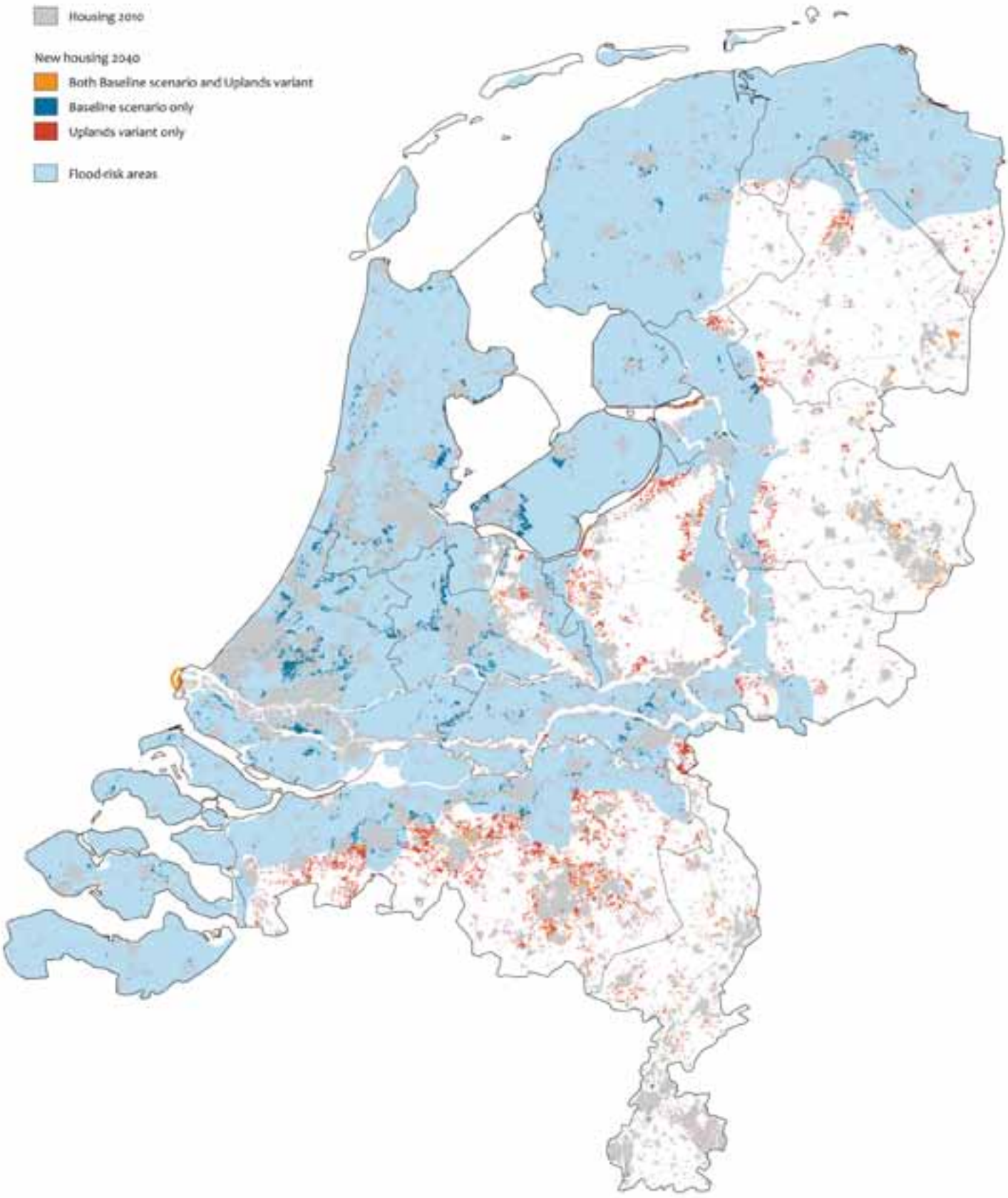
Flood safety

The *Differentiated Safety* variant is expected to lead to the sharpest decrease in risk of economic damage and particularly in the risk of casualties (Figure 4.4). The use of overflow dykes will increase the predictability of flooding and shorten the reaction time and so they should have a very positive effect

Figure 4.3

Growth in built-up area between 2010 and 2040, under the Differentiated Safety variant, compared with the Baseline scenario in 2040.

Development housing 2010 – 2040 according to Uplands variant



Effects of the climate and safety variants compared with the Baseline scenario for 2040 Table 4.2

Indicator	Differenti-ated Safety	Uplands	Widened Coastal Zone	Effects
Flood Defences				The *Differentiated Safety* variant leads to the sharpest decrease in the risks of economic damage risks and particularly the risks of casualties
Adaptation to Climate Change				Each of the variants offers in its own way more scope to absorb the effects of climate change than the *Baseline scenario*
Biodiversity				The *Uplands* and *Widened Coastal Zone variants* provide opportunities to improve biodiversity in the western Netherlands, the river areas and the coastal zone
Accessibility				The *Differentiated Safety variant* has a beneficial effect on parts of the western Netherlands; in other variants accessibility is worse owing to the more dispersed development pattern
Quality of the Living Environment				No significant change in the first variant. In the other two variants more green space becomes available around built-up areas
Residential Housing in Spacious and Green Surroundings				Concentration urban areas (fist variant) has adverse effect; land reclamation along coast (third variant) has positive effect
International Business Establishment				Positive image of the Netherlands generated by variants actively geared to increasing flood safety
Landscape Quality				All variants offer opportunities to retain the core qualities of the western Netherlands, the river areas of the coastal zone
Spatial Segregation				The Widened Coastal Zone and Uplands variants Are more likely to lead to spatial segregation

on the expected numbers of casualties. From an economic perspective, even better variants of the *Safety Differentiation* strategy may be possible (see Eijgenraam, 2005). The *Uplands* and *Widened Coastal Zone* variants lead to somewhat lower risks than the *Baseline* scenario. This is because the majority of the economic value and the population at risk are already found in the flood-risk areas (see Figure 4.1). Figure 4.1 also shows that, by 2040, the risk of damage can be reduced by no more than 20 to 30%, depending on the proportion of new housing that is 'flood proof'.

Biodiversity, landscape and quality of the living environment
Compared with the *Baseline* scenario, the effects of the *Uplands* and *Widened Coastal Zone* variants, in particular, are expected to be beneficial to nature and landscape in the low-lying Netherlands. The construction of new urban areas in the uplands substantially reduces the pressure on nature and landscape in the Randstad and the river areas. That creates opportunities for nature and landscape and contributes to the availability of open space (residential quality). In the uplands, however, development pressure will increase. The widening of the coastal zone creates new natural habitats, generates new and attractive living environments and relieves the pressure on the Green Heart. An important criterion for land use in any new coastal zone is to preserve the quality of the existing coastal settlements. It is still unclear to what extent the effects on these settlements of shifting the coastline can be compensated.

In the *Differentiated Safety* variant, the differences in spatial development are too slight. In contrast, the investment in new residential areas in the *Widened Coastal Zone* and *Uplands* variants may divert attention and funds away from urban restructuring.

Residential housing in spacious and green surroundings
The scope for meeting peoples housing preferences declines in the *Differentiated Safety* variant, because no new urban development is possible in the river areas and building is further concentrated in the dyke rings, where building density is already relatively high. In the *Uplands* variant, development pressure eases in the west but intensifies in the uplands. Because building densities are the same as in the *Baseline* scenario, the options for residential housing in spacious and green surroundings are similar. The *Widened Coastal Zone* variant, however, provides more scope to meet housing preferences owing to the development of attractive living environments in the new coastal zone.

Figure 4.5

Growth in built-up area between 2010 and 2040, under the Uplands variant, compared with the Baseline scenario in 2040.

Mobility and accessibility
Mobility and accessibility are better served in the *Differentiated Safety* variant than in the *Baseline* scenario. Accessibility increases particularly in the regions of Twente, Leiden, the bulb-growing area and eastern South Holland, as a result of the migration of people and jobs to those areas. In the *Uplands* variant, the shift in population away from the urbanised low-lying Netherlands to the more rural upland areas leads to increased mobility but impairs accessibility. The effects of the *Widened Coastal Zone* variant have not been calculated, but unless there are structural changes to the infrastructure, the already poor accessibility of the coast will probably worsen.

International Business Establishment
Apart from all the other factors that attract foreign businesses (see Section 4.6), the perception of the Netherlands as a safe delta and safe business location is important. At the moment, it is difficult to assess what this perception will be in future, given all the uncertainties and conflicting signals surrounding climate change and sea level rise. Strategies designed to enhance the protection of the low-lying Netherlands, particularly the Randstad, will presumably improve the country's image in this respect. The spread of government investments and the shift of new housing to the uplands, with no increase in the safety levels, will probably have a less favourable effect.

Adaptation to climate change
In both the *Uplands* and the *Widened Coastal Zone* variants, the vulnerability of the western Netherlands to groundwater seepage is reduced by siting a large proportion of new housing outside the areas at risk. This will allow the increasing seepage pressure and subsidence to be countered more easily by water management measures. In the case of existing built-up areas, however, such measures will be less effective. In the *Uplands* variant there is no longer any construction in the flood-risk area, which means that the Rhine-Meuse floodplain, the IJssel valley and the islands in the south-west of the Netherlands will largely remain open. The development of a wider and elevated coastal zone may have significant added value in the very long term, if the sea level rises by several metres. The costs of widening the coastal zone depend to a great extent on how wide this new coastal strip is, and its profitability depends on the ways in which the costs can be recouped.

Spatial segregation
The effects of the various safety variants on spatial segregation are almost impossible to assess. The *Differentiated Safety* variant does not involve that many spatial shifts compared with the *Baseline* scenario. In the *Uplands* variant, however, the spatial shifts are so dramatic that it is virtually impossible to determine the effects. Lastly, the *Widened Coastal Zone* variant entails the risk that it will be mainly the middle and upper socioeconomic groups who move to the new residential areas, but whether or not this will actually happen depends mainly on factors that are independent of this safety variant.

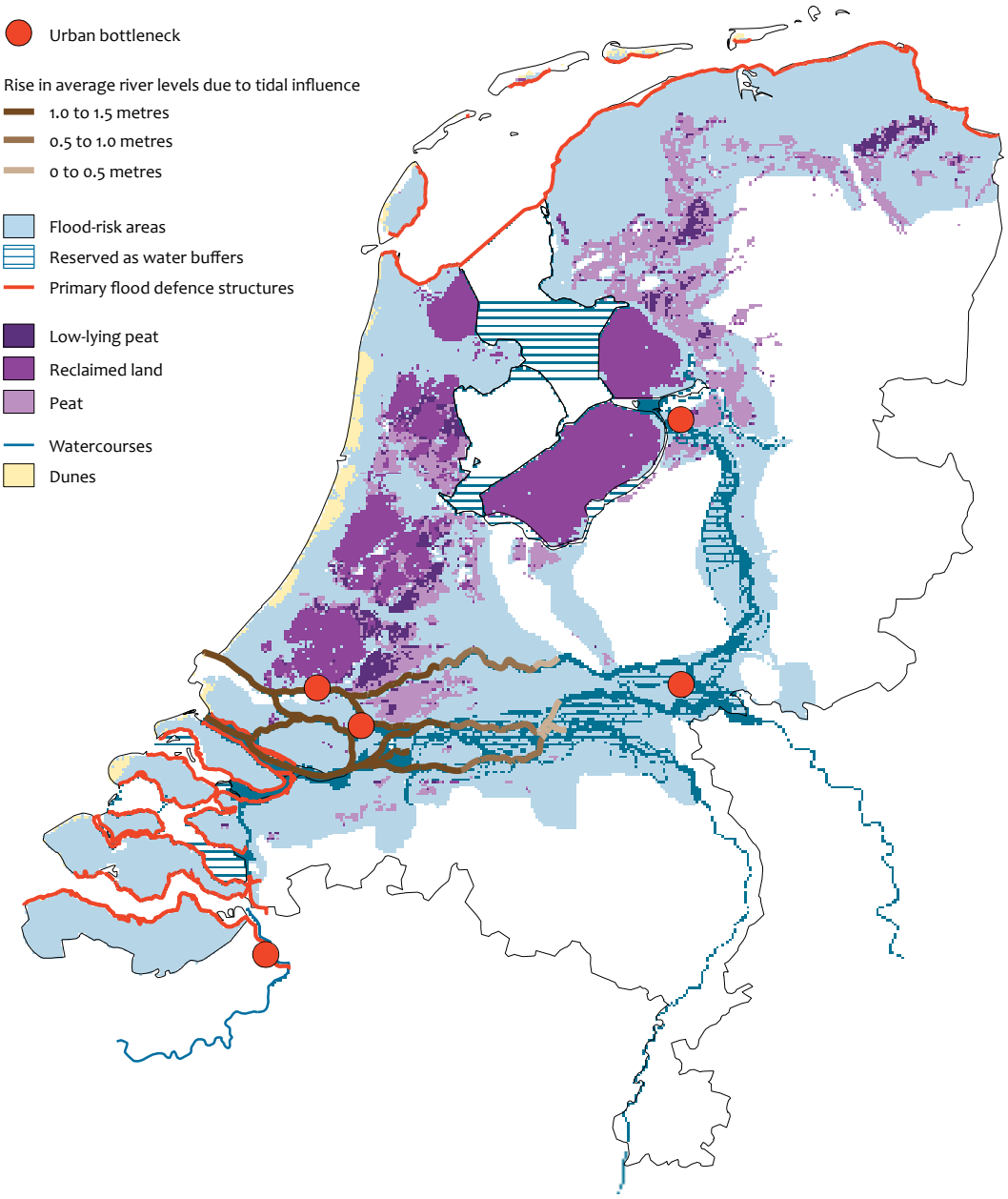
Vulnerability of the Netherlands to rising sea levels in the Worst-case scenario
The recent motion by MPs Bochove and Depla (2006) requested the government to draw up a list of the areas that, in a worst-case climate scenario, could be seriously threatened or would need large-scale water retention facilities before the end of the century. Extrapolating from the analysis in Chapter 2, a rise in sea level of 1.5 m per century can be regarded as the *Worst-case* scenario. The chances of such a rise are considered slight at the moment, but Dutch experts have, after intense deliberation, come to the conclusion that a rise of 1.5 m per century is 'not inconceivable' (see also Figure 2.1). If such a rise does actually occur, then not only will the situation around 2100 be an important factor when considering ways to manage the rise, but also the years thereafter. Because of the very delayed responses in the climatic and oceanic systems, the sea level will presumably continue to rise at the same rate after 2100.

Assuming that the sea level does rise by 1.5 m by 2100, and continues to rise beyond this date, protection of the Delta and inland areas against coastal flooding will be a problem (particularly around Rotterdam/Dordrecht and the IJsselmeer area). Also, the problem of increased river peak discharges and possibly increased groundwater seepage are then expected to become apparent (Figure 4.6).

Maintaining the protection level of areas protected by 'hard flood defences' (dykes) will require considerable additional efforts (to raise and strengthen the dykes). The areas affected are the urban bottlenecks of Rotterdam and Dordrecht (including the Maeslantkering storm surge barrier), Antwerp, the dyke rings in Zeeland and on the islands of South Holland and the dyke rings in the lower reaches of the main rivers subject to tidal influence, the Afsluitdijk (Enclosure Dam), the IJsselmeer area, and the dykes at Grevelingen, Oosterschelde and Haringvliet. 'Soft flood defences' (the dunes) present less of a problem, but more beach nourishment capacity is necessary to maintain the safety level. It is still not sufficiently clear how much increased groundwater seepage due to the higher water levels in the rivers and the delta will impair the stability of the dykes.

Assuming that it is possible to counter a sea level rise of 1.5 m per century by raising the dykes, the Advisory Committee on Financing Primary Flood Defence Systems (Adviescommissie Financiering Primaire Waterkeringen, 2006) estimates this will require an annual investment of around 800 million euros to maintain safety levels. In the event of such a rise in sea level, however, it is within the bounds of possibility that sometime in the next two centuries the river estuaries in the west will become entirely cut off from the sea (Klijn *et al.*, 2007). The latitude in the river system and the waters in the delta and the IJsselmeer areas will partly determine the possibilities for coping with such a situation.

Water depth is an important factor for the chances of survival in the case of flooding. Areas that will have to cope with relatively deep water and which are close to flood defences, therefore, run greater risks. Places where the physical situation (water depth and proximity to flood defences) is already very unfavourable will be in an even worse situation



Vulnerable areas in the Netherlands according to the Worst-case scenario of a 1.5 m rise in sea levels by the end of this century, in line with the motion by Bochove and Depla (2006). The chance of such a rise in sea level is considered very unlikely at the moment (see Chapter 2).

if water levels rise sharply. Apart from raising the dykes to reduce the likelihood of flooding, it is important to consider possibilities for evacuation, local refuge centres (high ground, tall buildings) and risk and crisis communication (what to do and what not to do).

Conclusions

- Even if the sea level rises by up to 85 cm per century, the low-lying Netherlands and the Randstad agglomeration would still seem to be able to withstand climate change and rising sea levels for some centuries, although this will require ongoing and intense efforts to maintain protection levels. The prevailing method of coastal reinforcement and beach nourishment are sufficient to cope with the rising sea level. There seems to be no great urgency to abandon further investment in the Randstad this century. Structural spatial planning responses, such as shifting investment to the uplands (retreat) or developing an extensive new coastal zone are unnecessary at the moment, from a flood safety perspective – other than as precautionary measures.
- The consequence of opting for further investment in the Randstad and the low-lying Netherlands is that the

... in the lower reaches of the rivers, high sea levels coincide with high river levels . . .

... the IJsselmeer, including the Markermeer, is an important high-water buffer ...

economic vulnerability of the Netherlands will continue to grow. By 2040 the potential economic damage will have increased by 100 to 250%, owing to the appreciation in value of existing buildings and infrastructure and the construction of new housing. Depending on the economy, demography and the housing market, the new built-up area will contain 20 to 30% of the total potential damage. For economic reasons, a rise in the safety levels of some dyke rings is justified. In the 2020-2040 period, this will require an additional investment of 0.8 billion euros, compared with 1.5 billion euros to maintain current safety levels in the same period (Klijn *et al.*, 2007).

- A strategy of differentiated safety standards, compartmentalisation and overflow dykes can also be pursued in order to considerably limit the risks, particularly the casualty risks, and to make the river system more robust. This will require an investment of over 3 billion euros in 2020 to 2040, but would reduce the potential annual damage by 35% and – depending on the engineering options – reduce the casualty risk by possibly as much as 70%.
- Given the serious consequences for the Netherlands, it is necessary to look at what the *Worst-case* scenario – referred to in the Bochove and Depla motion – would mean, although the chances of this actually happening are currently considered very slim. Assuming the sea level rises by 1.5 m each century, structural changes to safety strategy will be necessary within one or two centuries. Steering the direction of spatial development can reduce the vulnerability of the Netherlands and limit the long-term risks, while keeping future options open. Major decisions need to be taken on keeping the floodplains, the IJsselmeer area and the Delta area free from development or reserving land for water retention basins (WL | Delft Hydraulics, 1998; Klijn *et al.*, 2002). Further research is needed into the scale, severity and manageability of the potential groundwater and seepage problem, particularly in relation to the stability of the flood defences.
- Even if the sea level rises less rapidly, the pattern of development in those areas will eventually partly determine which hydrological solutions are still possible. Opting for robust spatial development, with an eye on the potential long-term risks related to the rise in sea level, brings other benefits: it offers significant potential synergies with the development of internationally important natural habitats and National Landscapes.

4.3 Robust nature

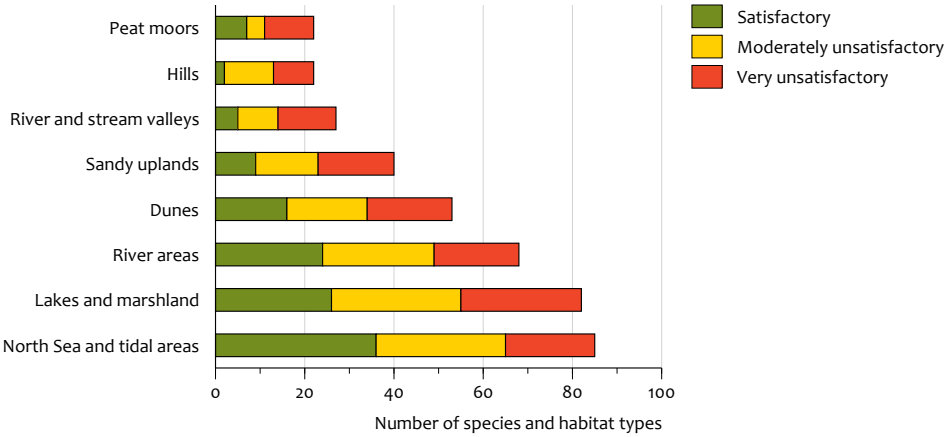
Problem outline

Within the framework of the global Convention on Biological Diversity (CBD), the EU has agreed that the decline in biodiversity must be halted by 2010. The Birds and Habitats Directives are important instruments for achieving this. To underpin these directives, the EU is creating the Natura 2000 network of protected areas. The Netherlands, similar to other Member States, have designated Natura 2000 areas and reported them to the EU. Most Natura 2000 areas in the Netherlands are also part of the National Ecological Network. All these policies aim to conserve biodiversity and variety in nature.

The conservation status of very many species and habitats in Natura 2000 areas is unfavourable (Figure 4.7).The current high pressures on the environment and on land (due in part to desiccation and eutrophication) have a detrimental effect on the conditions for these species. The same problems affect the target species of national policy. Such problem areas remain unresolved in the *Baseline* scenario. The realisation of the National Ecological Network will increase the overall area devoted to nature conservation, but this area will remain fragmented and so the spatial connectivity required to support certain species will still be insufficient and the pressure on the environment will remain high.

The Possible solutions and Spatial scenarios

The questions posed by the *Robust Nature* scenario focus are how the Netherlands can comply with European agreements and what that means for national nature policy. The goal of the focus is the sustainable conservation of Natura 2000 habitats and species. Spatial connectivity between nature conservation areas must then be established, as must the required environmental conditions. This may have



The conservation status of many species and habitats in Natura 2000 areas is still inadequate(Source: Ministry of LNV, 2006).

consequences for other land uses in Natura 2000 areas, as well as elsewhere.

An important starting point is that the conservation and restoration of biodiversity benefits from the maintenance and creation of large contiguous ecosystems. Large areas have the following advantages over smaller sites (see, for example, Verboom *et al.*, 2001; Opdam and Pouwels, 2006):

- There is enough space for natural processes, such as flooding and shifting sands, which is one of the basic objectives of nature policy.
- There is less pressure on environmental and water conditions from surrounding areas, owing to the greater distance between the core areas and the sources of these pressures, such as agricultural and urban land uses.
- The bigger the area the better the chance of certain environmental gradients being present; various species are dependent on such gradients.
- There is greater resilience to extreme conditions, such as climatic extremes due to climate change.
- There is enough space for species that require a relatively large habitat, such as the bittern, otter and sea eagle.
- Larger areas permit better zoning for recreational use, which reduces the chances of disturbance.
- Large sites provide certain amenity benefits, such as a sense of space and tranquillity.

The Natura 2000 areas which the government has reported to the EU, form the basis of the robust structure intended in this focus. The areas of some habitats (e.g. Junco-Molinion peat meadow) need to be expanded if their conservation is to be guaranteed over the long term. This focus foresees an expansion of the nature conservation area with habitats as yet insufficiently represented and located as close as possible to Natura 2000 areas (Figure 4.10). An expansion of nature sites is also necessary to increase the spatial connectivity of the nature network to an extent that will ensure the long-term conservation of Natura 2000 species.

The nature conservation sites in the *Robust nature* focus (terrestrial Natura 2000 areas plus additions; Figure 4.8) cover some 660,000 hectares in total. This is approximately the same number of hectares as the National Ecological Network in the *Baseline* scenario (NEN targets excluding agricultural conservation management). Although the areas in the two variants are therefore comparable, there are considerable differences in the spatial breakdown of that area.

Sustainable conservation of Natura 2000 habitats and species depends not only on activities within Natura 2000 areas, but also on the land uses and activities in their vicinity. Examples include the lowering of the water table for agricultural purposes and nitrogen emissions.

In this focus, Natura 2000 areas are surrounded by buffer zones, in which the land uses and activities have to be modified or adapted so that they do not prevent the respective Natura 2000 area from developing the desired nature conservation values.

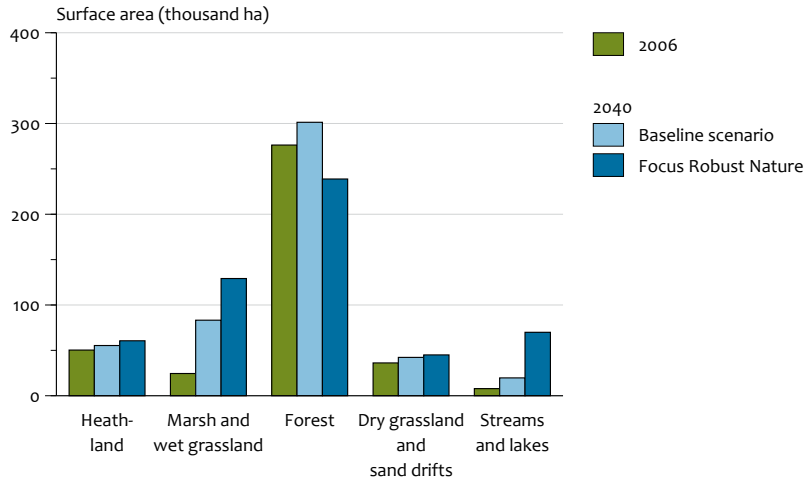
Agricultural uses will often continue in these buffer zones, but in a modified form (nature and water services). Other functions may sometimes also be possible, provided they meet the requirements of the Natura 2000 area. Housing, for example, need not be ruled out in the vicinity of Natura 2000 areas that are sensitive to desiccation, provided the construction methods are appropriate to the relatively moist conditions.

In this study, the boundaries of the buffer zones are based on the underlying hydrological systems. In these zones, the water table is allowed to rise to prevent desiccation in Natura 2000 areas. The total area of these buffer zones is approximately 400,000 hectares, of which about 320,000 hectares are in agricultural use. Approximately half of this area is more than 250 m from the site to be protected to keep water damage to crops to the minimum. There is a marked effect on the agricultural land that lies within 250 metres,

Focus Robust Nature **Figure 4.8**

Protection of Natura 2000 areas is insufficient to ensure the sustainable conservation of Natura 2000 habitats and species. The nature conservation areas need to be expanded at various locations. Zones in which land uses are adapted to the objectives of the Natura 2000 areas are also required. These zones are referred to here as buffer zones.

Surface area per nature type **Figure 4.9**



Compared to the Baseline scenario, the focus Robust Nature puts more stress on marshland, wet grassland, rivers/ streams and lakes, with less emphasis on forest ecosystems.

which is expressed by lower yields and limitations on use. In monetary terms, this amounts to approximately 25 to 100 million euros per year (based on Van Bommel *et al.*, 2007).

Qualitative assessment of effects

Biodiversity

The *Robust nature* focus puts greater stress on the wetland ecosystem types than the *Baseline* scenario (Figure 4.9). It also places extra emphasis on the dunes and ecological

The achievement of conservation objectives is often hampered by environmental pressure from other land uses, such as agriculture, in the buffer zones around Natura 2000 areas. In this case, flower bulb cultivation is incompatible with the higher groundwater levels necessary to achieve the conservation objectives for the coastal dunes.

gradients around the ice-pushed ridges, such as the Veluwe and the Utrechtse Heuvelrug. These are areas with a wide variety of soils and with high-quality groundwater, and they support many biodiversity hotspots containing Natura 2000 species. In contrast, forest ecosystems play a less prominent role than in the *Baseline* scenario.

In the *Robust Nature* focus, the countryside outside the nature conservation areas is also important to a number of Natura 2000 species. The Birds and Habitats Directives were not designed just to create a network of nature reserves; they also protect certain species, under provisions which apply both within and outside Natura 2000 areas. Protected species include the great crested newt, Montagu's harrier and various members of the bat family. To conserve the habitats of these species, it is generally unnecessary to assign them a nature function, although agricultural practices may need to be modified. The Montagu's harrier, for example, is found in the arable farmlands of eastern Groningen and in Flevoland, which partly lie fallow.

One of the basic aims of the *Robust nature* focus is to establish large contiguous ecosystems. This can be clearly seen in Figure 4.11. If the buffer zones are also included, there will be even more emphasis on larger nature conservation areas.One effect of the urban compaction policy is that spatial connectivity for animal species is much better than in the *Baseline* scenario. It should be noted that this applies not only to Natura 2000 species, but also to other target species for the National Ecological Network (Figure 4.12).

For the sustainable conservation of habitats and species, not only is spatial connectivity important, but also the environmental conditions must be right. Water table drawdown, water quality and ammonia deposition all need to be addressed. The creation of larger nature conservation areas often leads to considerable improvements in environmental conditions. In the case of desiccation (damage to habitats resulting from a water deficit), the formation of buffer zones around Natura 2000 areas will considerably improve the conditions in these sites. While the continuation of the current ammonia policy will undoubtedly reduce emissions and depositions, deposition will remain above the critical level in at least half of the nature conservation areas (Van Pul *et al*., 2004; MNP, 2006b). A more stringent generic policy is needed to reduce nitrogen deposition.

As well as the existing generic policy on aquatic nature, additional policy must be adopted for some Natura 2000 areas in order to reduce the input of nitrates and phosphates via surface water (MNP, 2006a). If groundwater levels are raised in some agricultural areas, the phosphates already present in the soil and adsorbed onto soil particles may be released into the soil solution, which can lead to greatly increased phosphate concentrates in the surface waters in Natura 2000 areas (RIVM, 2001). At some sites, local measures can resolve this problem, such as modified agricultural practices, purification of wastewater or the establishment of helophyte filter beds. These measures have already proved very successful in some cases, such as in the Naardermeer. The quality of large water bodies, such as the IJsselmeer and the North Sea, depends on measures that need to be taken on a much larger scale, sometimes even at the transnational level.

As a consequence of the lower environmental pressures than in the *Baseline* scenario, less intensive management efforts are required to combat these pressures. Large core areas also offer greater scope for natural processes, such as flooding and drifting sand, which have to be simulated in smaller areas, which in turn increases costs.

Land use 2040 according to focus Robust Nature

Several Natura 2000 areas require cross-border coordination of measures. For example, the upper reaches of a number of stream systems are in Germany or Belgium. The measures taken in the upstream areas determine to a great extent the water quality downstream in the Netherlands.

Since this report is mainly about spatial planning policy in relation to land use, the large bodies of water (the Wadden Sea, the delta area, the IJsselmeer and its 'ring lakes') are not covered. Nevertheless, some observations are called for. They are areas of great international significance and they also form part of Natura 2000. There are various plans that could have a major impact on these areas, such as the construction of the Maasvlakte 2 (Europoort) and the deepening of the Westerscheldt estuary. Plans to designate marine nature reserves are also being formulated.

Nature conservation outside the robust nature network
Outside the nature conservation areas included in the *Robust nature* focus (terrestrial Natura 2000 areas plus additions), there is an estimated further 150,000 hectares of existing 'nature areas', mainly multifunctional forest on the higher sandy soils. These are generally protected in municipal land-use plans.

For this focus, an analysis has been made of the consequences for these areas if they were not protected. It appears that various areas would come under pressure for development (Figure 4.13): the Utrechtse Heuvelrug, the urban concentration areas outside the Randstad (North Brabant, Twente, Groningen) and the woods along the eastern edge of the Flevoland polders. New housing, employment sites or facilities for intensive recreation or tourism would be planned in these areas if planning defences were removed.

Existing nature outside the robust nature network contributes only slightly to the quality of Natura 2000 *areas*. It does, however, fulfil an important function for a number of Natura 2000 *species* and for biodiversity goals at national level. Many of these areas also have considerable recreational value, particularly wooded areas close to the cities, such as the Utrechtse Heuvelrug. Existing nature areas outside the robust nature network are also important components of the landscape.

Part of the area of the National Ecological Network that has not yet been established is included in the robust nature network in this focus. Obviously, the realisation of this part of the National Ecological Network should be a priority. This land is also very attractive for other uses, such as housing, particularly in ecological gradient zones such as the fringes of the Veluwe. The development pressure on these areas is great.

Marshland strengthens the wetlands axis

Marshland is the habitat of numerous species. Many marshy areas are fragmented, despite the presence of a small number of large core areas. Moreover, species such as the bittern, great reed warbler and otter require a large area, so the larger marshes are their only suitable habitat. In the Robust nature focus, the wetlands axis in the western Netherlands is augmented with reed beds and wet grasslands. These habitat types are nutrient-rich, which makes a combination with water storage possible.

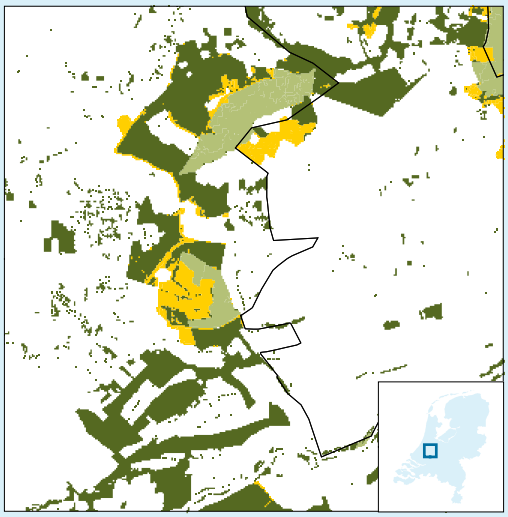


Figure 4.10

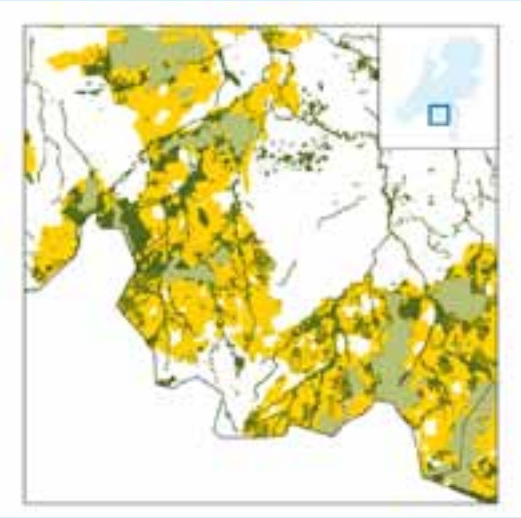
The Netherlands in 2040 under the focus Robust Nature.

Emphasis on ecological gradients

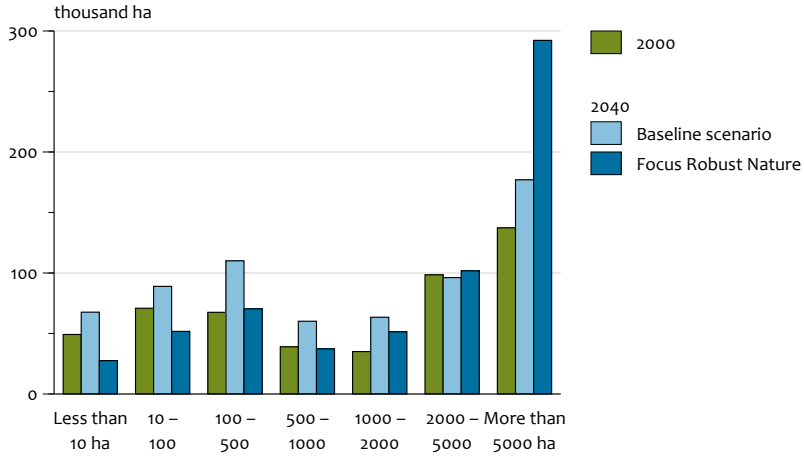
The ecological gradients around the ice-pushed ridges are important for the maintenance of biodiversity because they are home to concentrations of species. The reason for this biodiversity lies in the transition from the higher moraine material via the lower ground to the rivers and lakes. Water, in the form of streams and groundwater flows is an important factor in the maintenance of this biodiversity. Where water quality is good, there will be pockets rich in wildlife.

Fragmentation in stream valleys

The stream valleys are traditionally used as pastureland and hay meadows in combination with upland heath. The reorganisation of agriculture has led to fragmentation of the stream valleys habitats and many streams have been artificially straightened. Natural streams are important for aquatic species such as the European brook lamprey and the green club-tailed dragonfly, which are European protected species. Enlargement of the nature conservation areas and the restoration of the hydrological systems are essential for the protection of stream valley species. Wet heath and wet grassland are highly dependent on a supply of good-quality water. Safeguarding this will protect many endangered species. Natural upper reaches can be used for water retention and the lower reaches for flood prevention. In areas close to the eastern and southern borders, the upper reaches of these streams are in Germany and Belgium, so international cooperation is necessary.

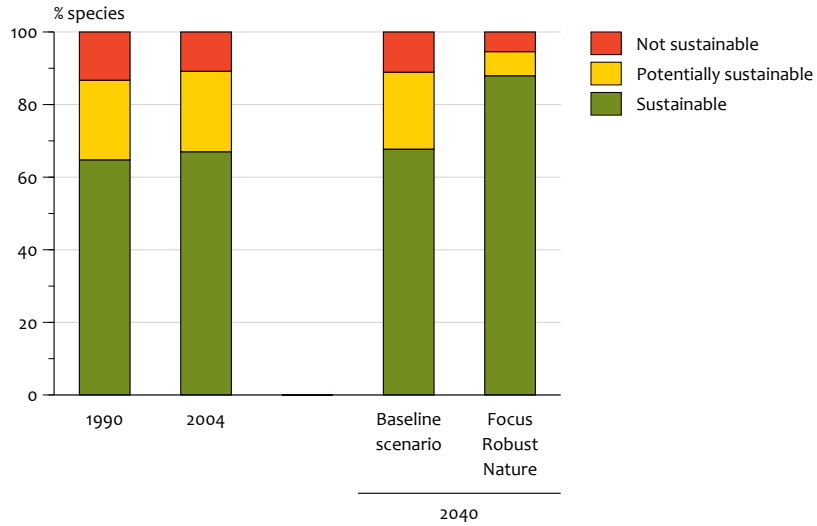


Nature surface area, per land surface area **Figure 4.11**



The Robust nature focus places greater emphasis on large contiguous conservation areas, whereas the Baseline scenario paints a more fragmented picture. This figure shows the breakdown in size of the combined categories 'terrestrial Natura 2000 areas' plus 'expansion of nature conservation areas' shown in Figure 4.8; buffer zones are not included.

Spatial conditions fauna species **Figure 4.12**



The Robust nature focus improves spatial conditions for both Natura 2000 animal species and the animal species targeted by national policy. Animal species that (possibly) cannot be sustainably conserved require such a wide area of habitat that they are also dependent on areas outside the Netherlands.

Climate and safety

In various places there is a positive correlation with other focuses, especially with *Climate and safety*. It is desirable, both from a safety and a robust nature focus to safeguard the peat meadows in the west of the Netherlands against building. This will secure more land for nature conservation and the establishment of a wetland axis. The opportunities to exploit such opportunities are particularly high in areas where there is a good chance of cracking or fracturing of the soil surface under the upward pressure of groundwater seepage (see Section 2.2).

A second form of positive correlation is the reservation of land in the catchment area of the river IJssel. This is necessary because water that can no longer be discharged through the branches of the Rhine near Rotterdam, owing to the rise in sea level, will be diverted to the IJssel. If this is accompanied by the creation of natural habitat it will create major opportunities to expand the area available for internationally important biodiversity.

Opportunities for water storage can also be found in the drainage basins of stream systems. If more water is retained in the upper reaches by modifying the landscape structure to make it more suitable for the development of natural

Not all existing nature contributes to the realisation of Natura 2000 goals. This applies particularly to woods, as shown in the photograph. Such areas do, however, fulfil an important landscape and recreational function. They are also of significance to national biodiversity.

Focus Robust Nature **Figure 4.13**

Some existing nature conservation areas are under considerable development pressure. This applies particularly to the Utrechtse Heuvelrug, but also to the nature areas situated in the urban concentration areas outside the Randstad.

The IJssel is expected to play a major role in the discharge of water from the Rhine. This will benefit nature if the landscape and land uses are adapted accordingly.

habitats, the risk of flooding in Breda, Den Bosch and other cities will be reduced.

The combination of the *Robust nature* and *Climate and safety* focuses makes clear the need for a vision on water management in the Netherlands. This involves a combination of factors:

- the sustainable conservation and restoration of internationally important biodiversity; not just providing space for nature, but also including the restoration of natural processes (flooding, tidal influences, exchange of fresh and salt water);
- protection against flooding, including land for water retention;
- the constant availability of sufficient fresh water to supply drinking water; the IJsselmeer and the Biesbosch should be looked at in this regard.

Accessibility
The accessibility effects are difficult to interpret because of regional shifts in development patterns. For instance, the population is declining both in poorly accessible regions, such as East Groningen, Delfzijl and North Friesland and in well-accessible regions, such as Rijnmond and Greater Amsterdam. The most significant effect, however, is the restriction placed on building in rural areas. This leads to a concentration of urban development, but not an intensification of the existing urban area. A consequence of the concentration effect is that, compared with the *Baseline* scenario, there is a nationwide increase in the numbers of people living in urban residential areas at the expense of rural living environments. Such a shift is expected to yield accessibility gains because people in urban locations have more options and potential destinations.

Quality of the living environment
There is more green space around the cities than in the *Baseline* scenario. This improves the opportunities for walking and cycling in the Randstad. An improvement is also seen outside the Randstad (particularly near the cities in North Brabant). If more land is allocated to building in nature areas outside the robust nature network, such as the Utrechtse Heuvelrug, this could reduce the recreational capacity of these areas.

Residential housing in spacious and green surroundings
The *Robust nature* focus places restrictions on new housing close to Natura 2000 areas. Space for residential housing in spacious and green surroundings will therefore become limited, particularly in the western Netherlands. Elsewhere, land for building may become available in parts of the National Ecological Network that have yet to be established and which do not fall within the robust nature network. It is expected that, on balance, the options for building residential housing in spacious and green surroundings will be fewer than in the *Baseline* scenario.

Landscape
The *Robust nature* focus is a considerably more favourable scenario for the core qualities of the Dutch landscape than the *Baseline* scenario. The impact of buildings on the open character of National Landscapes, such as the Green Heart, Hollands Laag and Hoeksche Waard, is limited, although the character of the area will change through the creation of more marshland. The cultural core qualities in the Green Heart and the Nieuwe Hollands Waterlinie (New Dutch Water Line) are better conserved than in the *Baseline* scenario.

Compared with the present situation, the amenity value of the landscape will improve in areas where core conservation

Effects of the focus Robust Nature, compared with the Baseline scenario for 2040 Table 4.3

Indicator	Robust Nature	Effects
Flood Defences		No significant change in risk to population and economic damage
Adaptation to Climate Change		Flood control can be linked to more space for nature in the river areas, fenland peat areas and stream valleys
Biodiversity		Natura 2000 habitats and species and national target species benefit from the robust-nature network
Accessibility		Socio-financial accessibility gains show no or only slight increases
Quality of the Living Environment		More greenery around the cities; no significant change in noise levels
Residential Housing in Spacious and Green Surroundings		Limited opportunities to meet individual housing preferences for spacious and green surroundings
International Business Establishment		No substantial changes in traffic congestion, risk perception, or growth opportunities in the northern wing of the Randstad
Landscape Quality		Little impact on the open character, cultural core qualities and amenity values of National Landscapes
Spatial Segregation		No significant effect on the spatial breakdown of socio-economic groups.

areas are strengthened, for example, the Green Heart, Laag Holland, north-west Overijssel and the river areas. This is at the expense of the amenity value of nature conservation areas that are under considerable pressure from urban areas and are outside the Natura 2000 core areas, such as the Utrechtse Heuvelrug and parts of Twente and western Brabant.

By setting up buffer zones around nature conservation areas, the *Robust nature* focus makes a greater spatial distinction between different types of agricultural activities.

Conclusions

- Based on the international objectives of the European Union and the Convention on Biological Diversity, the *Robust nature* focus strengthens the existing Natura 2000 areas in order to sustainably conserve the quality of the natural habitats they contain. This option highlights the delta character of the Netherlands: it stresses the marshlands in the low-lying Netherlands, the Rhine-Meuse floodplain and stream valleys.
- The nature conservation area required to meet the Natura 2000 objectives as defined in the *Robust nature* focus corresponds to the area of the National Ecological Network in the *Baseline* scenario. The two variants differ considerably in the spatial breakdown of the area devoted to nature. One major difference is that the National Ecological Network in the *Baseline* scenario has a fragmented character, while the *Robust nature* focus consists of large interconnected units. Such a coherent structure can only be created if relevant policies are actively pursued at the national level.
- Sustainable conservation of nature requires that land uses in the groundwater buffer zones around nature conservation sites adapt to the wetter conditions. The adaptation of urban land uses can be resolved by adopting certain engineering techniques, while the adaptation of agricultural activities could be stimulated by granting EU subsidies to support relevant measures in these areas.
- While the continuation of existing ammonia policy will cut emissions and depositions, depositions on at least half of the nature areas will remain above the critical level. A stringent generic policy is needed in order to reduce nitrate depositions. Supplementary policy is required for some aquatic Natura 2000 areas, in addition to the present generic policy, in order to reduce the input of nitrates and phosphates via surface waters.
- The development pressure on nature outside the Natura 2000 network is high at a number of sites close to urban areas. This is the case in the north of the Utrechtse Heuvelrug, in western Brabant, on the southern border of Flevoland and around cities outside the Randstad. The conservation of these areas should be undertaken at the regional level, which will allow the recreational function of such areas to be retained.
- The marshlands planned for the low-lying Netherlands and the landscape works in the river areas are in line with the measures that must be taken to protect against the effects of climate change. Water retention is necessary in the low-lying Netherlands and this can be accommodated in the marshlands, while the rivers must have the required capacity to safely discharge large volumes of water. House building in these areas is risky because of climate change and is undesirable from a nature conservation perspective.

4.4 Clustering and intensification

Problem outline

Compact urban development has been a basic principle of spatial planning in the Netherlands for the past fifty years. The way this principle has been applied, however, has differed over the years, and the motives for adopting this ‘compact city’ approach have also varied. The main aim

Old dockland areas offer opportunities for new uses within the existing urban area.

throughout the years has been to retain open space or open countryside (such as the Green Heart), but, over time, various other targets have been added, such as a reduction in car use and a limitation on traffic-related environmental impacts (see Zandee, 2006). Despite many decades of research into urbanisation patterns both in the Netherlands and abroad, there is still much discussion on the nature and extent of the effects, feasibility and support for urban compaction policy (see, for example, Jenks *et al*., 1996; Breheny, 1997; Geurs, 2006).

Current policy, as formulated in the National Spatial Strategy (Ministries of VROM, LNV, VenW and EZ, 2006), endeavours to concentrate urban development and economic activities within designated areas, where possible within adjacent existing built-up areas, or in new concentrated areas elsewhere. Central government wants to make optimum use of the limited space available and of the investment in infrastructure, and also to support the cities in their function as economic and cultural motors. The National Spatial Strategy gives an operational objective for urban compaction and a target for the degree of concentration. The longer-term target for concentration is that the ratio between the number of houses and jobs within the (designated) urban concentration areas and outside these areas must remain at least the same. The target for concentration is to realise 40% of the total expansion programme for houses and employment locations in the built-up area as it existed in 2000. The *Baseline* scenario assumes, based on extrapolation from historical trends, that the objective for urban compaction will be achieved, but that the (very ambitious) target for urban intensification is not (see Section 2.3). It is assumed that 13% of the net national house building programme between 2002 and 2030 will be realised in the existing built-up area, the majority of it being completed by 2010 (Groenemeijer, 2006). There are big differences between cities in ambitions and the availability of central locations. Some will be able to achieve the ambitious targets laid down in the National Spatial Strategy more easily than others. Brouwer *et al*. (2006) have compared the building programme for 2010 to 2019 with completion rates within the cities in the past ten years. In cities which still have large obsolete docklands, industrial sites or sizeable open sites available, planned housing provision is sometimes much greater than in the past, but in others it will be much harder to achieve the 40% target. The stated goal in the National Spatial Strategy of realising 40% of the house-building programme in the existing built-up area, therefore, seems somewhat over-ambitious.

The Proposed solutions and Spatial scenarios

In order to get an idea of the range of effects, a high degree of both clustering and intensification was analysed in the *Clustering and Intensification* focus. This is combined with various investment programmes for road and rail infrastructure and for road pricing. The basic principles underlying the *Clustering and Intensification* focus are as follows:

1. *Intensification*: Half of the house-building programme for between 2011 and 2040 will be realised (per region in the built-up area as it existed in 2000. This is based on the assumption that around 500,000 homes will be built in the existing built-up area between 2010 and 2040. It is assumed that the house-building programme for the province of Flevoland will be realised entirely in the form of urban extensions. According to the PRIMOS Medium-Term Forecast (Brouwer *et al*., 2002), net house building expressed as an absolute number of homes more or less amounts to the ambitious target in the National Spatial

Strategy. This focus does not assume any increase in the density of businesses and jobs in the existing urban area. It does assume that obsolete docklands and industrial sites will be transformed mainly into housing areas in order to achieve the house-building target for the built-up area.

2. *Clustering*: In provinces where concentration areas have been designated in the National Spatial Strategy, the urban extension locations (residual allocation) fall entirely within the concentration areas. No urban concentration areas have been designated in the provinces of Friesland and Zeeland; urban extensions in these provinces will be in line with the *Baseline* scenario. Urban extensions in the concentration areas are located 1200 metres from existing or planned railway stations. If there is insufficient space in those areas to accommodate the housing allocations, building can take place elsewhere (but still within the concentration areas). For employment, it is assumed, as in the *Baseline* scenario, that concentration percentage per province will remain the same.
3. *Infrastructure*: The investment programme for road and rail infrastructure is assumed to be identical to the *Baseline* scenario: the Multi-annual Programme for Infrastructure and Transport 2005 and the additional investment programme in the Mobility Policy Document are assumed to have been realised (see Section 2.3).

At a later stage in the analysis, four infrastructure variants of point 3 above were studied, with alternative investment programmes for road traffic or public transport. This was combined with the introduction of road pricing based on time, place and environmental criteria, in line with the basic principles outlined in the Mobility Policy Document. The variants were as follows:

- *Variant 1: Policy-neutral infrastructure.* The road investment programme in the Multi-annual Programme for Infrastructure and Transport of 2005 is completed. The additional investment programme in Mobility Policy Document is not realised.
- *Variant 2: Road pricing.* A national road pricing scheme based on a kilometre charge differentiated by time, place and vehicle characteristics, in line with the basic principles outlined in the Mobility Policy Document and the Coalition Agreement. This variant includes varying car ownership taxes and 25% of the car purchase tax, plus a congestion charge for all road traffic. The structure of the road pricing has been taken from analyses carried out for the Mobility Policy Document (AVV/MNP, 2005).
- *Variant 3: Road pricing and better quality public transport.* This variant includes an improvement in the quality of public transport in addition to road pricing. The package of measures includes improvements to the existing transport infrastructure but not the construction of new routes. Compared with the *Baseline* scenario, it will provide for (a) a doubling in the frequency of existing train services within and between urban concentration areas, (b) the opening of new railway stations and increased frequency of services in the southern wing of the Randstad (Stedenbaan) and at major urban extensions in Utrecht (introduction of Randstadspoor service) and (c) shorter waiting, changing and journey times for buses, trams and metro. This focus already assumes densification of housing areas within a short distance (1200 m) of railway stations.
- *Variant 4: Road pricing and additional road investment programme (Mobility Policy Document)*. This is a variation on the road pricing variant, to which the investment programme set out in the Mobility Policy Document (from the *Baseline* scenario) is added.

The above four variants vary little regarding the parameters for the degree of clustering and intensification, but may result in a different spatial distribution of housing and employment locations. Road pricing considerably reduces congestion, which increases the attractiveness of sites in and around the big cities as business locations.

The mobility and accessibility effects of this focus and the infrastructure variants have been analysed using the TIGRIS XL model of the DVS Transport Research Centre (for further information see Zondag *et al.,* 2007). The model was used in combination with the Land Use Scanner. A new method was used to evaluate the socio-financial accessibility gains (Text box 4.1).

Figure 4.14 shows the spatial development of housing and employment in the *Clustering and Intensification* focus in 2040. Figure 4.16 shows the difference in spatial development between the focus and the *Baseline* scenario. The map shows that more housing is allocated to the concentration areas than in the *Baseline* scenario. Owing to denser housing development in the existing urban area, fewer urban extensions are required than in the Baseline scenario. New urban extensions are developed in the urban concentration area in the Randstad: in the bulb growing area, Haarlemmermeer, near Amersfoort and in the Zuidplaspolder. In the concentration areas outside the Randstad urban extensions are moved closer to railway stations. Compared with the *Baseline* scenario, there is also a greater concentration of businesses in the concentration areas, although no additional compaction policy for employment sites is assumed. The total number of jobs in concentration areas increases at approximately the same rate as the population in those areas – around 4% more than in the *Baseline* scenario. This is the result of a reallocation of population-related business activities.

Effects: opportunities

Clustering and intensification has positive and significant effects on the functioning of the transport system, and may improve the economic base of the major cities and may help to counter spatial segregation. Clustering and intensification also limit impacts on the landscape and have a favourable influence on the core qualities and amenity value of the Dutch landscape.

The considerable volumes of new housing built in the vicinity of railway stations in the existing urban area leads to an increase in rail travel and has positive accessibility gains. The effect of clustering and intensification on passenger travel at the national level is relatively slight, but the local effects may be considerable. Car use decreases by around 2% nationally. Only a limited share of this is shifted to rail and most of this is reflected in an increase in commuter travel to and from the major cities in the Randstad (by about 10–15%). At the national scale, the effects on personal mobility are limited because a

large proportion of the present housing stock is immutable: about 7% of the total housing stock in the Netherlands is spatially varied in this focus. In relative terms the effects are significant. In addition, the concentration areas in the National Spatial Strategy provide a relatively large number of options for house building at locations that are not easily accessible by public transport. A fairly small proportion of the new housing programme in the Randstad is therefore in 'central-urban' residential areas with good public transport connections.

Clustering and intensification has positive effects on congestion in the main road network: the number of hours lost on the motorways in the Netherlands decreases by 5%, compared with the *Baseline* scenario (Figure 4.15). The decrease in car mobility resulting from clustering and intensification, on balance, has greater effects on congestion than the increase in traffic and congestion on the already very busy roads around the major cities.

The road investment programme in the Mobility Policy Document will reduce congestion on the main road network by 35%, despite a (5%) increase in road traffic (compare the policy-neutral variant 1 with the *Clustering and intensification* focus). No further road investment is projected for after 2020 and congestion is expected to increase. The introduction of a national road pricing scheme would be effective in reducing congestion. Under this scheme, car use would decline nationally by approximately 10% and congestion would be half that of the policy-neutral infrastructure variant for 2040, in which only planned road investments are assumed.

An improvement in the quality of public transport in the concentration areas adds considerably to the number of rail passenger kilometres, especially in commuter traffic in the Randstad (Figure 4.17). In the *Baseline* scenario, rail passenger numbers grow by some 15% between 2000 and 2020: road pricing is the reason for about 5% of this growth, while the improved quality leads to an additional doubling of growth by 2020. This should lead to an annual growth in rail travel of about 1.5% by 2020. The relatively high levels of congestion on the roads in the Randstad lead to particularly strong growth in train commuting (by about 60% in 2000–2020). Commuter traffic outside the Randstad shows a much smaller increase and rail travel in off-peak hours declines. Both road pricing and the improvement in quality boost commuter traffic. This is detrimental to railway operations, since commuter traffic takes place mainly in the rush hours when occupancy rates are already high. Growth in rail travel will slow again after 2020 owing to economic and demographic factors.

The accessibility effect of the *Clustering and intensification* focus, compared with the *Baseline* scenario, seems relatively limited, but in monetary terms, the accessibility gains are considerable (Figure 4.18). The accessibility gain (for private car transport over all other modes of transport) rises to 1.2 billion euros per year by 2040. The reason for the accessibility gains is that more people live in the cities (due to intensification – building production in the urban area) or close to the city in urban extensions of the concentration areas. The policy-neutral infrastructure variant (variant 1) shows the effect of not implementing the road investment programme in the Mobility Policy Document. There is a marked drop in accessibility gains compared with the *Clustering and intensification* focus, which does include the

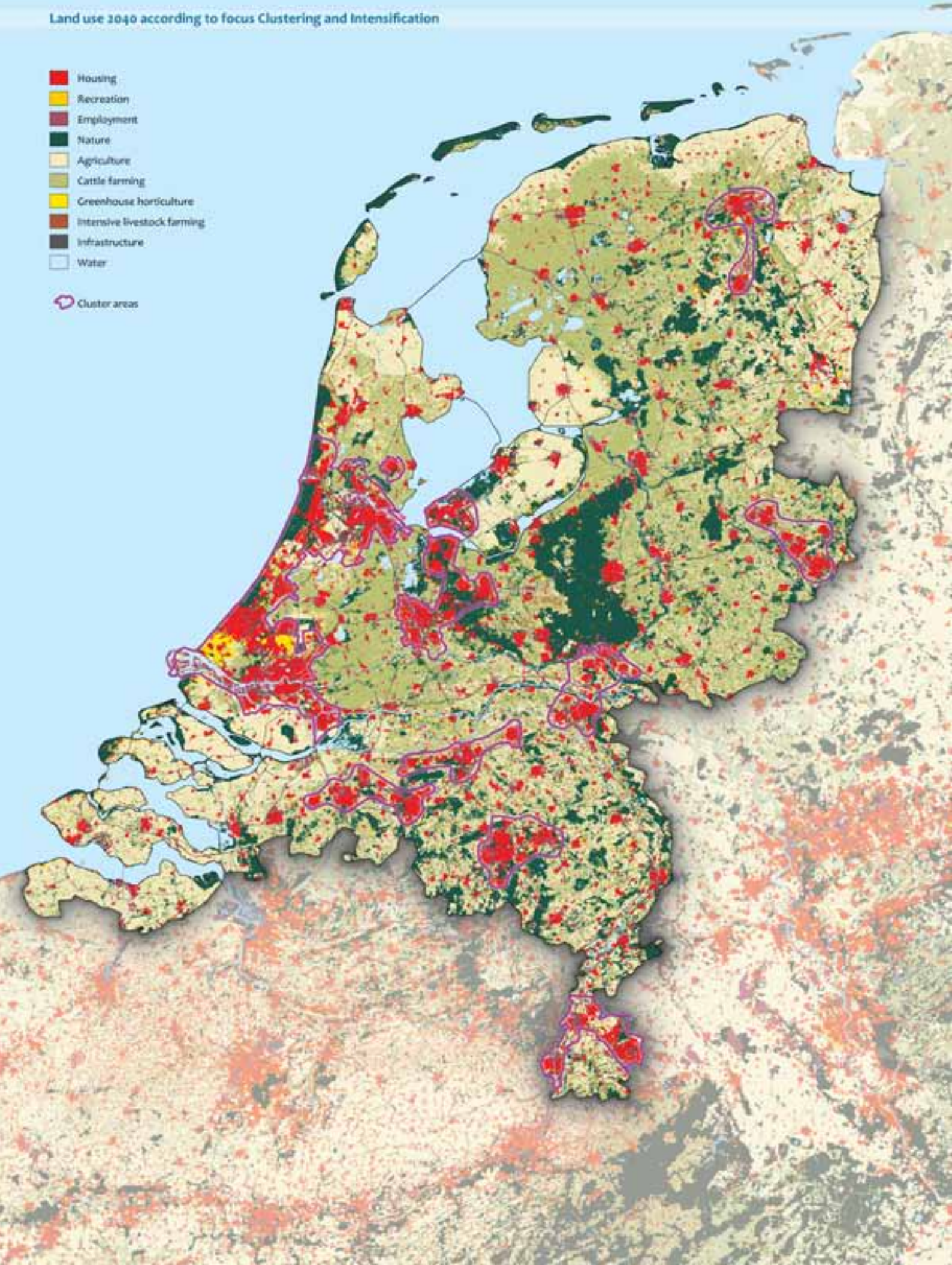
Text box 4.1: Evaluation of accessibility gains

In cost-benefit analyses of transport infrastructure projects in the Netherlands (based on the Analysis of Economic Effects guidance) accessibility effects have so far been mostly translated into economic effects based on travel time losses (or gains). Accessibility effects may, however, be more wide-ranging than just changes in travelling time. They can also consist of changes in the number of destinations or activities that people can reach in the same travelling time or at the same cost. These aspects are particularly important for the accessibility effects of spatial planning measures. If, for example, the density of housing and employment uses in an existing urban area is increased, the inhabitants of that area can reach more activities within the same travel time. This accessibility gain is not reflected in the standard assessment method. This study adopts the so-called logsum method that more fully interprets the accessibility effects (and thus the welfare gains) based on the outcomes of a transport model.

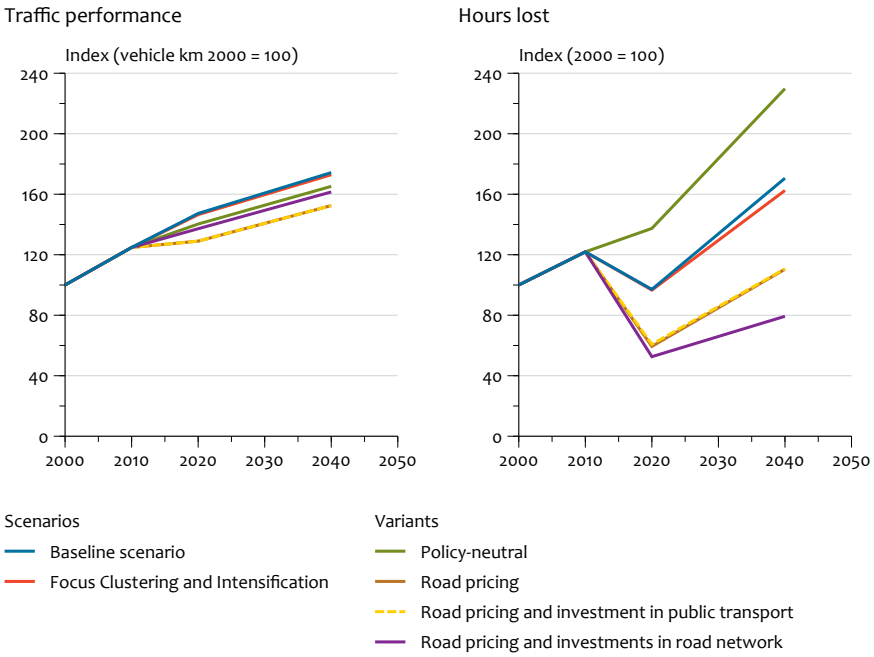
Included in this method, is the calculation of the welfare gains (or consumer surplus) from changes in the chosen transport mode, destination, and time of travel, which result from the introduction of a certain measure. In other words, the method computes the relative accessibility benefits of improved/reduced levels of access to offered activities (housing, employment, amenities, etc) at various locations using different modes of transport (car, train, bus/tram/metro, bicycle/foot).

In this study, the logsum method is calculated on the basis of the outcome of the Dutch National Transport Model, which is the transport component in TIGRIS XL. The logsum method has been applied earlier to evaluate the effects of road and rail investment (Rand Europe, 2005). This report presents the first application of the method to evaluate the effects of spatial policy or spatial investments. This evaluation method covers more aspects of accessibility than the consensual 'rule-of-half' method. Still, not all aspects of accessibility have been covered. The Mobility Policy Document states that the predictability or reliability of journey times is an important aspect of accessibility. At the moment, not enough information is available on the effect of changes in the reliability of journey times and peoples appreciation of these changes to allow these to be properly incorporated into projections. In addition, the method identifies only the accessibility gains for passenger traffic; accessibility benefits for freight transport is not included. For details of this method, see Zondag et al. (2007).

Land use 2040 according to focus Clustering and Intensification



Traffic on the main road network **Figure 4.15**



Traffic growth (left) and the number of hours lost on the main roads (right), in the Baseline scenario, the Clustering and Intensification focus and infrastructure variants

investments announced in the Mobility Policy Document. The accessibility gains in the policy-neutral variant are, however, still positive compared with the *Baseline* scenario, owing to the spatial shift as a result of the clustering strategy. Clustering and intensification, therefore, provides higher accessibility gains than the investment programme in the Mobility Policy Document under modest growth in traffic and congestion levels.

The accessibility benefits are greatest in the road pricing variants (based on time, place and environmental criteria). There are three net effects: (1) an increase in variable costs (leading to a negative effect), (2) transport changes, such as total journey time, chosen time of travel, choice of destination and choice of mode of transport (positive effects are expected; the dominant effect is that the congestion charge reduces congestion and less time is lost) and (3) the motorist is compensated through the abolition of car ownership taxes and (25% of) the purchase tax on cars and motorcycles.

Variant 3, the infrastructure variant with an improvement in public transport (in addition to road pricing) delivers positive accessibility gains, owing to the improved quality of the existing public transport infrastructure (about 0.2 billion euros more than the *Baseline* scenario). This gain mainly benefits public transport passengers; railway investment has little effect on the national congestion problem. This study does not analyse the social return, but the analysed improvements in the quality of existing public transport infrastructure in and between the (relatively densely populated) cluster areas seem to be socially beneficial, unlike the mostly small returns on investment in completely new rail links. The ultimate economic return depends greatly on the eventual cost of investment (estimated at somewhere between 3 and 8 billion euros) and on the effects on the reliability of train services and on occupancy rates during and outside rush hours.

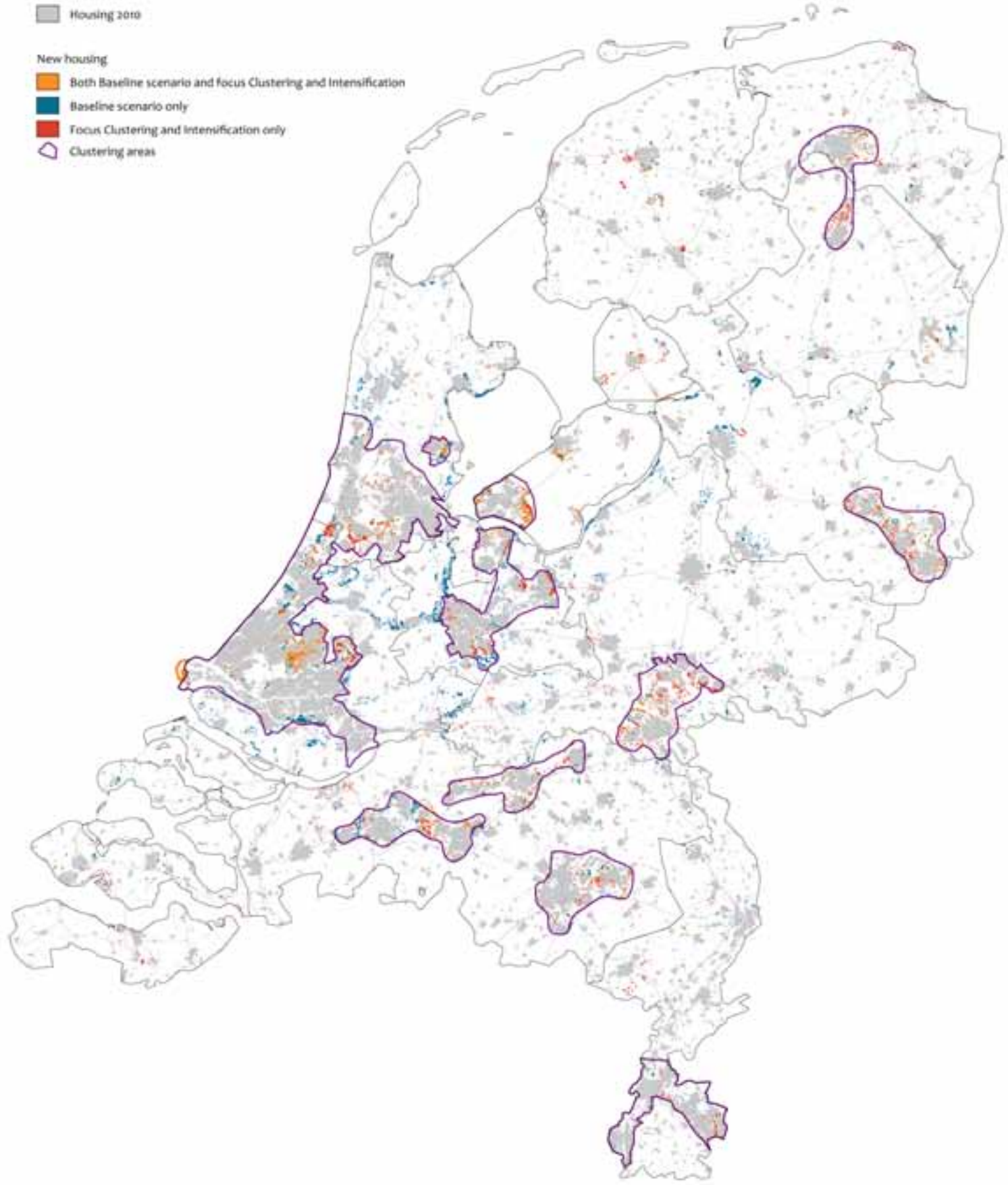
The accessibility gains of the investment programme in the Mobility Policy Document (about 0.3 billion euros more than the *Baseline* scenario, excluding benefits to freight transport and an improvement in the reliability of journey times), seem relatively small, compared with the total investment costs of around 14 billion euros. The accessibility gains for families and business passengers are less than a third of those stated in previous analyses by the Netherlands Bureau for Policy Analysis (CPB), which put the social return on the investments contained in the Mobility Policy Document at 8% (Besseling *et al.*, 2004). The conclusion is that with a high degree of clustering and intensification plus road pricing, the economic return on road investment is much less than under a scenario in which efforts are directed solely at expanding the transport infrastructure. This conclusion leads to the following conceptual model for selective and efficient investment in infrastructure:

1. take the opportunity of using spatial policy (clustering and intensification) to make better use of the available capacity in the main road network;
2. optimise use of the main road network by introducing road pricing;

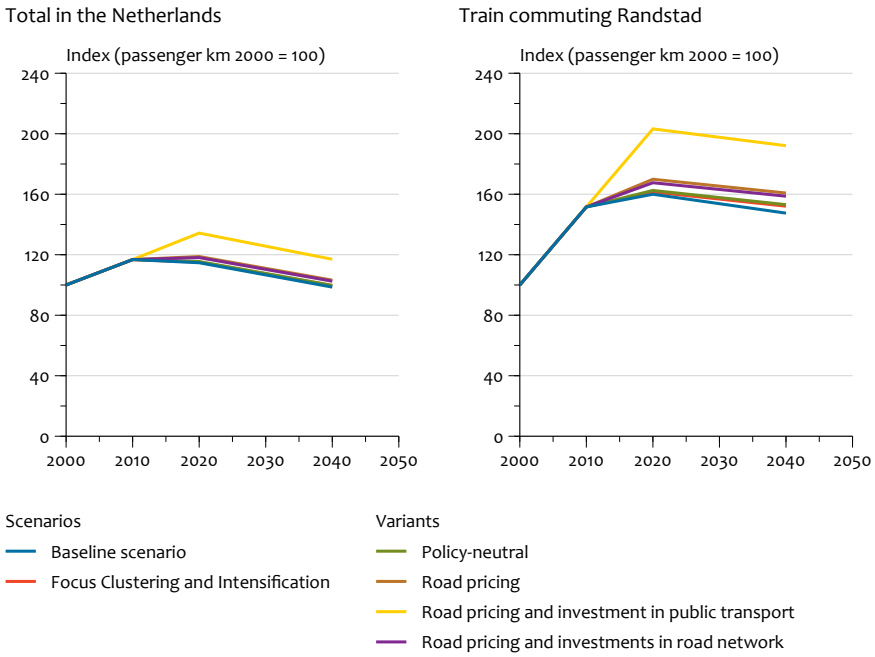
Figure 4.14

The Netherlands in 2040 in the Clustering and intensification focus.

Development housing 2010 – 2040 according to focus Clustering and Intensification



Train use **Figure 4.17**



Trend in total train use in the Netherlands (left) and train commuting in the Randstad (right) in the Baseline scenario and in the Clustering and intensification focus and infrastructure variants, expressed in passenger kilometres.

3. if the above do not provide an adequate remedy, take up the option of expanding the transport infrastructure.

This conceptual model is in line with the conceptual model of the Social and Economic Council (SER, 1999) for the allocation of the limited space available. In addition, the Netherlands Bureau for Economic Policy Analysis (Besseling *et al.*, 2004) has already stated that the social return on some investment in road capacity, as announced in the Mobility Policy Document, does not offset the investment costs, particularly,

Text box 4.2: Estimated and planned growth in rail travel

There are varying forecasts of train use in the Netherlands. The Mobility Policy Document (Ministries of VenW and VROM, 2006) are based on a 20% increase in passenger rail travel between 2000 and 2020 (or approximately 1% growth per year), assuming the infrastructure plans in the Multi-annual Programme for Infrastructure and Transport 2004 are carried out. The long-term outlook of the Dutch policy assessment agencies (CPB, MNP, RPB, 2006) forecasts a 10 to 20% growth in passenger car traffic between 2002 and 2020 without road pricing, and 15 to 25% with road pricing (CPB, 2006a). The range in the forecast depends on population and economic trends.

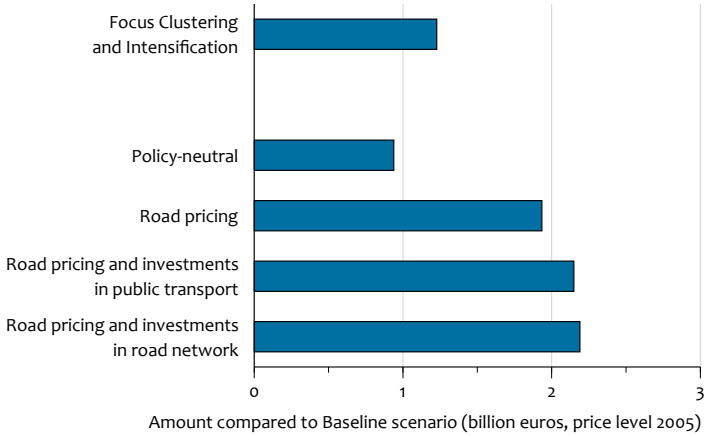
The Netherlands Railways has set a target of 2.5% in annual growth for 2020 (about 40% from 2006), based on structurally higher oil prices (50–70 US dollars per barrel), increased parking problems in the cities, the introduction of road pricing and its own plans for the future (NS, 2007). Additional investments of about 7.5 billion euros on top of the Multi-annual Programme for Infrastructure and Transport 2006 should enable the realisation of more than a third of the projected growth. This will have to resolve several bottlenecks in the system and rail capacity will have to be increased by increasing the frequency of services and raising the maximum speed to 160 km per hour on the major rail links.

The Coalition Agreement of 2007 targets even higher growth for rail traffic, forecasting a 5% annual increase in passenger kilometres (the actual increase in the past two years; NS, 2006). This growth target, given the above forecasts, does not seem feasible in the period up to 2020, even with considerable additional investment in the railways. Partly because of the differing growth forecasts, the Ministry of Transport, Public Works and Water Management is currently carrying out a national market and capacity analysis of the railways (Letter from the Minister of Transport, Public Works and Water Management to the Dutch Lower House, dated 16 October 2006, 2006–2007, 29644 no. 74).

Figure 4.16

The Netherlands in 2040 in the Clustering and intensification focus.

Accessibility gains in passenger transport, 2040 **Figure 4.18**



Accessibility gains in the variants relative to the Baseline scenario in 2020 and 2040.

if the costs of adjustment are high. Further evaluation and prioritising of investment within the total road investment package of the Mobility Policy Document is therefore desirable, taking account of the introduction of road pricing and the uncertainties in mobility projections.

Effects: risks

Clustering and intensification is at odds with the objectives for green space in and around the cities and improvements in the living environment (noise). The accessibility of open space for walking and cycling within five kilometres of each home is lower in the *Clustering and Intensification* focus than in the *Baseline* scenario. Intensification heightens demand for open space around the cities, while the supply remains the same. The effect of this focus on the accessibility of open space per urban dweller has not been assessed, but is also expected to decline, given past trends. Between 1993 and 2000 the area of public green space, including parks, public gardens and forests, increased slightly, despite the compact city policy. However, the growth in the area of public green space has failed to keep pace with population growth so the area of available open space per inhabitant has decreased (De Niet, 2005). The area of semi-public green space, including sports grounds and allotments, has also diminished and some of this has been moved out to the urban edge (Snellen *et al*., 2006).

In the *Clustering and Intensification* focus, more housing will be built at locations that already have relatively high noise levels, such as the central urban areas and greenfield locations near major cities. Examples include the bulb-growing area, the Haarlemmermeer and the Zuidplaspolder. Figure 4.19 breaks down the housing programme in noise levels, in the *Baseline* scenario and in this focus. The number of new-built homes exposed to noise levels above 55dB is 8% higher in this focus than in the *Baseline* scenario, taking account of prevailing noise nuisance policies (double-layer porous asphalt at locations identified in the Multi-annual Programme for Infrastructure and Transport and noise barriers along all motorways). Figure 4.20 shows that in the four major cities of the Randstad, the majority of the housing stock is exposed to noise in excess of 55dB. Densification in the major cities, therefore, means a relative deterioration in the quality of the living environment also for the occupiers of new houses. This is a major challenge in the fields of urban design, engineering and land-use planning.

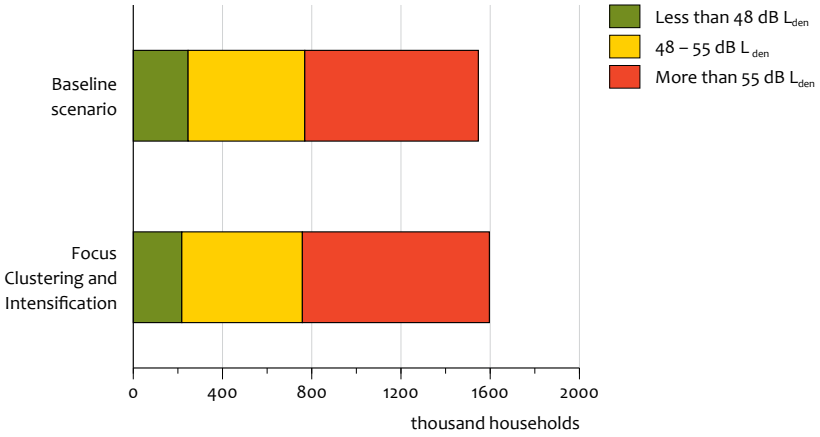
Effects: correlation with other functions

The *Clustering and Intensification* focus correlates positively with other focuses. By taking account of the long-term horizon for climate change, international biodiversity and National Landscapes, the existing urban area can be put to optimal use. Amsterdam, The Hague and Rotterdam have little room for expansion in their immediate surroundings,

Text box 4.3: Effects of road pricing are uncertain

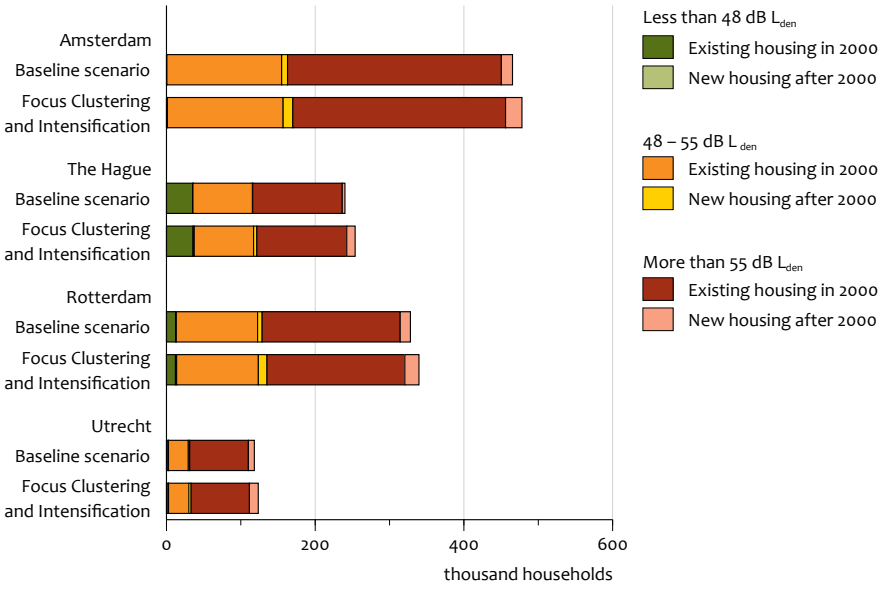
The effects of a national road pricing scheme on mobility and accessibility are uncertain, at the moment. First, these effects depend heavily on the system of road pricing and on price levels, which still have to be decided. Second, the Netherlands has no experience of such a road pricing system, and how motorists and businesses will actually respond to road pricing is therefore uncertain. Past experience of other types of pricing measures and experiences with different road pricing systems in other countries (such as those in London and Stockholm) are not really comparable. The traffic model used probably overestimates the behavioural response of motorists, partly because it takes no account of the possible ways that employers will reimburse their employees. The degree to which the effects and accessibility gains are overestimated cannot be assessed, at the moment. However, the direction of these effects and how the variants studied will score are not expected to change.

Noise burden on new housing, 2000 – 2040 **Figure 4.19**



Growth in housing stock between 2000 and 2040, broken down into noise levels, in the Baseline scenario and the focus Clustering and Intensification.

Noise burden on housing in the major cities, 2040 **Figure 4.20**



Existing housing and new housing in 2000-2040, divided into noise categories, in the four major cities, in the Baseline scenario and the focus Clustering and intensification.

owing to their location in and close to deep polders (reclaimed land) and the presence of valued landscapes (and habitats). This focus delivers only slightly less new housing development than the *Baseline* scenario in the areas reserved for future designation within flood-risk areas.

At the national scale, clustering and intensification make only a small contribution to reducing greenhouse gas emissions because they have a limited effect on passenger car traffic. The introduction of road pricing (based on time, place and environmental criteria) has a much greater effect on passenger car traffic and, therefore, on CO_2 emissions from traffic (a reduction of 2.5–3.5 Mt CO_2 in 2040) than the measures in the *Clustering and Intensification* focus (0.3–0.4 Mt CO_2 in 2040). Clustering and intensification are therefore not very effective in reducing CO_2 traffic emissions, but they do contribute towards the mitigation of effects targeted by other transport policies geared to reducing CO_2 emissions. Mobility costs may increase in the coming decades, because of high oil prices and technological measures geared to making substantial cuts in CO_2 emissions from the transport sector. Residents in central urban areas are better able to absorb a sharp increase in transport costs because they can reach more destinations in the same travelling time and at the same cost than people living in the suburbs or peripheral urban areas. Clustering and intensification policies are

Effects of the focus Clustering and Intensification, compared with the Baseline scenario in 2040 Table 4.4

Indicator	Clustering and intensification	Effects
Flood Defences		Only slightly less housing development in the reserved space -within flood-risk areas- for future designation.
Adaptation to Climate Change		Only slightly less housing development in the reserved space -within flood-risk areas- for future designation
Biodiversity		Slight decrease in local environmental pressure in Natura 2000 areas
Accessibility		Road pricing delivers the greatest financial accessibility benefits, followed by clustering and intensification and additional road investment gains
Quality of the Living Environment		More housing development in central urban locations with high noise levels, reduced accessibility of green open spaces around cities
Residential Housing in Spacious and Green Surroundings.		Limited opportunities to meet individual housing preferences for spacious and green surroundings
International Business Establishment		Clustering and intensification increases congestion in the big cities, but reduces overall congestion on the main motorway network
Landscape Quality		Less adverse impacts on the landscape than in the Baseline scenario
Spatial Segregation		Clustering and intensification may enhance the economic and social functioning of cities

therefore more robust in the longer term than policies that result in a more dispersed development pattern (see also Monzon and Nuijten, 2006).

Conclusions

- Clustering and intensification have positive and significant effects on the functioning of the transport system and may improve the economic base of the major cities and efforts to counter spatial segregation. In addition, clustering and intensification have a beneficial effect on the core qualities and amenity value of the Dutch landscape. Clustering and intensification are, however, at odds with targets for green space in and around the cities (recreational facilities) and for improving the quality of the living environment (noise).
- Various Dutch cities still offer many options for making better use of the existing urban area, but a high degree of intensification requires a costly programme of restructuring and intensification. It is desirable to make a further integral evaluation of the various costs and benefits of densification and cluster locations at the local level.
- Selective and efficient investment in infrastructure can be achieved through: (1) spatial policy ('clustering and densification') geared to making better use of the capacity available in the road network, (2) optimising use of the road network by road pricing, and (3) in the final instance, expanding the transport infrastructure. If the above sequence is followed, accessibility goals will be achieved with less investment than if only the infrastructure was expanded.
- Clustering and intensification delivers a considerable accessibility gain. This is greater than the gain delivered by the package of investments in the road network contained in the Mobility Policy Document, assuming modest traffic growth and congestion levels. The accessibility gains (spread over all modes of transport) from clustering and intensification rises from a few hundred million euros in 2020 to 1.2 billion euros in 2040 (compared with the *Baseline* scenario). The accessibility gains are achieved because more people move to the cities (via intensification building programmes in the existing urban area), or because of the new urban extensions on the edges of the cities in the concentration areas.
- The accessibility gains of the road investment programme envisioned in the Mobility Policy Document, in addition to the introduction of road pricing, are relatively limited in the case of modest mobility demands and congestion levels. Further evaluation and prioritising of investment within the total package of road investments is desirable, taking account of the introduction of road pricing and the uncertainties in mobility projections.
- Improving the quality of public transport, in addition to the introduction of road pricing, delivers a considerable accessibility gain for public transport passengers. Investment in the rail infrastructure has only a limited effect on national congestion levels.

4.5 Residential housing in spacious and green surroundings

Problem outline

Currently, most people's housing preference is either for a home in a 'central-urban' environment or in a 'green-urban' or 'urban village' environment. There is only limited demand for purely rural residential areas because, although people want to live in a green environment, they also like to be within easy access of amenities. To meet these preferences, restructuring programmes and new housing developments should provide housing in lower densities, and proximity to attractive (rural) areas should be a major criterion when selecting new locations.

... green urban living ...

... many people want to live in green surroundings, but only with amenities close by ...

Possible solutions and spatial images

The key element of the *Residential housing in spacious and green surroundings* focus is that people enjoy more living space, preferably in attractive landscapes that are also close to cities with good amenities. This focus has been elaborated as follows:

- Residential housing and employment locations are reallocated per 'housing region' (in principle, per province, except that North Holland is grouped with Utrecht and Flevoland, and South Holland with western Brabant).
- Apart from central-urban living environments, the general rule is 15 homes per hectare.
- New residential locations should preferably be located in attractive areas (close to nature conservation areas and/or water bodies and in attractive landscapes) which are also close to attractive cities with good amenities.
- It is assumed that, by 2040,. many jobs will be less tied to specific locations, so a greater distance between homes and jobs will be more acceptable.

The spatial scenario

The *Residential housing in spacious and green surroundings* focus leads to a more dispersed development pattern than the *Baseline* scenario, with more urban development, particularly in the concentration areas (Figures 4.21 and 4.22). Unlike in the *Baseline* scenario, there is no new urban development near Lelystad, Purmerend, between Rotterdam and The Hague, nor in the Utrecht-Leiden and Utrecht-Amsterdam transformation zones. Instead, there is more dispersed urban development in 't Gooi, the Utrechtse Heuvelrug and the Waterland areas, between The Hague and Leiden, in Midden-Delfland and the Lopikerwaard. There is therefore less compact development in the Randstad.

In the northern Netherlands, there is a strong shift in new development towards the area around the city of Groningen (northern edge, northern Drenthe). In Overijssel, urban development fans out from the Twente conurbation. In Gelderland, urban development shifts from the Overbetuwe area between Arnhem and Nijmegen to northern Arnhem and south-east Nijmegen and to the eastern slopes of the ice-pushed ridge of the Veluwe. In North Brabant there is a marked rise in the rate of urban development around Roosendaal, Etten-Leur and Breda; this region meets some of the housing needs of the southern wing of the Randstad. The areas around other Brabant cities also become more built-up.

Effects

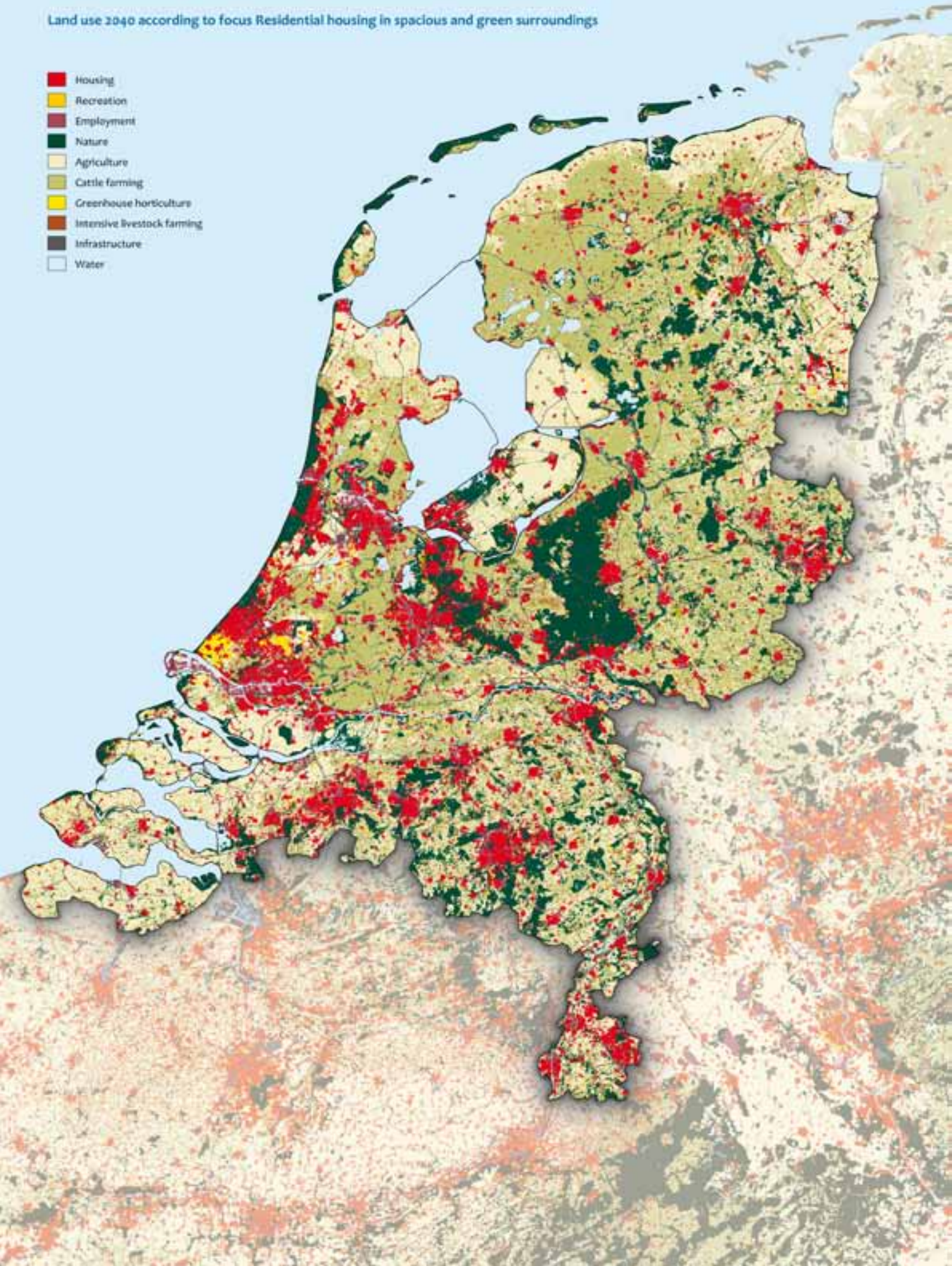
This focus originates from the desire to build new low-density housing in attractive landscapes. At the same time, taking a walk or bicycle ride through the countryside will become less attractive owing to the resulting general decline in landscape quality and biodiversity.

The total area with low noise levels will contract, because building will continue in areas where currently noise levels are still low. Despite an increase in (automotive) mobility, the number of homes exposed to noise levels above 55 dB will decrease, because average housing density is lower and urban extensions are further away from motorways. Noise reduction measures at places where noise levels are above 65 dB are relatively expensive, owing to the lower housing density.

There is more space for open green areas on a neighbourhood level and for private gardens, although this reduces the availability of green space per resident within reach of existing built-up areas. The shift in population away from the cities to green and spacious living environments reduces accessibility, but less than would be the case if rural residential areas were developed.

The benefits to the inhabitants of green residential areas are to some extent won at the expense of nature and the landscape. The National Ecological Network has been only partly assembled (for example in the Utrechtse Heuvelrug area). The area of contiguous ecosystems decreases because of the presence of pockets of building. To comply with people's housing preferences, new housing is more dispersed and there is less concentrated development.

Land use 2040 according to focus Residential housing in spacious and green surroundings



Effects of the focus of Residential Housing in Spacious and Green Surroundings, compared with the Baseline scenario for 2040 Table 4.5

Indicator	Residential housing in spacious and green surroundings	Effects
Flood Defences		
Adaptation to Climate Change		Sharp increase in dispersed housing development in the reserved space -within flood-risk areas- for future designation
Biodiversity		More housing development near and in nature conservation areas
Accessibility		Shift to residential environments in which fewer facilities and amenities are within reach in the same travelling time, by car or public transport
Quality of the Living Environment		Less noise nuisance because of lower housing densities, an increase in car-based mobility and less green space per resident
Housing in Spacious and Green Surroundings.		Sufficient space to create residential environments that satisfy residents' preferences
International Business Establishment		Adverse impact on the economic base of big cities
Landscape Quality		More space taken up by housing and larger decrease in landscape quality
Spatial Segregation		Chance of more segregation because of more dispersed housing development.

Conclusions

- The *Residential housing in spacious and green surroundings* focus is in fact the opposite of the *Clustering and Intensification* focus. The effects, therefore, are virtually the opposite.
- Lower housing densities and urbanisation of attractive landscapes results in the landscape becoming less open and in an increase in adverse impacts on landscape quality. This is particularly the case around the major cities, in the Utrechtse Heuvelrug area, in some urban buffer zones and in some parts of the Green Heart.

- For new housing areas, this focus favours lower-density housing in non-central urban environments, which provides more scope for neighbourhood green space and privately owned gardens. Noise nuisance here declines compared with the baseline trend, but the area with low noise levels also contracts. As a consequence, the accessibility of green space from the existing built-up area also declines.
- At the same time, these developments have a negative impact on housing, because building development impairs the type of living environment that attracted people in the first place. Homes in green surroundings for some people (new-build sites) mean less green space for the (larger) existing housing stock. The chance of a middle-class flight from the city increases, as well. There is less concentration of urban development, which leads to higher levels of car-based mobility and less use of public transport.

4.6 International Business Establishment

Problem outline

Foreign investment can lead to the transfer of knowledge and can boost local enterprise and generate new jobs, in turn strengthening the competitive position (CBS, 2006). It encourages the development of new products and knowledge and attracts further inward investment. It is therefore important to attract foreign businesses to the Netherlands. It is the Randstad's ambition to be one of the top five European regions (in terms of gross regional product per capita) by 2015. The possible negative side to focusing on creating environments attractive to international markets is that:

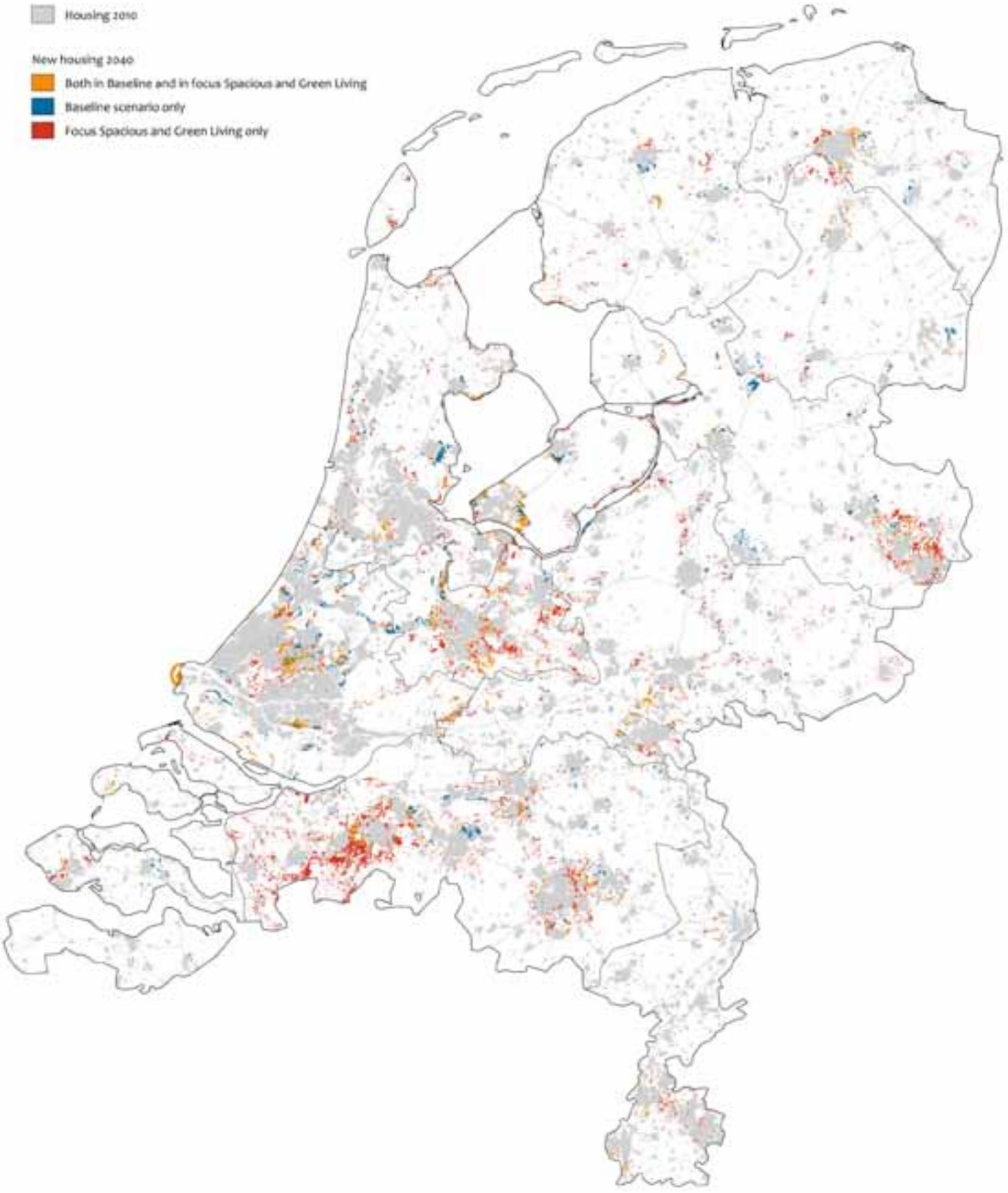
- it can lead to polarisation owing to wider income differences between the highly qualified and the unqualified and between the employed and the unemployed (CPB, 2004; Sassen,1991);
- it can widen the gap between strong and weak regions (Sassen, 1991);
- development pressure increases, particularly in attractive landscapes close to cities with high growth.

The main criteria that companies apply when they are locating or relocating, are market aspects, availability of a suitable labour pool, accessibility and quality of infrastructure (road, rail, water, air, ICT), political and regulatory climate (e.g. environmental regulations, labour laws, tax regulations, subsidies), presence of research institutes, composition of the regional production network, availability of suitable

Figure 4.21

The Netherlands in 2040 in the focus of Residential housing in spacious and green surroundings.

Development housing 2010-2040 according to focus Residential housing in spacious and green surroundings



premises and sites, social climate, residential areas and living conditions. The importance that businesses attach to these factors differs per business and varies over time (Telos, 2006). In recent years, the Netherlands has scored highly on such factors as the political and social climate, infrastructure (particularly Schiphol Airport), a suitable labour pool and consistent and clear regulations (Ernst and Young, 2004/2005). Managers are downbeat about the availability of good and affordable office premises, the labour climate (costs and flexibility) and subsidies (Ernst and Young, 2005; OECD, 2006b). Many internationally operating companies currently take little account of spatial factors, such as the quality of the living environment, infrastructure and business accommodation, in their choice of location. Spatial planning does have an indirect influence, because the availability of attractive living environments has a bearing on the availability of suitable employees.

The Randstad scores below top-ranking position in Europe for accessibility by road and rail (Manshanden *et al*., 2006). According to the OECD, the Randstad does not have an integrated public transport network and Amsterdam does not have a first-rate regional public transport system.

The possible solutions and spatial scenarios

Spatial factors, such as the quality of the living environment, infrastructure and business accommodation, currently often carry little weight among many internationally operating companies when deciding on their location. However, macroeconomic factors, the internal market and taxation are converging in the European Union, thanks to the introduction of the euro, the Growth and Stability Pact and other EU directives. In addition, the Member States of the EU are disinclined to be too far out of step to avoid losing foreign investors. Over the past ten years, the EU15 have undergone a significant degree of convergence in taxation on capital, diesel duty and social expenditure (Mooij, Gorter and Nahuis, 2003). As a result, there has been an increase in the relative importance of spatial factors in the choice of location by foreign businesses (Buck, 2005).

The key to the focus of *International Business Establishment*, therefore, is to promote the physical aspects of the Netherlands as a business location. The following assumptions have been mapped out:

- Land for housing and employment is allocated per 'housing region' (mostly per province, except for North Holland which is grouped with Utrecht and Flevoland, and South Holland which is grouped with western Brabant).
- Urban development is concentrated in the regions with the greatest potential: 'Greater Amsterdam' (northern wing of the Randstad including Utrecht) and around Eindhoven.
- Amsterdam and Almere do not become 'twin cities'. Almere remains a less popular residential commuter area.
- The southern wing of the Randstad continues to grow until 2040, thanks to the presence of specific (internationally) competitive clusters. This also applies to other major urban agglomerations, such as the Brabant city cluster, Arnhem-Nijmegen, Twente, and Groningen-Assen.
- Investment is made in attractive living environments in the central urban areas, in new residential oases with green areas and water bodies in the Vechtstreek area, the bulb cultivation area (Tulip National Park) and along the river Linge. For recreational purposes, investment is made in green space around the cities and new National Parks close to the cities.
- Some of the capacity (25%) at Schiphol Airport is rerouted to Lelystad Airport (shifted slightly to the north-east) in 2020. This allows Schiphol to fully meet the demand for flights by 2040. This is almost 40% more than in the *Baseline* scenario and, thus, increases international accessibility. A branch of the Hanze railway line provides a rail link between the two airports.
- For safety reasons, the whole IJsselmeer remains reserved as a buffer against flooding and no development takes place on the islands in the Markermeer and IJmeer. Almere develops new residential areas by bringing the water deeper into the city.
- Public investment in the regions is coordinated to enhance the specific strengths of each region and ensure that the regions complement each other. An example is the clustering of bulk transport in Rotterdam, which means there is now no need to construct an extra sea lock near Amsterdam.
- The high-speed rail link in the south-east runs across the Amsterdam–Eindhoven–Venlo axis to the Ruhr and Cologne.
- Compared with the *Baseline* scenario, the budget for main motorways shifts to the busiest regions: the Randstad, particularly, to Amsterdam because of the urban compaction policy, and also Eindhoven. Investment is made in roads and in high-quality rapid transit, particularly in and around Greater Amsterdam.

To counter the threat of polarisation of international business locations in the Netherlands, and thus prevent problems similar to those in Paris, this focus is based on the assumption that prospects are created in the labour market for the socially disadvantaged and that problem neighbourhoods in the major cities are restructured. More emphasis is placed on the maintenance of cultural heritage. This focus also assumes that the provinces pursue a strict integrated policy of rationalising the distribution and size of business parks to put a halt to the competition between local authorities on land prices for employment land. They would then no longer compete over prices, but over quality. The result will be a sufficient supply of varied and high-quality office and industrial locations, and old sites are restructured and upgraded.

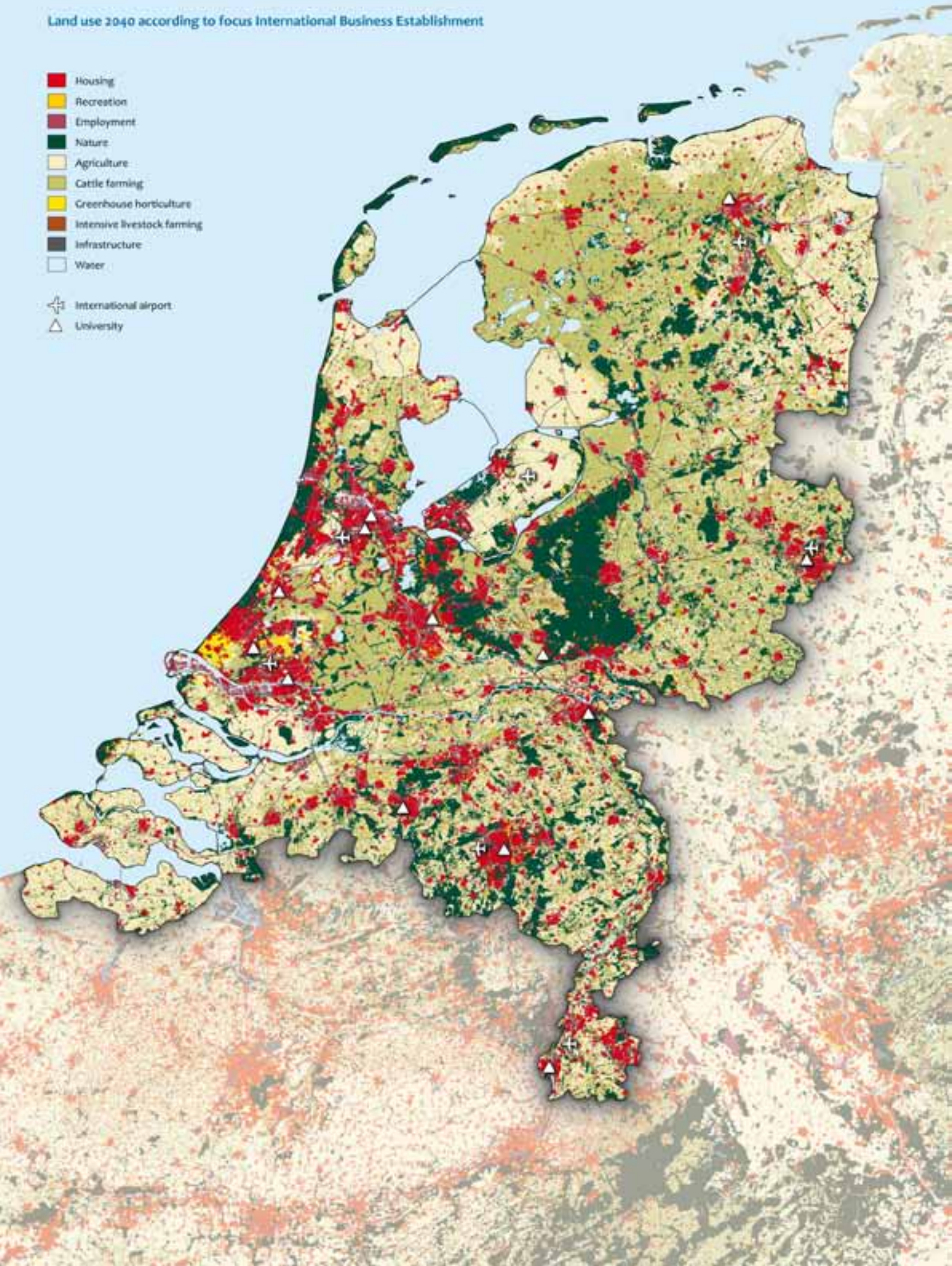
The spatial scenario

Compared with the *Baseline* scenario, the map shows a shift in urban development to the northern wing of the

Figure 4.22

Growth in the built-up area between 2010 and 2040, in the focus on Residential housing in spacious and green surroundings, compared with the Baseline scenario for 2040.

Land use 2040 according to focus International Business Establishment



Randstad, in particular to the area around Haarlem, to the south of Amsterdam and around Utrecht (Figures 4.23 and 4.24). This new housing is confined to a 10 km wide strip on each side of the A2 motorway to ensure that sufficient green space remains close to the built-up area. A few new upmarket suburbs are created near Haarlem, around the Braassemermeer and in the Gelderse Vallei. New nature conservation areas with important recreational functions (National Parks) are created in the Green Heart. In the southern region of the Netherlands a shift can be seen towards Den Bosch and Eindhoven/Helmond (particularly between the two cities). In other parts of the country, urban development is clustered in the concentration areas.

The rerouting of some air traffic away from Schiphol to Flevoland leads to fewer restrictions on residential building around Amsterdam. In this focus, therefore, there is new housing development to the south and south-west of Amstelveen and in the Haarlemmermeer between Hoofddorp and Nieuw-Vennep (Figure 4.25). Because of the shift of some spatial investment to Amsterdam, Utrecht and Eindhoven, the other regions develop less quickly than in the *Baseline* scenario.

These qualitative improvements ensure that accessibility via a well-connected system of rapid transit links in Greater Amsterdam and other regions is of the same or better quality than in the other European below top-ranking metropolitan regions in 2040.

Effects

The same advantages and disadvantages of urban compaction apply to this focus, as those described for the *Clustering and Intensification* focus, but to a somewhat lesser degree. The additional land area for housing and employment, therefore, is (almost) the same as in the *Baseline* scenario. Since all new

Text box 4.4: Assumptions regarding the partial rerouting of air traffic from Schiphol

As part of the study 'The Netherlands in the Future', the Netherlands Environmental Assessment Agency investigated the significance of the possible rerouting of some of the flights to and from Schiphol Airport to Lelystad. This study largely drew on existing studies, including a study of the development potential of Lelystad (Regional Airports Study) by the Netherlands Institute for Spatial Research (RPB), scenarios for fleet development at Schiphol taken from the Prosperity and Living Environment studies (SEO, 2006), and a study of the possible further developments in aircraft noise (Wubben et al., 2005). The highest 'Flevomax' variant in the RPB study was used. In this variant, the RPB investigated the implications of transporting 15 million passengers and 800,000 tonnes of freight from an airport near Lelystad. As a comparison, Schiphol handled about 45 million passengers and approximately 1.5 million tonnes of freight in 2006. In the Flevomax variant, aircraft take off and land on two parallel runways situated to the north-east of the current runway (on the other side of the Larsservaart canal).

The possible restrictions on the development of such an airport owing to the presence of the Oostvaardersplassen nature reserve have not been included in the analysis. For reasons of flight safety, in the area around Schiphol restrictions have been placed on any new land uses or developments that may attract birds. The analysis also focuses solely on the environmental effects of rerouting 15 million passengers and 800,000 tonnes of freight from Schiphol to the new airport near Lelystad.

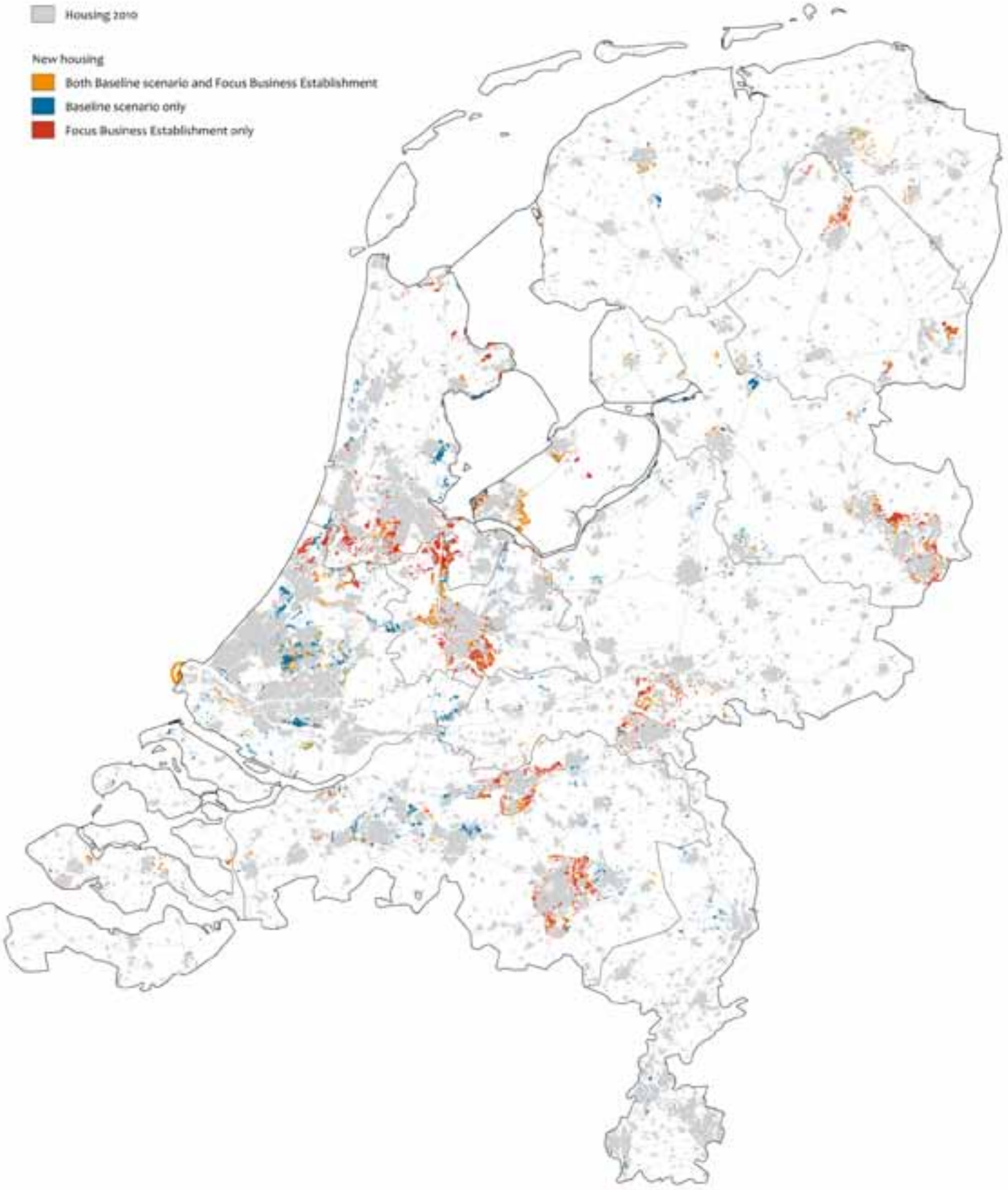
The Flevomax variant has been recomputed based on expectations of fleet performance in 2020 and 2040, taken from the Transatlantic Market scenario for air traffic at Schiphol (SEO, 2006). Besides the noise and external safety contours that arise around the airport at Lelystad in 2020 and 2040, the same contours around Schiphol Airport were also examined, together with any changes in them. It was also assumed that the capacity to be made available at Schiphol in 2020, due to rerouting, would be used solely to improve environmental quality and alleviate the pressure on land around Schiphol. Between 2020 and 2040, the airports will expand further within the 2020 noise contours if the noise emitted by the average aeroplane decreases by 1dB between 2020 and 2040. This may be a conservative assumption, given existing expectations. If capacity at Lelystad Airport does not expand after 2020, Schiphol will be faced with a shortfall in physical capacity. This shortfall will not arise if the planned number of flights are rerouted to Lelystad. Schiphol and Lelystad can therefore jointly meet the total flight demand (152 million passengers and 7 million tonnes of freight), which is almost 40% more than without rerouting. However, the total demand for air transport at the two locations may possibly turn out to be lower than what it would have been at one location, because Lelystad is not as well situated as Schiphol (Province of North Holland, 2007). It is also conceivable that the two airports will become more specialised, which could push up demand. The social effects of the move to Lelystad have not been investigated in this study.

All international studies on the trends in aircraft noise forecast a lower decline in noise production of new, still to be developed aircraft models (Wubben et al., 2005). The Netherlands Bureau for Economic Policy Analysis has different expectations (CPB, 2006). It does not expect such a lowering, and expects noise production by new aircraft to continue to decline by more than 2.5 dB per decade. This leads to only small differences in the environmental burden or noise capacity in 2020, but to a large difference by 2040, because these expectations not only provide scope for accommodating the total flight demand at Schiphol, but even for a contraction (1.4 dB) in noise contours.

Figure 4.23

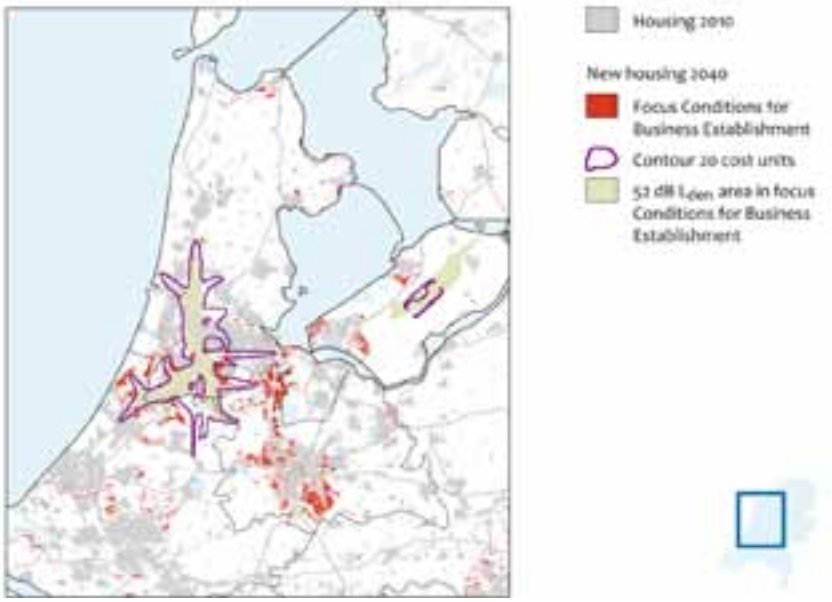
The Netherlands in 2040 in the focus of International Business Establishment.

Development housing 2010-2040 according to focus International Business Establishment



Development housing 2010-2040 around Schiphol in focus International Business Establishment

Figure 4.25



Growth in the built-up area between 2010 and 2040, in the focus of International Business Establishment, compared with the Baseline scenario of 2040, and the changes in noise contours resulting from the partial rerouting of air traffic to Flevoland.

housing and employment land in the western Netherlands and North Brabant is concentrated around Amsterdam, Utrecht, Den Bosch and Eindhoven-Helmond, impacts on the landscape increase in these areas. Elsewhere, these impacts diminish, but not to a corresponding degree, because there are areas of high-quality landscape around those cities.

The need for additional infrastructure (for example, the Breukelen–Lexmond and Driebergen–Vianen connections) add to the negative impacts on the National Landscapes in the Green Heart and river areas. The shift in the budget for road infrastructure to the Amsterdam and Eindhoven areas improves overall accessibility, because the provision of additional infrastructure in densely populated areas is more effective.

The focus of *Attractiveness to foreign businesses* assumes that some air traffic is rerouted away from Schiphol. Rerouting some flights to Flevoland also allows Schiphol to meet the full demand for air transport in 2040, which improves international accessibility. Without this rerouting, almost 40% of demand cannot be met. The number of people who suffer serious noise nuisance may consequently decrease by some 30%. Noise nuisance eases around Amsterdam, but increases near Lelystad and may also affect the Oostvaardersplassen nature reserve.

The National Spatial Strategy stipulates that no large-scale housing development may take place within the 20 Ke contour around Schiphol. Of the L_{den} contours, the 52 dB(A) contour is the closest to the 20 Ke contour. Without rerouting, the area around Schiphol where no (large-scale) building may take place amounts to 350 km². After rerouting, this area is just over 250 km², which opens up new opportunities for housing development near Amstelveen and in the Haarlemmermeer polder. Around Lelystad, an area of 90 km² will then fall within the 52 dB(A) L_{den} contour. On balance, the area subject to constraints on large-scale housing development remains approximately the same.

The expansion of the airport at Lelystad must take account of 'bird-attracting' activities in Flevoland, such as fish farming and nature conservation. Restrictions on such activities apply to a large area around Schiphol.

It is assumed that because of the investment in a rapid transit network in Greater Amsterdam, public transport will be better in this focus than in the *Baseline* scenario. It is also assumed that to encourage foreign companies to locate in the Netherlands it will be very important to deal with the threat of flooding by investing in safety measures to protect the Netherlands as much as possible from flooding. Disparities in affluence between regions widen, but policy is geared to preventing polarisation in the interests of creating a good business location climate. Extra attention is paid to the socially disadvantaged in the big cities by investing in education and the restructuring of rundown neighbourhoods, which reduces the number of disadvantaged areas. This focus assumes that social and economic conditions in the rural areas remain good without government intervention. Quality

Figure 4.24

Growth in the built-up area between 2010 and 2040, in the focus of International Business Establishment, compared with the Baseline scenario for 2040

Effects of the focus of International Business Establishment, compared with Baseline scenario in 2040 Table 4.6

Indicator	International Business Establishment	Effects
Flood Defences		Measures identical to those in the *Baseline* scenario
Adaptation to Climate Change		Almost no housing development in the reserved space -within flood-risk areas- for future designation
Biodiversity		Increase in green areas around the cities; decrease in biodiversity around Amsterdam, Utrecht, Eindhoven and possibly in the Oostvaardersplassen nature reserve
Accessibility		Shorter commuting distances; investment in infrastructure where this delivers the greatest benefits (Amsterdam, Utrecht, Eindhoven)
Quality of the Living Environment		A true metropolitan environment, less noise disturbance from Schiphol and more space around the cities
Residential Housing in Spacious and Green Surroundings.		Development of a number of locations for residential housing in spacious and green surroundings is one of the basic principles of this focus
International Business Establishment		Amsterdam is a real metropolis; investment in social harmony; better quality of life
Landscape Quality		Decline in landscape quality around Amsterdam, Utrecht and Eindhoven; a slightly smaller decline elsewhere
Spatial Segregation		Investment in education and urban restructuring

of life in the countryside is affected only by the mobility problem (lack of private transportation) (Netherlands Environmental Assessment Agency, 2004).

Conclusions

- Investment in the strongest regions delivers the greatest benefits to the attractiveness of the Netherlands as an international business location. At the moment, only the northern wing of the Randstad (including Utrecht) attracts sufficient foreign companies to bear comparison with other below top-ranking European cities (Barcelona, Munich). The northern wing and eastern Brabant are the most popular regions among foreign companies.
- A strategy of investing more in the strongest regions, which have the greatest potential for future growth, leads to a greater decline in landscape quality, because these same regions also contain the relatively better quality landscapes.
- Because the quality of the living environment influences the ability to attract international investment, a good investment climate also means more green space in and around the cities, social cohesion, attractive, compact and easily accessible urban areas.
- Relocating capacity from Schiphol to the airport at Lelystad (relocated slightly to the north-east) enables extra growth in air traffic and, on balance, delivers improvements in the quality of the living and working environment around Amsterdam and in the Netherlands as a whole, and improves international accessibility.

4.7 Landscape, tourism and recreation

Problem outline

The focus of *Landscape, tourism and recreation* emphasises strengthening landscape features in conjunction with the development of tourism/recreation and environmental and landscape management services. The Netherlands possesses some internationally rare and nationally distinctive landscapes, cultural heritage features and habitats. During the 20th century the quality of the Dutch landscape deteriorated sharply, initially due to agricultural reclamation, the scaling up and intensification of agriculture (greenhouse horticulture, intensive livestock farming) and later due to expanding urbanisation and infrastructure construction, particularly, in the west of the country. The Netherlands is one of the most urbanised countries in Europe. Almost 15% of its surface area is built up or used for infrastructure, and more than a quarter of the country lies within the urban shadow and is affected by the presence of urban areas or infrastructure (Netherlands Environmental Assessment Agency, 2005a). In many places this has led to cluttering and homogenisation of the landscape (Netherlands Environmental Assessment Agency, 2006).

Land-based agriculture is the main manager of the countryside. Agriculture does not, however, receive any direct support for managing and opening up the landscape for recreation. The scaling up of agricultural operations has led to the disappearance of many landscape elements and unpaved roads. Opportunities for the recreational use of the countryside have therefore also diminished sharply in recent decades, and so the demand for recreational facilities in and close to the cities greatly exceeds the current supply. In 2000, the shortfall in walking and cycling facilities amounted to 41,000 and 37,000 hectares, respectively, assuming forest to have the highest take-up capacity (NOC*NSF, 2005; Snellen *et al.*, 2006). Moreover, green spaces in the cities are under pressure. Continuing development in the cities means that open spaces, particularly allotments and sports grounds, are disappearing (De Niet, 2005). A consequence of urban expansion is that green open spaces around the city are

... restrictive planning policies are needed for landscape conservation at a reasonable cost; clear planning policies save money ...

pushed further outwards. House building is proceeding at a faster rate than the creation of green recreational areas, resulting in a growing shortage of open space in some regions, despite the fact that extra green space is being created. Many recreational activities, such as walking and cycling, take place in the countryside and various studies have shown that green spaces in residential areas are highly appreciated. Green spaces also have positive effects on health and fulfil a recreational function in the immediate vicinity of residential housing.Recreation and tourism are upcoming sectors, both in terms of the numbers of people involved and in their economic importance. Significant recreational trends include the growing popularity of golf, horse riding, wellness, and recreational shopping. Between 1990 and 2006, the number of golf courses increased from about 100 to 179. According to data published by the chambers of commerce, 640 riding schools were set up in the past ten years. The number of riding schools in the Netherlands now totals 1,220. The economic value of the equestrian sector, including trading and ancillary services, is estimated at 1.0 to 1.2 billion euros – more than either the poultry or bulb growing sector (MNP, 2006). Collaboration within the tourist and recreational sector is limited, however, so there are still opportunities for both the economy and the development of the landscape. There were over ten million foreign visitors to the Netherlands in 2005, and this number has been growing since 2003 (CBS, 2005). The most popular places were the four major cities, which attracted 4.5 million tourists, of whom just under 3.8 million visited Amsterdam. The second most popular destinations are the North Sea resorts (over 1.2 million visitors), followed at a greater distance by (parts of) Brabant, Limburg and Gelderland. Generally, approximately 2.1 million tourists visit one of the water recreation areas (including the coast). Dutch and foreign visitors to those areas are estimated to have spent 2.2 billion euros in 2002 (MNP, 2006).

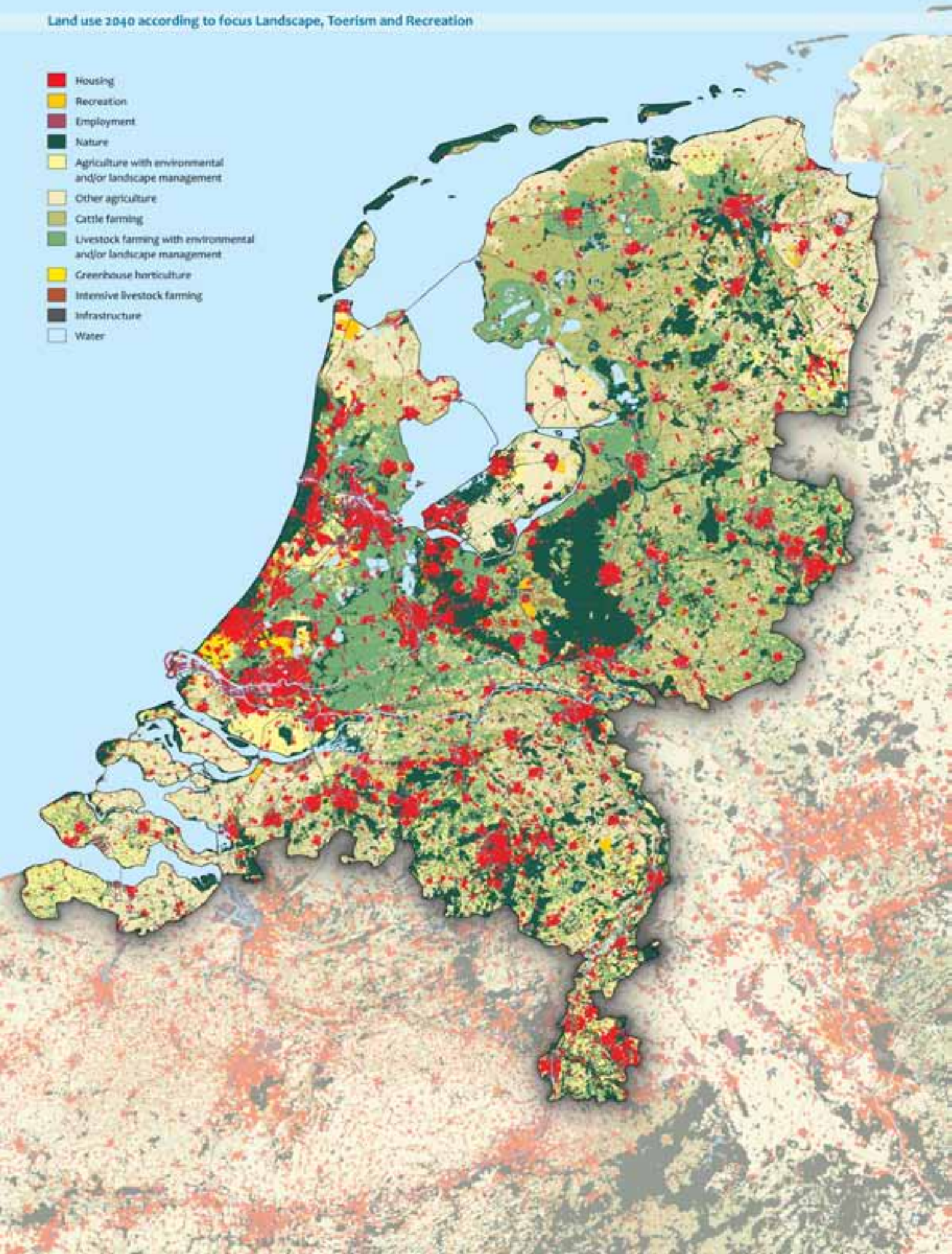
Future development of tourism and recreational facilities should take account of climate change, the changing composition of the population (more older people, the different recreational preferences of ethnic minorities) and changes in recreational behaviour. If the summer climate becomes unpleasant in the Mediterranean but more agreeable in the Netherlands, this will generate major opportunities for the tourist sector.

Landscape, tourism and recreation cannot be viewed separately. In England, for example, the character of the landscape is protected by well-organised walking societies. Such opportunities are exploited much less in the Netherlands.

The possible solutions and spatial scenarios

What would the Netherlands look like in 2040, if new urban development is planned so that valuable landscape features are retained, as much as possible and considerable investment is also made in additional green space, water bodies and agricultural landscape management? Additional funding is needed for the sustainable conservation of the core qualities of the Dutch landscape (see, for example, the implementation programmes of the National Landscapes and the 'Make the Netherlands Beautiful Again' campaign

Land use 2040 according to focus Landscape, Toerism and Recreation



(Vereniging Nederlands Cultuurlandschap, 2006)). Landscape investment is for the long term, and for the benefit of the living, working and recreational environments, and helps to create good spatial and environmental conditions and contributes to happiness and prosperity. Investments in the landscape, therefore, are sustainable investments (LNV, 2006). In addition, planning is needed to conserve these core qualities at reasonable public cost. The targeted application of agricultural subsidies in National Landscapes, areas close to the major cities, and in the urban buffer zones, should be considered for landscape management as well as nature conservation purposes.

The map of the focus of *Landscape, tourism and recreation* (Figure 4.26) was drawn up in the following way:

- Housing and employment land is allocated per 'housing region' (mostly per province, except for North Holland which is grouped with Utrecht and Flevoland, and South Holland which is grouped with western Brabant) .
- Valued landscape features in National Landscapes, peat meadows, five-kilometre zones around the bigger cities, and urban buffer zones, are conserved and developed via agricultural landscape management schemes (creation and maintenance of landscape elements, admitting walkers on farmland and laying footpaths). It is assumed that, by 2020, the areas covered by these schemes will amount to 200,000 ha, increasing to 350,000 hectares by 2040 (the total area of extensive farming in the above four categories currently amounts to around 900,000 ha).
- To protect existing landscapes, development (housing, employment, tourist facilities) is not permitted at all in the urban buffer zones or areas of high scenic value (landscapes of high cultural and natural value), and only to a very limited extent in the National Landscapes and UNESCO World Heritage Sites. No new major infrastructures are permitted to cross vulnerable landscapes. The many restrictions in some regions mean that new housing and employment locations are only available at a considerable distance from the bigger cities.
- Greenhouse horticulture and intensive livestock farming are concentrated as much as possible in the development areas designated in current central government and provincial policies.
- The biggest shortages of green open space around the cities are in the west of the country, where 25,000 hectares of new green space is created for recreational purposes. These areas are indicated as 'nature' on the map.
- The development of water-based recreation is centred around the 'Blue Arrow' zone, a continuous zone of water and wetlands from Zeeland through the middle of the country to the north (recreational/pleasure craft) with day-trip facilities. As part of this development, new recreational water bodies have been created at various places in this zone. These new water bodies are located in certain polders reclaimed from old lakes (such as Groot-Mijdrecht-Noord, Horstermeer, Kop van Overijssel), where they help to counter the effects of desiccation in nature conservation sites, link nature conservation areas together, create water storage capacity and create a tourist waterway (Noordoostpolder 'edge lake').
- In several regions, landscape quality is poor, intensive livestock farming needs to be transformed (Gelderse Vallei, Peel area) or the socioeconomic position is bad (Veenkoloniën and the north of the North Holland peninsula). In these regions, new landscape features emerge along with new economic drivers in the form of tourism (bungalow parks) and retail complexes. The tourist/recreational complexes absorb a large part of the growing demand for land for new recreational facilities and tourist accommodation. They also provide room to replace tourist accommodation and facilities of those

Text box 4.5: 'Tourism-for-Landscape' arrangements

These arrangements are based on an integrated concept for tourism and landscape management, centred around specific themes:

1. 'Wellness experience' in the Veenkoloniën (region of reclaimed peat mining landscape): hotels with wellness centres and golf; contributing to socioeconomic revitalisation and development of landscape qualities.

2. 'Dutch experience' in Flevoland: international tourism and recreational shopping in a reconstruction of Amsterdam (already present on the Turkish coast) relieve tourist pressure on Old Amsterdam.

3. 'Amsterdam experience' in Old Amsterdam: much heavier accent on up-market cultural tourism; contributing to the cleaning up of the Amsterdam street scene.

4. 'Beach experience' on the coast of North Holland: enjoy beach, sea, sun and nightlife in the pleasant climate of the Dutch Mediterranean, budget hotels, amenities (bars, discos) for young people.

5. 'Brabant delta' in western Brabant: water sports and holiday accommodation, used as levers to resalinate and transform the Volkerak-Zoommeer into a clean salt-water system again; contributing to diversification of the rural economy.

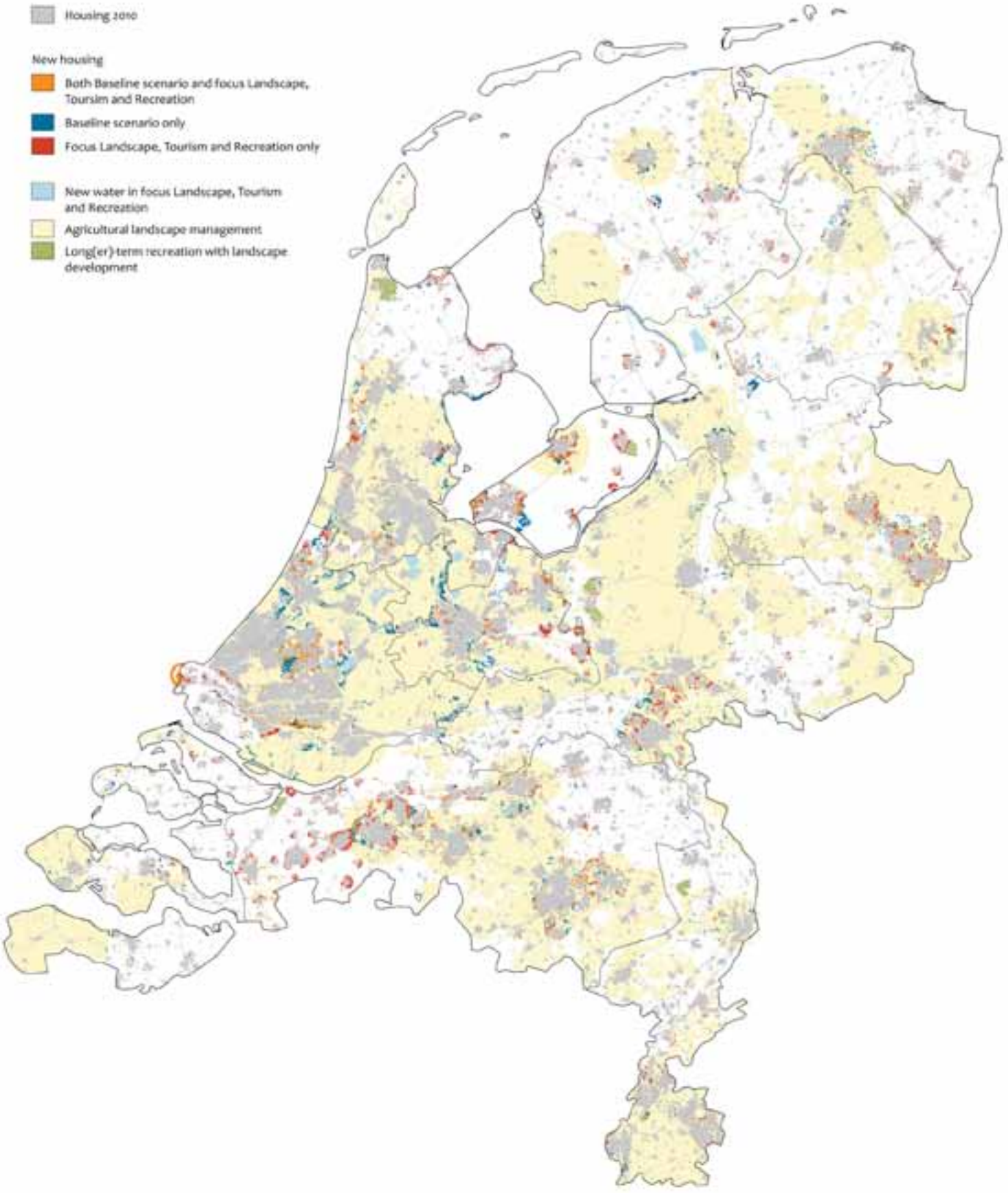
6. 'Forest living' in the Gelderse Vallei: new holiday accommodation as an alternative to amenities relocated from the nature conservation areas of the Veluwe; opportunities to live permanently in a green environment; contributing to the restructuring of intensive livestock farming.

7. 'Texas experience' in the Peel region of Limburg: development of riding schools and livery stables, bridle paths, hotels and holiday accommodation with stables.

Figure 4.26

The Netherlands in 2040 in the focus on Landscape, Tourism and Recreation.

Development housing 2010 – 2040 according to focus Landscape, Tourism and Recreation



... heavy investment in green areas and water can make good the considerable shortage of recreational areas around the big cities ...

... many cities are surrounded by attractive landscapes. Restrictive planning policies can ensure that this remains the case ...

removed from areas in the National Ecological Network, and can contribute financially to the relocation of intensive livestock farms, the improvement of water quality, the alleviation of the pressure on nature conservation areas, and the creation of green space ('Tourism-for-Landscape' arrangements).

Effects

Biodiversity increases. The quality of the National Ecological Network improves, as holiday accommodation is relocated and measures are taken to reverse desiccation. Scattered sites of conservation value outside the National Ecological Network also improve in quality due to investment in green services by farmers and the creation of additional green space and water bodies. The funding of this investment is an uncertain factor in this focus.

The effects on accessibility are varied. On the one hand, fewer sites are available for new housing around the main cities, but, on the other hand, new residential development is largely concentrated around the other towns and cities. The quality of the living environment improves as a result of extra investment in agricultural landscape management and the provision of extra green space and water. Landscape quality rises considerably due to investment in agricultural landscape management, restrictive urban development policy (particularly for National Landscapes, urban buffer zones and the National Ecological Network), and to the concentration of intensive forms of agriculture in certain areas. In many areas, diversified farm businesses are supported through the financing of green services. In other areas, agriculture can develop by generating income from the market. Intensive forms of agriculture can expand in areas where there is sufficient room for expansion. The improvement in the quality of the living environment and the landscape also helps to increase the climate for business establishment. The many restrictions mean that in some regions land for new housing and employment locations is available only at a great distance from the major cities (such as Amsterdam, The Hague and Utrecht) (Figure 4.27), which harms the economic base of those cities. However,, restrictions on dispersed building benefits other towns and cities. Lastly, the creation of new areas of open water can contribute towards adaptation to climate change if it is combined with water storage.

Conclusions

- Big cities, such as Amsterdam, The Hague and Utrecht have little room to expand because the surrounding landscape contains many protected areas (landscape and conservation values), making urban restructuring and intensification of housing and employment areas even more urgent.
- The shortage of recreational facilities close to the major cities necessitates investment in green space around the cities and in new water-based recreation. For the cities where the pressures on the available land are very high, an obvious option is to concentrate new recreational facilities in a small area of intensively used green recreational space; a further option outside these areas is to encourage the provision of green services in land-based agricultural areas.
- Concentration of business parks, greenhouse horticulture and intensive livestock farming contributes appreciably to the restoration of landscape quality.
- Well-placed and designed recreational and tourist developments can be used to conserve and improve landscape quality. Recreation and tourism are new drivers in the countryside, both as economic motors and as a means of shaping the landscape.
- People want to fit more activities and hobbies into their free time and so intensify their experiences. This

Figure 4.27

Growth in the built-up area between 2010 and 2040, in the focus of Landscape, Tourism and Recreation, compared with the Baseline scenario for 2040.

Effects of the focus of Landscape, Tourism and Recreation, compared with the Baseline scenario in 2040 Table 4.7

Indicator	Landscape, Tourism and Recreation	Effects
Flood Defences		Measures identical to those in the *Baseline* scenario
Adaptation to Climate Change		Virtually no change in housing in the reserved space -within flood-risk areas- for future designation
Biodiversity		More greenery around the cities, reduction in desiccation by inundation of the low-lying polders (reclaimed land)
Accessibility		On the one hand, less new housing development around the biggest cities, while, on the other hand, this is increasing around the bigger cities, and it is less dispersed. On balance, the effect is limited
Quality of the Living Environment		More greenery and water around the cities, and an increase in the quality of traditional agricultural landscapes
Residential Housing in Spacious and Green Surroundings		Less space for dispersed housing outside the cities.
International Business Establishment		More greenery and water around cities, and increase in quality of the agricultural landscape
Landscape Quality		Protection and reorganising of areas with high landscape value, more greenery and water around the cities, more agricultural landscape management
Spatial Segregation		Measures identical to those in the *Baseline* scenario

is exploited by choosing a theme, such as 'Netherlands – Water Land' for the Netherlands as a whole, and by giving the regions a distinct identity and image. Because the sector is poorly organised and in order to be able to take full advantage of synergies with other functions, government direction is desirable for region-specific tourism and recreational projects (for example, the Blauwe Stad). Also, area development planning can exist only because there is regulatory system of development control in place. In other words, only when development opportunities are scarce can investors in new residential, employment or tourism projects be obliged to finance the creation of new green space.

4.8 Cost comparison

When comparing the focuses with the *Baseline* scenario and vice versa, costs are naturally an important factor. This applies not only to one-off investment costs, but also to the recurrent annual management and maintenance costs.

In 2005, investment in construction and civil engineering projects in the Netherlands amounted to 47 billion euros, or almost 10% of the national income (CBS, 2007). Government authorities provided a quarter of this investment; the remainder came from the private sector. Government was the biggest investor only in road and hydraulic engineering projects, providing 80% of the required finance. This expenditure was invested not only in new projects; a considerable proportion was spent on maintenance.

Method

The transformation and management costs of the various focuses were calculated using a computer module that made use of the outcomes of the Land Use Scanner (Arcadis, 2007). This method is, however, still experimental, and so the results should be seen as purely indicative.

Transformation costs

If the land use at any location changes, the module computes the cost of converting the land from its existing use into its new use. The costs depend, among other things, on land acquisition costs (location-specific), the cost of demolition and clean-up, land preparation and landscape works (including infrastructure) and all-in construction costs. There may be income to offset the costs, particularly if property is involved. Net transformation costs (costs minus income) must be calculated along with total costs. These net investments are in principle the public costs. How these costs are apportioned is a political decision.

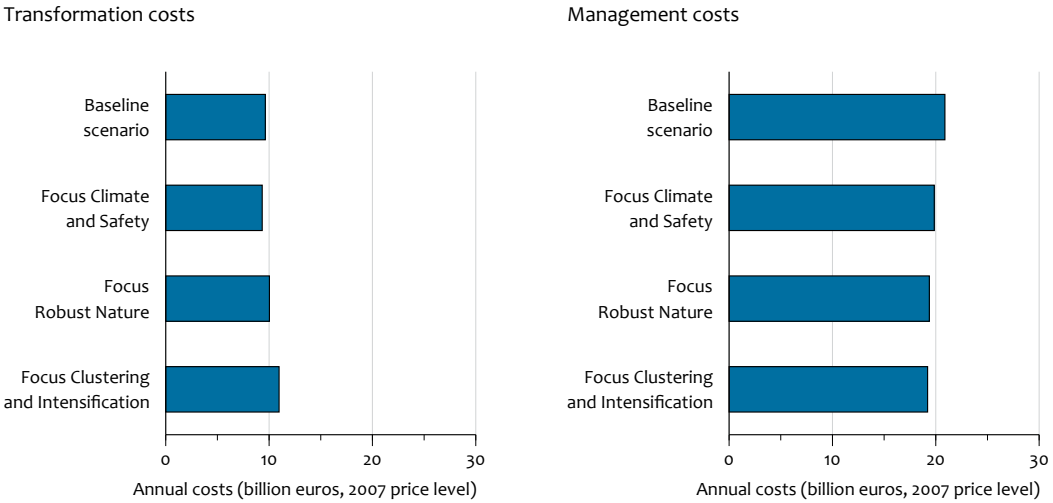
Restructuring costs

Earlier studies (for example, IBO, 2004) indicate that the costs of urban restructuring may be heavy. The chosen method, therefore, takes account of restructuring costs (assuming land use does not change). The *Baseline* scenario and the focuses, with the exception of *Clustering and Intensification*, assume a restructuring percentage of 7.5% over 30 years, which is equivalent to approximately 17,500 houses per year. This is based on 7,000 houses per year in the priority neighbourhoods, a similar number in large-scale restructuring programmes outside those neighbourhoods and the remainder in smaller projects. This means that 10% of the housing stock will be renewed over the next 30 years. The focus of *Clustering and Intensification* assumes that an average of 28,000 houses are demolished and rebuilt each year, in order to meet the inner city housing target.

Management costs for the three calculated focuses are lower than those for the Baseline scenario. The transformation costs for the Clustering and Intensification focus are higher than for the Baseline scenario Table 4.8

	Climate and Safety	Robust Nature	Clustering and Intensification
Management costs			
Transformation costs			

Indication of the public costs of transformation and management, 2040 Figure 4.28



An indicative calculation of public costs shows that management costs are considerably higher than transformation costs. The transformation costs in the focus of Clustering and Intensification, between 2010 and 2040, including the restructuring programme, are higher than in the Baseline scenario. However, recurrent annual management costs are lower from 2040 onwards. The management costs for the other focuses are also lower than for the Baseline scenario.

Management costs

In addition to transformation costs, the costs of maintaining and managing existing (or new) land uses have been calculated for the Netherlands as a whole. These cover only the costs of maintaining and managing public buildings or spaces and those components of new developments with public access. To clarify the differences between the focuses, the calculation is based on land use in 2040 and on 2007 price levels.

Results

According to the chosen method, around 70% of the maintenance and management costs and about 30% of the transformation and new-build costs are public costs (Figure 4.28). A major component of the maintenance and management costs are for the maintenance of infrastructure, sewerage and various other public facilities (including parks and public gardens in the cities). Public costs are those borne by central government, the provincial and local authorities and water boards.

Differences in management costs are mainly due to the size of the built-up area. Management costs are therefore highest in the *Baseline* scenario and lowest in the focus of *Clustering and Intensification.* It should be noted with regard to transformation costs that building on greenfield sites often generates income, whereas new-build developments on brownfield sites, as part of restructuring programmes, are often more expensive.

Table 4.8 summarises how the investment and management costs calculated for the various focuses perform in comparison with the *Baseline* scenario.

Conclusions

- The public costs of maintaining and managing the present built environment (including infrastructure) are much higher than the transformation costs (including restructuring costs).
- In the longer term, compact land use is cheaper than continuing to build on greenfield sites. In the latter case, the built-up area continues to expand, pushing up management and maintenance costs as well. If compact building is not the chosen option, some investment costs will be saved in the short term, but in the longer term, the recurrent annual management costs will be higher. In other words, these costs are passed on to future generations.

5 Combining focuses for policy coherence

5.1 Introduction

The previous chapters outlined possible future land-use scenarios, in which the optimal situation for each focus has been determined. Table 5.1 gives an overview of the effects of all the focuses measured against the sustainability indicators, compared with the *Baseline* scenario in 2040. By analysing the relationships between these focuses and the structural trend, a new spatial scenario can be constructed in which risks are reduced as much as possible and opportunities are exploited to the full. No ready-made methodology is available for this. In view of this, a map of a *Combination* scenario *(Combination Map)* was drawn up in an iterative process based on expert judgements. Section 5.2 describes the basic principles underlying the *Combination Map.* Section 5.3 describes the resulting *Combination Map* and Section 5.4 describes the effects on the sustainability indicators. The results from the Combination variant are then translated into an integrated policy agenda in Section 5.55. Section 5.6 contains the conclusions and Section 5.7 contains a list of topics for future research.

The *Combination Map* is intended as an illustration of the possibilities for drawing up a series of development perspectives for the Netherlands, using the Land Use Scanner, which perform better on sustainability than the structural trend (Figure 5.3).

5.2 Basic principles and criteria

The following basic principles underlying the *Combination Map* were drawn from the conclusions from the focuses and the interrelations between them.

Flood defences

The *Climate and safety* focus shows that the Netherlands can probably withstand climate change and rising sea levels for centuries and that structural measures, such as shifting investment to the higher ground or to a substantially widened coastal zone, are therefore not urgently required. The *Combination Map,* thus, assumes further investment in the low-lying Netherlands, particularly the Randstad, and confines itself to a targeted differentiation in safety levels to reduce the damage and casualty risks while creating a robust protection system in the Rhine-Meuse floodplain. Areas with the lowest safety standards are kept free of new urban development as much as possible. The introduction of overflow dykes is expected to increase the predictability of any flooding and reduce the casualty risk even further.

Adaptation to climate change

Although there are many uncertainties surrounding the rate and scale of climate change and the rise in sea level, the analysis in Chapter 2 shows that the diminishing opportunities for a free discharge of water from the rivers determine the long-term future of the Netherlands. In the event of a two-metre rise in sea level, other structural solutions may have to be found for the main and peak discharges from the Rhine. A rise in sea level to somewhere at the upper end of the KNMI's estimations, would take two or three centuries to occur. The densely populated lower reaches of the Rhine and Meuse rivers, with cities such as Rotterdam and Dordrecht, are particularly vulnerable (Figure 5.1). To keep open the long-term options for adjusting the river discharges and storing water, the *Combination Map* contains areas reserved for water retention in the south-western delta, the river areas, the IJssel valley and IJsselmeer area. These emergency water retention areas make the Netherlands more resilient in the event of an unexpected acceleration in the rise in sea level in this century.

The low-lying Netherlands must contain areas for extra water storage. Some of the deepest polders (reclaimed land), or sections of these polders, as included in the *Landscape, tourism and recreation* focus, would be the most appropriate locations, because this would also serve to reduce the intrusion of salt water into the polder drainage system, and combat desiccation in surrounding nature conservation areas, as well as create additional opportunities for recreation and green residential areas. A separate saltwater drainage system would deliver additional options for expanding facilities for water-based recreation. Given the fact that options for adapting sewerage systems and reserving land for water retention at a later date are limited and would also entail higher costs, it is assumed that new urban areas will have a robust design that includes provisions for additional water storage. This is also an important requirement for the restructuring of existing urban areas. Reservation of areas in the IJsselmeer area for longer term water retention needs, which would also

Overview of the effects of the six focuses on sustainability, compared with the Baseline scenario Table 5.1

Sustainability indicators	Explanation	Coverage Trend scenario	Effect viewpoints versus Trend scenario					
			Climate and Safety	Robust Nature	Clustering and Intensification	Residential Housing in Spacious and Green Surroundings	International Business Establishment	Landscape, Tourism and Recreation
Protection against flooding	Risk of damages and human casualties							
Adaptation to climate change	Potential areas for inundation within risk areas							
Biodiversity	In Natura 2000 areas							
Accessibility	Social financial accessibility benefits							
Quality physical living environment	Greenery surrounding the city and noise pollution							
Conditions international business establishment	Congestion, perception of risks, growth in Northern Randstad areas							
Spacious and green living	Low density housing, close to amenities and within attractive landscapes							
Quality of the landscape	Main qualities, perception and recreational values of the landscape							
Spatial segregation	Spatial distribution of the various income brackets							
Management costs	Maintenance and management of public areas							
Transformation costs	Net transformation costs of changes in land use							

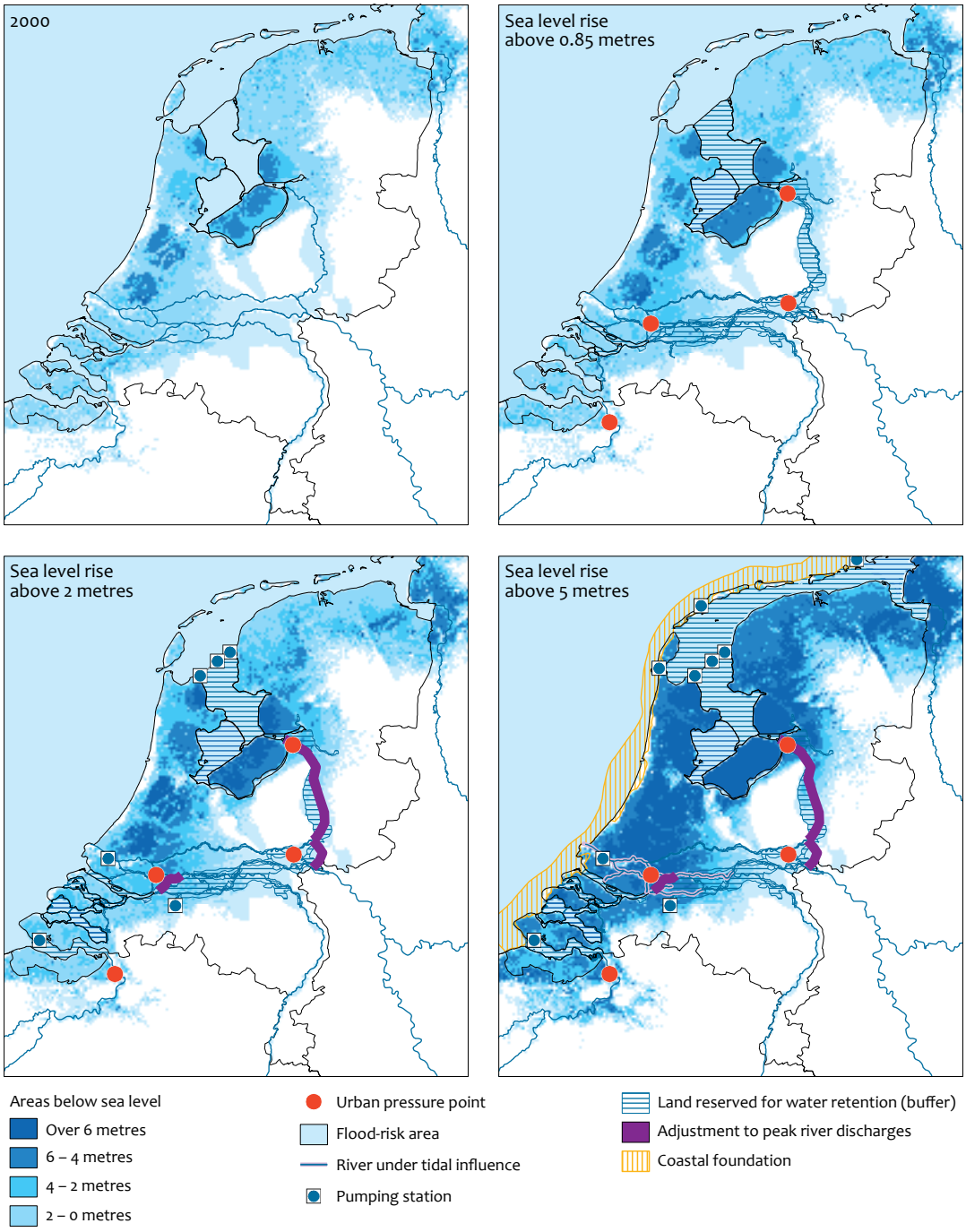
keep options open for substantial fluctuations in the water table in that area, and the development of internationally important nature conservation areas will reduce vulnerability to droughts.

Biodiversity

The *Robust nature* focus indicates that to comply with the agreement of the European Commission to conserve internationally important habitats and species (Natura 2000 network), the Netherlands needs to strengthen several nature conservation areas by enlarging them and reducing the environmental pressure from the surrounding areas. The *Combination Map* incorporates this expansion of the Natura 2000 areas as well as the measures, including financial compensation, to be taken in the buffer zones around the Natura 2000 areas. There is greater emphasis on wetlands (peat marshes, regional river/stream systems, the major water bodies and the river areas) and the fringes of the Veluwe and the Utrechtse Heuvelrug.

Accessibility

The *Clustering and Intensification* focus shows that with a high degree of clustering and intensification, accompanied by the introduction of road pricing (based on time, place and environmental criteria), the investments needed to achieve the stated accessibility goals are lower than if only the infrastructure is expanded. The improvement in public transport also delivers a significant accessibility gain



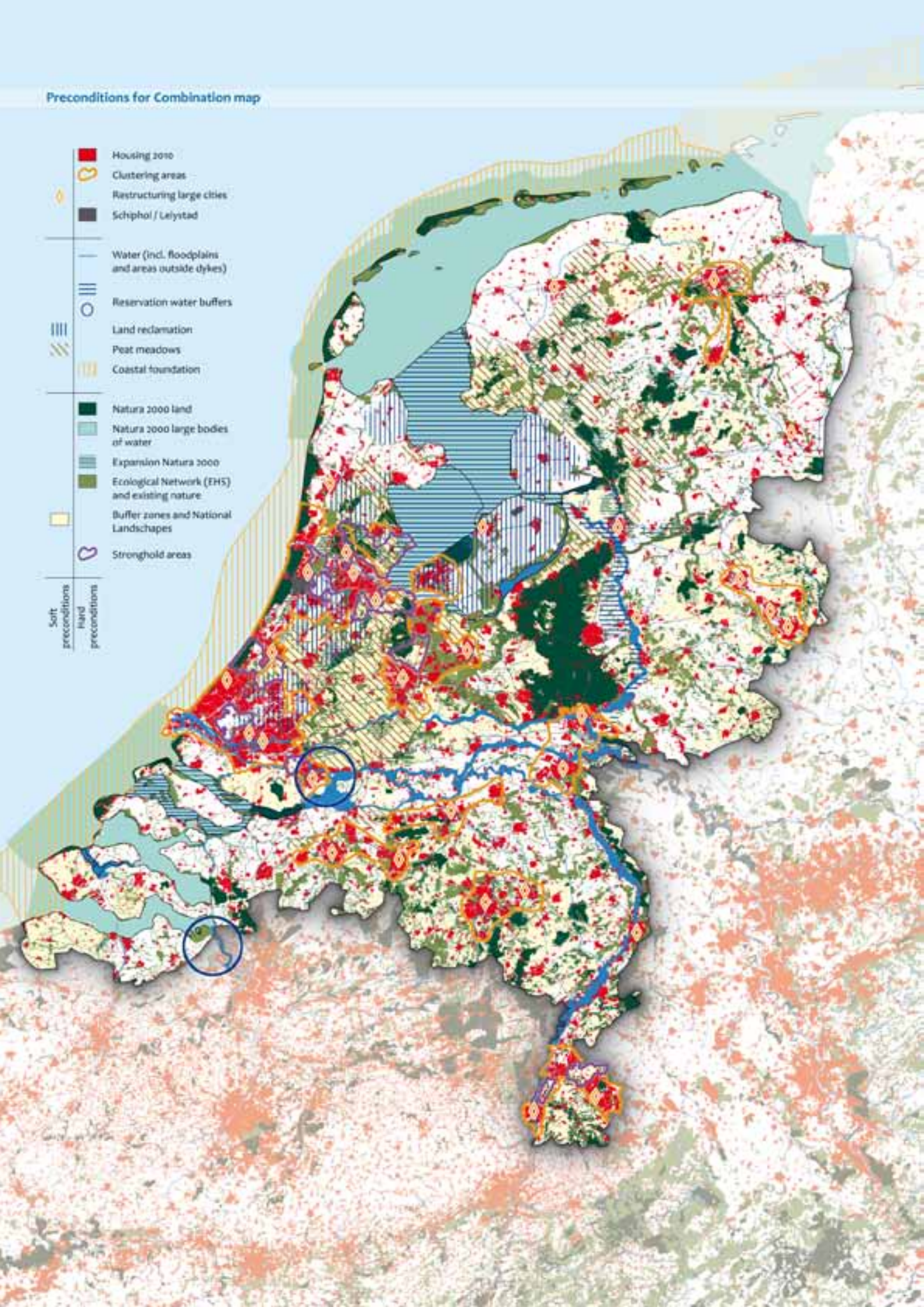
The ongoing rise in sea levels will make water management increasingly dependent on pumping stations and on options for dealing with peak river discharges. The rate at which the sea level rises and what measures will be needed are still uncertain.

in addition to that from the introduction of road pricing. Both instruments have therefore been incorporated in the *Combination Map.*

Another advantage of clustering and intensification is that urban development takes up less space, which leaves the flexibility of the spatial structure of the Netherlands intact, makes it easer to reserve land for flood protection (ability to adapt to climate change) and limits impacts on the landscape.

This makes the concentration of urban development a fundamental principle behind the *Combination Map.* Clustering and intensification also have negative effects. The main effects are a (relative) decrease in the area of green space in and around the cities (recreational opportunities) and an increase in noise nuisance. As compensation, the map includes the creation of additional areas of surface water and green space around the cities from the *Landscape, tourism and recreation* focus.

Preconditions for Combination map



Quality of the living environment

The focus of *Residential housing in spacious and green surroundings* performs less well than the *Baseline* scenario against many indicators, because of the greater claims on land and the development of urban land uses in attractive landscapes. Therefore, these are not included in the *Combination Map*. To improve the quality of the living environment, not only in new developments but also in existing housing areas, the *Combination Map* includes additional areas of water and green space around the cities (see the focus of *Landscape, tourism and recreation*).

Residential housing in spacious and green surroundings

There is more government intervention in the *Combination Map* than in the *Baseline* scenario, and urban development is prohibited in attractive residential landscapes, such as the National Landscapes and urban buffer zones. Consequently, less land is available for this type of housing development.

International Business Establishment

The focus of *International Business Establishment* assumes that only the northern wing of the Randstad is equally attractive to foreign businesses as the European below top-ranking cites (Barcelona, Munich). A great deal of the urban area in the western part of the Netherlands, therefore, is concentrated around Amsterdam. However, this has an adverse effect on other city regions and on the natural habitats, landscapes and water bodies around Amsterdam. It has not been incorporated into the *Combination Map* because there is unlikely to be such a bias towards Amsterdam in government planning. The focus of *International Business Establishment* also shows that moving part of the capacity of Schiphol Airport to Lelystad Airport (shifted slightly to the north-east) would improve the quality of the living environment around Amsterdam and, on balance, in the Netherlands too. This relocation of airport capacity, therefore, is incorporated into the *Combination Map.*

Landscape

The focus of *Landscape, tourism and recreation* assumes a restrictive urban development policy for National Landscapes and urban buffer zones, and this is included in the *Combination Map.* Additional green space around the cities and additional water bodies are included in order to reduce the negative effects of clustering and intensification strategies.

The extra emphasis on agricultural landscape management in the focus of *Landscape, tourism and recreation* is included in the *Combination Map.* This strategy is applied to National Landscapes, the peat meadows, a five-kilometre zone around the larger cities and the urban buffer zones. The basic principle here is that the reform of the EU's Common Agricultural Policy will enable a substantial shift away from the present system of agricultural subsidies to a system of rewards for landscape stewardship by farmers in the public interest. This will make it possible to fund agricultural landscape management in those areas, as well as additional environmental measures in the buffer zones around Natura 2000 areas. The *Combination Map* also incorporates the greater degree of concentration of intensive forms of agriculture (greenhouse horticulture, intensive livestock farming) in this focus.

Criteria for the Combination Map

The *Combination Map* assumes the same land requirements for housing as in the focus of *Clustering and Intensification*, based on a high degree of urban intensification (50% of the housing programme in built-up areas of 2000). Given the uncertainties about the precise areas of land required and the degree of intensification (percentage of new-built housing in existing urban area), a *Combination Map with high development pressure* has been drawn up, with housing land requirements on a par with those in the *Baseline* scenario *with high development pressure.*

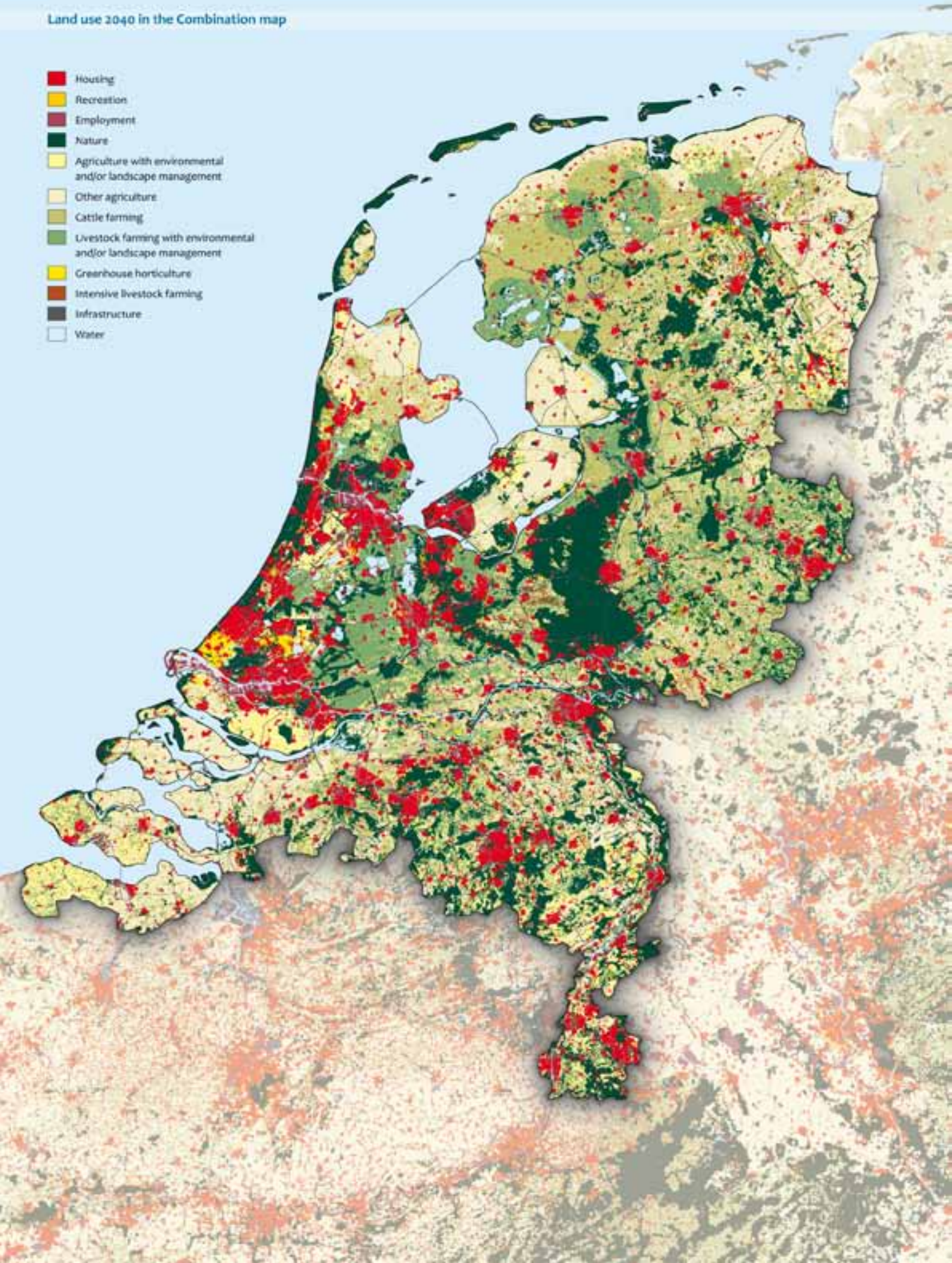
The *Combination Map* (compared with the *Baseline* scenario) applies the following principles to land-use planning:

- Space for housing and employment is allocated per 'housing region' (mostly per province, except for North Holland which is grouped with Utrecht and Flevoland, and South Holland which is grouped with western Brabant).
- Housing land requirements are clustered in the concentration areas (in line with the *Clustering and Intensification* focus, which for greenhouse horticulture are the glass concentration areas and for intensive livestock farming the agricultural development areas. Areas near railway stations are considered particularly attractive for housing.
- Firm restrictions on housing, employment, greenhouse horticulture, intensive livestock farming and tourism in the areas with a flood safety function, or which have been reserved for this, in Natura 2000 areas plus planned sites for expansion of these areas, other existing nature conservation areas (as in 2010), and in the urban buffer zones.
- National Landscapes are subject to some restrictions: the Oude Rijn and Vecht transformation zones are the least restrictive.
- Allocation of housing and employment land takes account of the differentiation in safety levels, as in the focus with differentiated safety levels per dyke ring.
- Some of Schiphol's capacity is moved to Lelystad (Lelystad Airport is relocated slightly to the north-east), which allows the areas within noise contours around Schiphol to be kept as small as possible.
- New nature conservation areas are allocated in accordance with the *Robust nature* focus. New water bodies are allocated in line with the focus of *Landscape, tourism and recreation*.
- Agricultural and livestock farming with agricultural environmental or landscape management is allocated to the hydrological buffer zones around Natura 2000 areas. National Landscapes, peat meadows and a five-kilometre belt around the G30 cities.

Figure 5.2

Criteria for the Combination Map.

Land use 2040 in the Combination map



Effects of the Combination Map scenario (structural trend in development pressure) compared with trend. Table 5.2

Indicator	Combination map	Effects
Flood Defences	GROEN	Differentiation in safety levels, use of overflow dykes, concentration of urban development in the low-lying Netherlands in areas with the highest safety levels, and limited urban expansion in the river areas.
Adaptation to Climate Change	GROEN	Retention of reserved areas for future designation within flood-risk areas and more water bodies in and around the cities provide more options for water storage.
Biodiversity	GROEN	Expansion of Natura 2000, additional green around the cities, and agricultural environment and landscape management of buffer zones and National Landscapes.
Accessibility	GEEL	Accessibility benefits resulting from urban compaction policy brings homes and employment closer to each other.
Quality of the Living Environment	GROEN	More green and water around the cities, and an improvement in the quality of agricultural landscapes; less noise nuisance from Schiphol Urban intensification increases pressure on the quality of living environment.Airport.
Residential Housing in Spacious and Green Surroundings	GEEL	In and around the Randstad there is some scope to develop new green living environments in the direct vicinity of the cities.
International Businesses Establishment	GROEN	More green and water around the cities, and improvements in the quality of agricultural landscapes; less noise nuisance from Schiphol Airport.
Landscape Quality	GROEN	Areas of high landscape quality kept free of urban development and agricultural intensification; more green and water around the cities, more agricultural landscape management and reorganising of dispersed greenhouse horticulture and intensive livestock farming.
Spatial Segregation	GEEL	Effect barely differs from structural trend.

- The greatest shortage of green space around cities is in the west of the country. An additional 25,000 ha of new recreational green space has been added to the map as 'nature'. New areas of surface water are also created.

The *Criteria Map* (Figure 5.2) shows several of these criteria for the future spatial development of the Netherlands. The map shows the concentration areas that are attractive for urban development. Future urban development in the western part of the country in particular is subject to many criteria.

5.3 Combination Map

The *Combination Map* shows a much greater clustering of housing and employment in the concentration areas (Figures 5.3 and 5.4) than the *Baseline* scenario. In the western Netherlands there is a major shift in new housing and employment locations away from the Green Heart to Almere and Amersfoort. Greenhouse horticulture moves from Westland and Aalsmeer to the fringes of the Randstad (Voorne, North Holland). It could also move south to western Brabant.

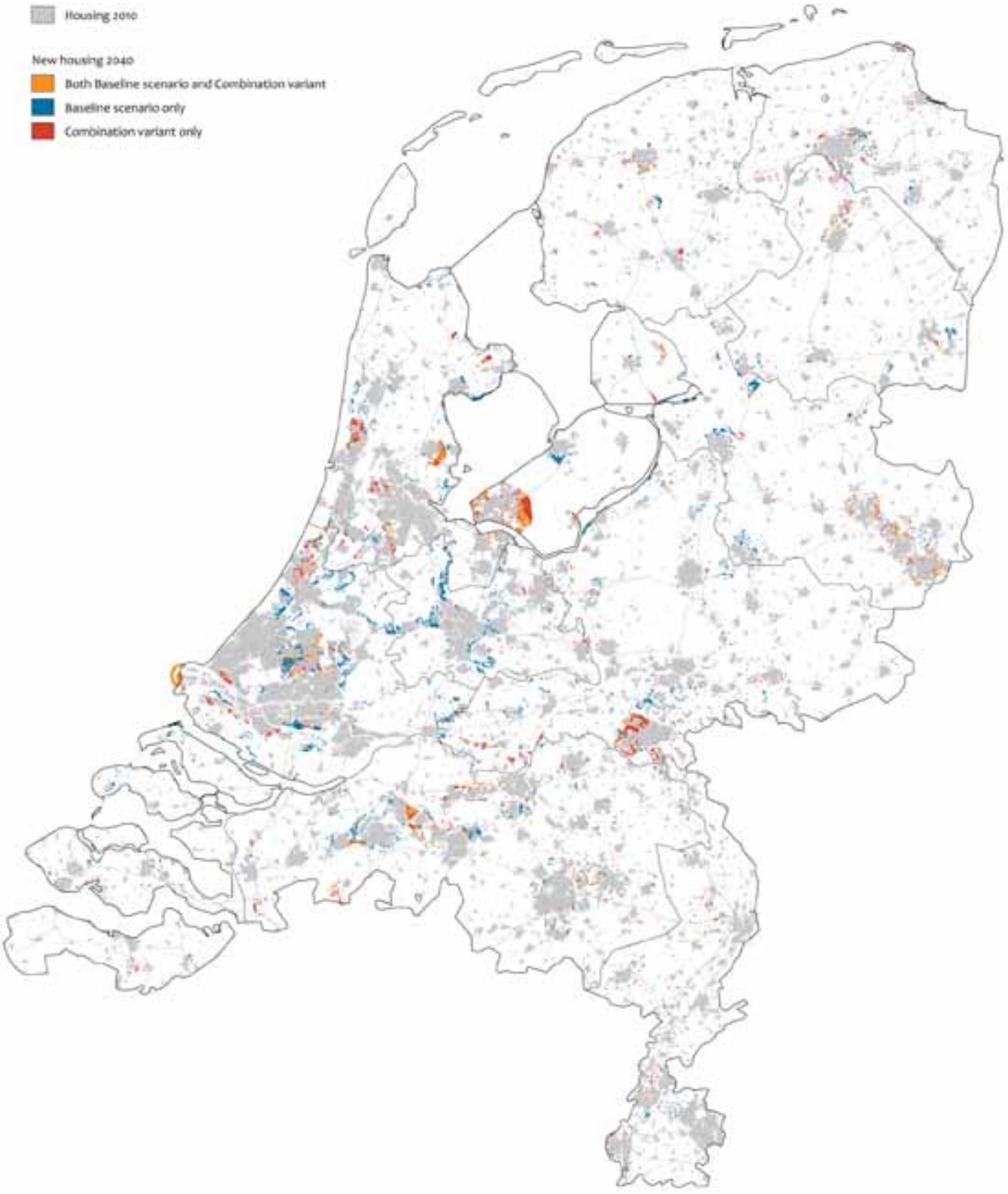
Land-based agriculture in the buffer zones around Natura 2000 areas, in the National Landscapes, the urban buffer zones and within a five-kilometre zone around the major cities is classified as agricultural or livestock farming with environmental and/or landscape management. In those areas, financial compensation is needed in return for accepting a higher water table and/or environmentally friendly farming methods (buffer zones), or as remuneration for agricultural landscape management (other categories).

The *Combination Map with the High Development Pressure* scenario (Figures 5.5 and 5.6) shows an expansion of the Randstad. The new urban areas are located along a wider Randstad ring via the coastal zone, Rotterdam, the Brabant cities, Nijmegen, Arnhem and Amersfoort to Almere and Amsterdam. The increased size of Almere stands out, as does the new development in the Gelderse Vallei and the south-west of Brabant. There is little room for expansion around the big cities, which means that if these cities want to meet the demand for new housing in a sustainable way, a greater effort will be required to provide new housing in the existing urban areas.

Figure 5.3

The Netherlands in 2040 in the Combination Map.

Development housing 2010 – 2040 in Combination variant



5.4 Effects

The effects of the *Combination Map* score higher than the trend on many indicators. If, however, the spatial pressure increased, the scores on the indicators would be lower.

Flood defences

The map (Figure 5.3) shows that the areas with the lowest safety levels, such as those in the *Differentiated safety standards* variant, remain free of new urban development in the *Combination Map.* However, because many other kinds of (non-safety) criteria are applied, urban development is not concentrated solely in the areas with the maximum safety levels. There is, for example, some development in the area between Arnhem and Nijmegen. The long-term safety of this area is assured by the option of diverting some of the Rhine discharge to the IJssel if river discharges are higher than projected in the Room for the River programme. In the event of less extreme discharges but higher sea levels, extra water can be diverted to the IJssel to relieve pressure in the lower reaches. Future river discharge volumes will, however, depend on international agreements on flood risk management in the river basins (EU Floods Directive).

Biodiversity

As far as biodiversity is concerned, the *Combination Map* combines the benefits of extra efforts in support of robust nature in Natura 2000 areas with the conservation of other National Ecological Network sites and the conservation and development of valued landscape features. From a Natura 2000 perspective, there are many opportunities in the river areas (land reserved for widening the IJssel river, the Kampen bypass and Dordrecht bypass), in the IJsselmeer area and in the eastern half of the Green Heart (inundation of the lowest-lying polders, limiting flushing management, peat marsh restoration). Of significant added value here are the expected changes in precipitation dynamics in the years ahead. Inundation of (parts of) the polders, the development of peat marshes and the open IJsselmeer area should make a significant contribution to water storage in the Green Heart. The variation in landscapes and habitats, and the conservation of open space, are also springboards for the expansion of recreational facilities for the Randstad conurbation.

Accessibility

The size of the social (financial) accessibility gains of the *Combination variant* will be comparable to the infrastructure variant in the *Clustering and Intensification* focus, which envisages the introduction of national road pricing (varying according to time, place and environmental criteria) and improvements to the existing public transport infrastructure.

The *Combination variant with high development pressure* will not perform nearly as well as the plain *Combination variant.* Accessibility gains are smaller because a large proportion of the urban development in the *High Development Pressure* scenario is outside both the existing built-up area and the concentration areas. Furthermore, the current investment programmes for road and rail networks are directed at tackling the bottlenecks in the Randstad and are not geared to meeting demand resulting from a major expansion of the urban area outside the Randstad.

Quality of the living environment

On the one hand, the quality of the living environment improves because of additional green and water areas around the cities, new bodies of water and agricultural landscape management; on the other hand, urban intensification puts increasing pressure on the living environment: for example, noise nuisance worsens and air quality deteriorates. The conservation of green space in and between cities needs attention.

Residential housing in spacious and green surroundings

The *Combination Map* offers some scope for attractively located residential areas in the Randstad, particularly along the inner fringes of the coastal dunes, such as the bulb growing area. The tip of the North Holland peninsula became the major area for bulb cultivation some time ago. From a tourism perspective, it makes sense to retain a part of the bulb-growing acreage in the direct vicinity of the Keukenhof.

International Business Establishment

If the Netherlands can make a convincing case that the safety margins it applies to flood protection are much higher than in low-lying regions elsewhere in the world, it can turn this apparent weakness into an advantage for attracting foreign businesses. The higher concentration of urban development in the concentration areas provides opportunities to support the development of a metropolitan urban environment and upmarket tourism.

Because of the rerouting of some air traffic to Flevoland, Schiphol Airport can also meet all the demand for air travel in 2040, which improves international accessibility. Without this relocation of airport capacity to Flevoland, it will not be possible to meet almost 40% of the demand. The rerouting of some flights from Schiphol to Lelystad reduces the total number of people experiencing severe noise nuisance by some 30%. This reduction benefits the Amsterdam area, but noise nuisance increases around Lelystad. Relocation of airport capacity will reduce the area around Schiphol where no (large-scale) development is permitted, by about 100 km², Opening up new opportunities for new housing close to Amsterdam.

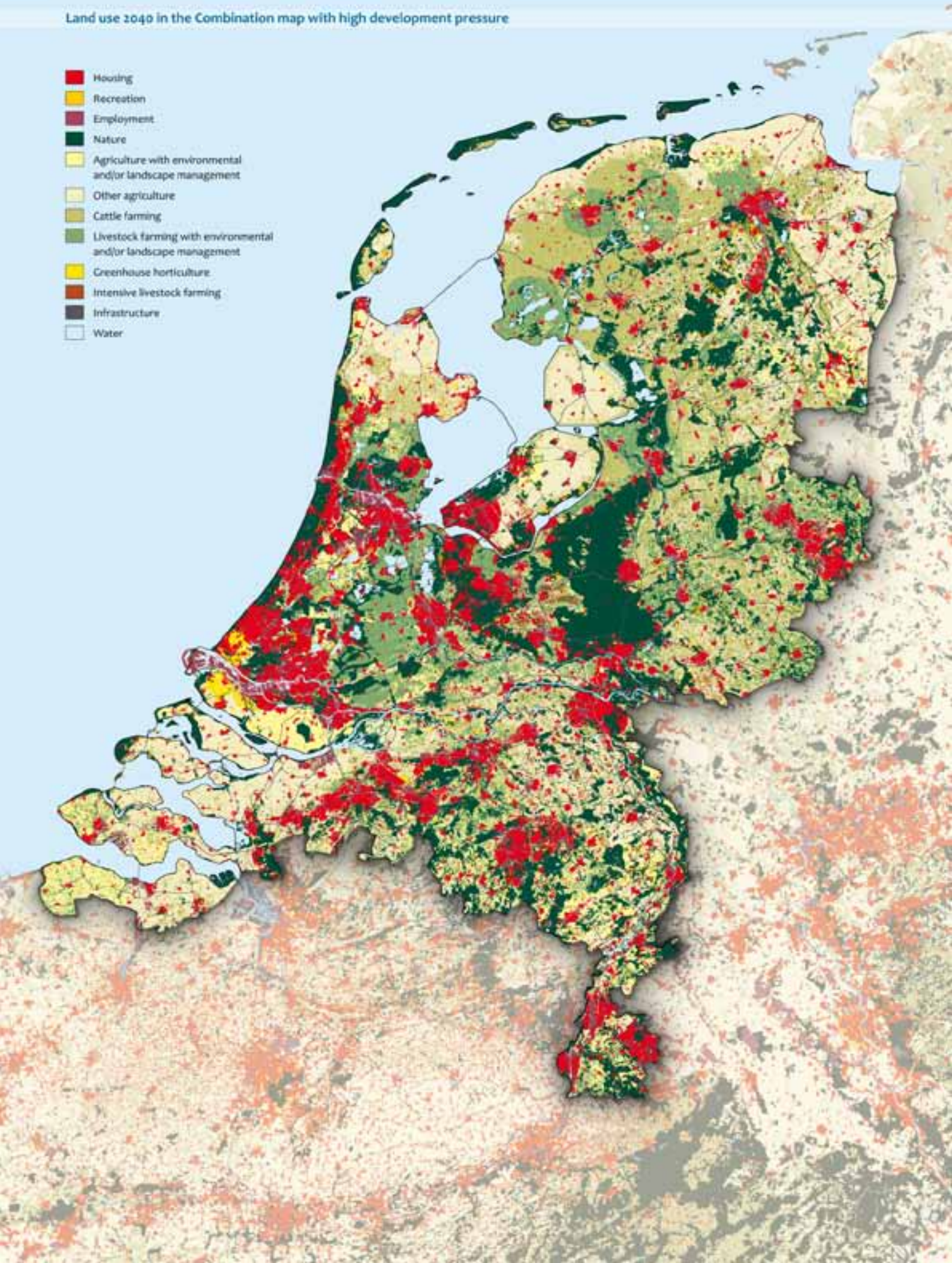
Landscape quality

Landscape quality improves considerably due to investment in green services by farmers, a restrictive urban development policy (particularly for the National Landscapes, the urban buffer zones and the National Ecological Network) and the concentration of intensive forms of agriculture. Diversified farming is supported in many areas by the financing of green services; intensive agriculture is supported by concentration in locations offering abundant space for expansion. Outside these areas there are relatively fewer prospects for farming, because of the loss of generic support.

Figure 5.4

Growth in the built-up area between 2010 and 2040, in the Combination Map.

Land use 2040 in the Combination map with high development pressure



Greenhouse horticulture shifts from Westland and Aalsmeer to the fringes of the Randstad. Because land for greenhouse horticulture is allocated per province, new horticultural businesses will become established along the borders of the Randstad provinces (Voorne, North Holland). Locations elsewhere in the Netherlands could prove to be more sustainable.

Because of the many restrictions, in some regions new housing and employment locations are only available at a great distance from the major cities (such as Amsterdam, The Hague and Utrecht). Without a greater focus on intensification, these remote urban extensions will impair the economic base of these cities.

Adaptation to climate change

In order to ensure flood safety, the IJsselmeer, including the Markermeer and the IJmeer, and parts of the south-western delta must remain reserved for water discharge as the sea level rises high. When these regions start to play a major role in water management, conditions for ecosystems and the landscape may change dramatically. Extra vertical storage in the IJsselmeer will, for example, have drastic consequences for the buildings in the old Zuiderzee villages. Raising the dykes in the lower reaches of the major rivers may have adverse effects on the local landscape and architectural heritage because many of these old buildings were built on and next to the dykes. Water storage generally has few adverse effects on habitats in the river areas, but the opposite is true of the delta area. The inflow of large volumes of fresh water has major effects on the Grevelingen saltwater lake.

5.5 A coherent policy agenda

At the moment, political and administrative decisions on the social themes discussed above are frequently taken from a sectoral perspective and therefore do not address the full picture. This encourages partial solutions and fragmented policy initiatives. An integrated and long-term approach, which also recognises the irreversibility of certain developments, is essential if we are to resolve the major issues, such as climate change and the conservation of biodiversity. More generally, this applies also to sustainable development, in other words, the interrelationship between the social, ecological and economic dimensions (people, planet, profit). Sustainable development spans a range of scales (global, continental, national, regional and local) and that means that the substantive problems and possible solutions will be different at each level. This study analyses how the persistent problems discussed above are interrelated. The main links between the themes are set out below. In the case of adaptation to climate change, the focus is on water, (see also WWR, 2006) and, particularly, on the long-term safety of the Netherlands.

Links between urban development, infrastructure and quality of the living environment

By clustering urban development in concentration areas and endeavouring to build more houses on brownfield sites as they become available (urban intensification), less existing open space will be developed and accessibility will be improved. The economic base of the larger cities will also be increased. Clustering and more intensive use of existing urban space will also help to reduce climate change. A challenge for policy is to combine clustering and intensification with the creation of sufficient recreational green space in and around the cities. Another goal is to reduce the noise nuisance from traffic along urban and provincial roads. These problems can be resolved by harmonising urban policy, the Multi-annual Programme for Infrastructure, Spatial Planning and Transport (MIRT),and policy for the National Landscapes, urban buffer zones and green space.

Links between flood safety, habitat creation and landscape

By combining space for water and habitat creation, the Netherlands can reserve land for absorbing the effects of climate change while at the same time complying with international nature conservation commitments and preventing urban development in the National Landscapes. The main opportunities are the IJssel valley, the IJsselmeer, the Delta area and the Green Heart. Pursuing this aim will require greater harmonisation of the Room for the River programme, and the Natura 2000 and National Landscapes policies.

Links between agriculture, nature and landscape quality

Agriculture will continue to play a major role in rural areas. Transforming subsidies for land-based agriculture into compensation for agricultural environmental and landscape management will improve the environmental quality of nature conservation areas and give farmers better prospect as managers of the agricultural landscape. This is particularly important in the buffer zones around Natura 2000 areas, in National Landscapes and the peat meadows (landscape quality), and in the zones around the larger cities and the urban buffer zones (recreational facilities). The reform of the EU Common Agricultural Policy (CAP) in 2013, the policy for National Landscapes and the policy for Natura 2000 areas will provide a suitable framework for this. If the reformed CAP does not move in this direction, more national funding will be necessary.

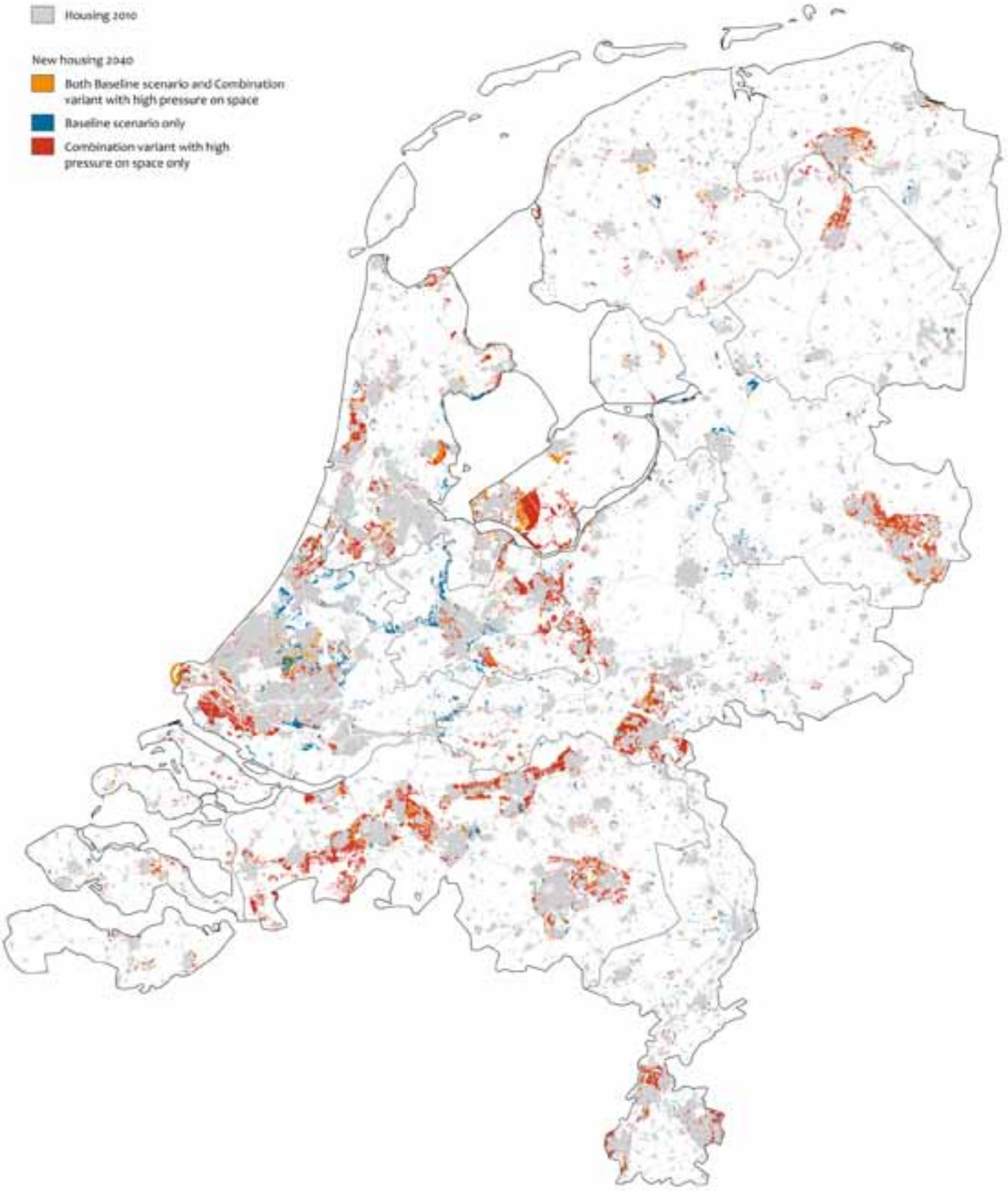
Links between policy, implementation and enforcement

Clear spatial planning policies and the enforcement of land-use designations are important requirements for sustainable development. Many rural land-use plans are out of date and poorly enforced (Ministry of VROM, 2006a and 2006b, VROM Inspectorate, 2005), and even approved developments, such as urban restructuring, are also lagging behind policy targets. Policies need to be enforced more keenly and pursued with greater vigour, and the investment conditions for achieving the desired developments need to be improved. Consideration should be given to further deregulation and/

Figure 5.5

The Netherlands in 2040 in the Combination Map with high development pressure

Development housing 2010 – 2040 in the Combination map with high pressure



... better integration of urban development, infrastructure and quality of the living environment ...

or integration of regulatory systems, and adapting EU regulations to the Dutch situation, which differs greatly from other countries in several ways, such as geographical location and population density.

From next year, central government and provincial councils will be able to take advantage of the new Spatial Planning Act. The Act allows spatial conflicts and opportunities of national importance (decentralised where possible, centralised where necessary) to be prioritised in spatial strategies, accompanied by an enforceable implementation agenda. A new Sustainable Structure Enhancing Fund will provide financial support for this implementation agenda.

The new Spatial Planning Act is ideally suited to reducing the strong emphasis on sectoral policy. The opportunities it provides for central and provincial government to exert greater control over the nature and direction of spatial development removes the need for highly regulatory, and thus inflexible, sectoral policies. This can be achieved by increasing sector involvement at all stages of the spatial planning process, at the national level, and by ensuring that spatial plans are always 'upwardly compatible'. New scientific insights and new social needs will not just be incorporated into sectoral strategies and visions (for example, for water management), but can also be evaluated and incorporated into a revision of the national strategy for spatial development.

Figure 5.6

Difference in spatial development of the built-up area, between 2010 and 2040, in the Combination Map with high development pressure.

Additional policy actions Table 5.3

	Short term (before 2010)	Long term (after 2010)
Links between urban development, climate (safety) and biodiversity	• Reserved land (water storage) in IJssel Valley, IJsselmeer, Volkerak-Zoommeer, Grevelingenmeer • Criteria for urban expansion (e.g. Almere, Kampen, Deventer, Zutphen, Dordrecht) • Robust design for restructuring and new urban development (sewerage, water storage) • Differentiation in safety standards + criteria for new urban developments • International agreements on managing river discharges • Planning protection for the National Ecological Network and Natura 2000 • Expansion of Natura 2000 and revision of the land acquisition policy for the National Ecological Network • International promotion of the Netherlands as the world's safest delta	• Strengthen spatial coherence of development in the delta – river areas – IJssel valley and IJsselmeer area • Adapt urban development to differentiated set of safety standards • Accelerating dyke reinforcement + building of overflow dykes and flood retention basins • Payment for agri-environmental buffer zones • Improve water quality of large water bodies
Links between urban development, infrastructure and quality of the living environment	• Introduce a national road pricing scheme (a kilometre charge differentiated by time, place and vehicle characteristics) • Operationalise goal for intensification of existing housing areas • More ambitious concentration policy • More greenery around the cities; integration with water management • Amelioration of noise nuisance along urban and provincial road network • Promote multiple land use • Retain green areas in and between cities	• Creating new water bodies
Links between agriculture, nature and landscape	• Planning protection for National Landscapes, urban buffer zones, peat meadows • Concentration of greenhouse horticulture, intensive livestock farming, tree nurseries, bulb cultivation • More control over planning of new business parks	• Payments for agricultural landscape management
Links between policy, implementation and enforcement	• Clear land-use planning and enforcement • Provisions in new Spatial Planning Act for matters of national importance • Converting Economic Structure Enhancing Fund into Sustainable Structure Enhancing Fund	• Use reformed Common Agricultural Policy to support agri-environmental and landscape stewardship schemes

Policy initiatives for the short and longer term

Both short-term and long-term policy initiatives can be used to achieve greater integration of sectoral policies, which in turn will deliver sustainability gains. These policy initiatives are summarised in Table 5.3. Implementing these initiatives will not require any fundamentally new policies. The National Spatial Strategy and many other policy documents already contain many policies that lean in this direction. The National Spatial Strategy Monitor (Snellen *et al.*, 2006), however, does show that we cannot always be sure that policy objectives can be achieved in practice. The underlying study also demonstrates that stronger policies will be needed, particularly for flood safety in the longer term and international nature conservation commitments.

5.6 Conclusions

- In order to provide the necessary new housing, employment, transport infrastructure and green space and at the same time maintain the quality of the living environment for existing and future generations, we need to take a more holistic approach to development and environment. Only then will it be possible to meet all the policy objectives and create a spatial structure that can rightly be called sustainable.
- The greatest improvements can be achieved by ensuring a much better fit between urban development and infrastructure and between flood protection, habitat creation/restoration and landscape development. Important gains can also be made by integrating agriculture and nature and landscape quality, and even integrating measures for flood protection, with those for improving the attractiveness of the Netherlands to foreign businesses.
- Existing policy objectives provide sufficient opportunities to make concrete steps towards more sustainable land use in the Netherlands. However, this will depend on vigorous implementation of these policies at the local level and effective harmonisation with EU policy. Clear spatial planning policies and enforcement of adopted land-use plans are important requirements for creating a sustainable living environment. The new Spatial Planning Act allows the preparation of spatial visions that can prioritise the spatial opportunities and conflicts for developments of national importance, accompanied by an enforceable implementation agenda. From a sustainability perspective, benefits that will accrue in the more distant future should weigh more heavily when political decisions are taken.
- Clustering and intensification will deliver considerable accessibility benefits. If the rise in mobility and congestion levels is modest, these gains will be greater than those that would be realised through the investments in the road network proposed by the Mobility Policy Document. Investments in infrastructure is more efficient if it is made according to a sequential approach as follows: spatial policy (clustering and intensification) – road pricing – physical expansion of infrastructure.
- The Randstad will increase in scale, particularly in the *High development pressure* variant. The new urban area will then run in a wider ring from the coastal zone to Rotterdam and

... greater linkage between flood protection, habitat creation and landscape development ...

... more integration of agriculture, nature and landscape quality ...

via the Brabant linear conurbation to Nijmegen, Arnhem and on through Amersfoort to Almere and Amsterdam.
- In the *Combination Map,* some of the greenhouse horticulture complexes in the western Netherlands will move to the fringes of the Randstad. To alleviate the pressure on space in the west, consideration can be given to designating areas for greenhouse horticulture elsewhere in the Netherlands.
- There are many opportunities for coupling habitat creation with spatial policies for the river areas (land reserved for widening the river IJssel and the Kampen and Dordrecht bypasses), the IJsselmeer area and the eastern half of the Green Heart: inundation of the lowest-lying polders, reclaimed from lakes, limited flushing with fresh water to remove intruded salt water and peat marsh development.
- Clear spatial planning policies, which will bring the price of agricultural land under control, are a necessary precondition for ensuring the continuity and development of land-based agriculture needed to manage the cultural landscapes (National Landscapes) and for providing effective buffer zones around Natura 2000 areas. Financial compensation is necessary for agricultural landscape and environmental management in these areas. The necessary conditions can be provided through a combination of EU agricultural subsidies and national policies for the National Landscapes and Natura 2000 areas. The reform of the EU's Common Agricultural Policy (CAP) in 2013 is an essential although uncertain factor here. Co-funding will have to come from national as well as EU sources.

5.7 Research agenda

The key questions in this study are how far spatial planning can contribute to sustainability, what dilemmas may arise and which specific strategic actions can be taken. This study does not mark the end of research into the relationship between spatial planning and sustainability. The questions that still have to be answered are set out in the research agenda listed below. The nature of these questions does not preclude the implementation of policy actions in the shorter term, although further research on the following topics is necessary to define policy actions in the longer term. The research agenda consists of general questions and specific questions for each policy theme.

General questions

- What is sustainable urban development and what are its implications for the Netherlands? Follow-up of the study *The Netherlands in the Future* for specific regions (such as the implications for the northern wing of the Randstad with regard to urban development, the future of Schiphol Airport and the IJsselmeer area, and the measures required to deal with high river discharges) and specific themes (including sustainable urban planning in relation to water management and public health).
- What is the energy consumption of other urban structures in Europe? What are the explanatory variables and what policy strategies can be identified?
- What ideas do the general public have about sustainable land use? Follow-up to the 'give me space' questionnaire.
- What effects do technological developments have on sustainable land use?
- What sustainability indicators should be used for the social (people) dimension and the economic (profit) dimension to carry out an integrated 'people planet profit' sustainability analysis?

Safety and adaptation (water)

- How can the flood risks in safety policy be brought more into line with economic values and the effects of climate change?
- What are the opportunities and costs/benefits of the different strategies for coping with the extreme peak discharges from the Rhine and Meuse under rising sea levels, and which areas of land need to be reserved for water retention? How are these costs and benefits related to interventions upstream?
- Which parts of the lower-lying areas of the Netherlands will be affected by an increase in groundwater seepage as a result of further subsidence and rising sea levels, to the extent that it will pose a risk to new housing?

- What are the implications to future development in the coastal region imposed by the considerable uncertainties in climate scenarios, such as a possible breaking up of the Greenland and Antarctic Ice Sheets or increasingly violent and more frequent storms?

Biodiversity

- What effects can climate change have on biodiversity?
- What restrictions and opportunities do the Natura 2000 buffer zones throw up for agriculture and housing in Natura 2000 areas?
- How could the buffer zones around the Natura 2000 areas be drawn, and what requirements do they impose on agriculture and building?
- Even with all the measures in the *Combination Variant*, not all the environmental goals for the Natura 2000 areas can be achieved. How can ammonia concentrations be reduced, water quality improved and desiccation reversed?
- What policy options are there for tackling problems in the Wadden Sea (rising sea levels and subsidence) and the delta (sand depletion in the Oosterscheldt, blue-green algal blooms in Volkerak-Zoommeer) by restoring natural dynamics and saline gradients? What are the effects of this on biodiversity, freshwater supplies and water storage?
- What policy options are there to give the stream systems in the upper catchments of the rivers in Belgium and Germany a more natural character, so that more water can be retained to limit environmental effects downstream in the Netherlands?

Traffic and transport

- What is the effect of clustering and intensification on the reliability of journey times by road (clustering and intensification make busy roads even busier) and on accessibility effects and the social (financial) costs of accessibility?
- What investments in road and rail infrastructure (Multi-annual Programme for Infrastructure and Transport, Mobility Policy Document) are robust (yield a sufficiently high economic return) under the high and low mobility projections in conjunction with road pricing?
- What are the accessibility effects of clustering and road pricing under conditions of high economic and population growth (= high development pressure) and what is then the policy goal for accessibility?
- What are the effects on the landscape of investments in the main road and secondary road networks in the Netherlands, as set out in the Mobility Policy Document, the Multi-annual Programme for Infrastructure and Transport, and regional plans, and how should these be factored into existing evaluation methods for infrastructure projects (Overzicht Effecten Infrastructure method (Overview of Infrastructure Impacts))?

Quality of the living environment

- Where in the Dutch cities is there room for restructuring and intensification, and at what cost?
- How does the shortage of green open space around the cities increase in the baseline development trend and in the scenario with greater clustering and intensification, and how much green space, new areas of water and agricultural landscape management will be needed to make good this shortfall?
- How can the negative impacts of noise nuisance in the baseline trend and in the scenario with greater clustering and intensification be mitigated? Which noise-reducing measures are necessary for main roads, provincial roads and urban traffic? How can any remaining air quality problems best be tackled and how can concentrations of fine particulates and ozone be reduced further to reduce health impacts?
- How can multifunctional land use contribute to an increase in the quality of the living environment?

International Business Establishment

- How will physical business location factors increase in importance as the financial and socioeconomic factors within the EU increasingly diverge? Which specific business location factors will remain unique selling points for the Netherlands within the EU?
- How much will demand decline as a result of the relocation of some of the capacity at Schiphol Airport and what are the effects of this on the network function?

Landscape quality

- What are the options for reforming the EU's Common Agricultural Policy in such a way that it will provide the appropriate instruments for paying farmers for agricultural landscape management and compensating them for measures taken in the buffer zones around Natura 2000 areas? What effects will such a realignment of subsidies have on agriculture?
- What extra costs do farmers incur in areas with natural handicaps (both the areas so classified by the Netherlands Ministry of Agriculture, Nature and Food Quality and additional smaller areas and buffer zones around Natura 2000 areas)? Precisely how much money will be needed to achieve agricultural landscape goals in the National Landscapes?
- What are the effects of agricultural developments (scale up, intensification, diversification) on landscapes, and in particular on the core qualities of National Landscapes?
- What are the effects of agricultural developments on the accessibility of the countryside to walkers and cyclists?
- Based on the differences in recreational carrying capacity of different types of landscapes (e.g. open and closed landscapes), types of land uses (e.g. specific recreational locations, forest and agricultural areas) and access (e.g. density of paths and roads), what are the various options for making good the shortfall in recreational amenities around the bigger cities and what are the possibilities for combining this with the realisation of other spatial planning objectives in the areas concerned?
- In what way does the landscape contribute to the attractiveness of the Netherlands as a business location, both now and in future, in the perception of employers and employees, particularly, in the knowledge economy?
- What is the importance and value of the Dutch landscape, both now and in the future, to the Dutch tourist industry and international tour operators?
- What are the links between landscape management/improvement and conservation management/habitat creation?

Appendix 1 Overview of geographical names in this report


COUNTRY
PROVINCE
Larger city or town
Other urban area
Dam
Sea, lake or river
Geographical region
National landschape
Wadden Sea
North Sea
IJsselmeer
Markermeer
Ems
GRONINGEN
FRIESLAND
DRENTHE
NORTH HOLLAND
FLEVOLAND
OVERIJSSEL
GELDERLAND
UTRECHT
SOUTH HOLLAND
ZEELAND
NORTH BRABANT
LIMBURG
GERMANY
BELGIUM
Leeuwarden
Groningen
Assen
Emmen
Meppel
Zwolle
Kampen
Lelystad
Alkmaar
Zaanstad
Haarlem
Amsterdam
Almere
Amersfoort
Leiden
The Hague
Delft
Rotterdam
Schiedam
Dordrecht
Utrecht
Deventer
Almelo
Hengelo
Enschede
Arnhem
Nijmegen
Breda
Tilburg
Eindhoven
Helmond
Venlo
Sittard-Geleen
Heerlen
Maastricht
Veluwe
Randstad - North wing
Randstad - South wing
South-west delta
South-west Fryslân
Drentse Aa
Green Heart
Linge
Waal
Rhine
Vecht
IJssel
Oosterschelde
Westerschelde
Haringvliet
Maasplassen
The River Area
Green Forest
South Limburg
West Friesland
Polders
IJsselmeer area

Figure A1

Overview of geographical names in this report

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Colophon

Responsibility
Netherlands Environmental Assessment Agency

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Coherent policies are a precondition for a sustainable Netherlands

How can the Netherlands be developed in a sustainable way? It is a country with many spatial tasks on a very limited surface area, and has to deal with widespread issues, such as the consequences of climate change, and traffic issues in the Randstad. In the coming decades, many more houses will have to be built here, while nature and landscape increasingly come under pressure. Economic development requires a metropolitan climate for business establishment, and concerns over the physical living environment are rising.

This report connects all of the various spatial tasks, and shows that the Netherlands can only develop sustainably, if policy coherency is achieved at government level. The added value that is thus created will provide a country for future generations that is beautiful, safe and dynamic!

Netherlands Environmental Assessment Agency, June 2010