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LANDSCAPE POLICY AND VISUAL LANDSCAPE ASSESSMENT

THE PROVINCE OF NOORD-HOLLAND AS A CASE STUDY

10.1 INTRODUCTION

"One of the biggest challenges of the 21st century will be to maintain or strengthen landscapes as expressions of regional identity and sustainability while accommodating regional economic developments." This observation by the Council of Europe is echoed by initiatives such as the European Landscape Convention (Council of Europe, 2000). This convention strives for the protection, management and planning of all landscapes and for raising awareness of the value of a living landscape [1]. From this perspective the individual undoubtedly has a part to play in the preservation of landscape quality, but laying down the general framework for protecting landscape quality is the responsibility of the public authorities. The convention is therefore trying to establish the general legal principles to guide regional and national policies on landscape and international cooperation in this field. Concepts related to landscape quality such as coherence, diversity and cultural identity can be effectuated by means of new policy instruments and state-of-the-art landscape assessment and monitoring. Targeted economic incentives and modern spatial planning techniques have put these landscape issues within reach, so that they can be incorporated in local, regional, national and international policies (Wascher, 2000).

10.1.1 Visual character assessment and the Province of Noord-Holland

Landscape character assessment is a key element in landscape management, planning and monitoring and serves as an important basis for landscape policy. Landscape characterisation

can be broken down into four main categories of landscape value types: (1) *biophysical* (form and functioning of the landscape), (2) *socio-economic-technical* (human influence on the landscape form), (3) *human-aesthetic* (human experience of the landscape), (4) *political* (opinions and rights of stakeholders) (Groom, 2005; Wascher, 2000). It has been argued that identifying character is, to a large extent, built upon human perception and therefore landscape character assessment can be questioned with regards to its scientific rigour and hence its role as an analytical tool for landscape planning (Wascher, 2005). So, capturing aspects of visual landscape character is crucial in this respect.

This chapter aims to describe a landscape planning and design-oriented approach to visual landscape indicators, involving state-of-the-art GISc-based methods. It focuses on landscape character assessment addressing visual attributes such as spaciousness, degree of openness, landscape enclosure and visibility. The Province of Noord-Holland (the Netherlands) serves as a case study of how regional authorities can include visual landscape character (assessment) in landscape policy. The combination of expert knowledge and GISc-based research methods and techniques resulted in a physiognomic landscape framework for landscape policy, planning and design. This framework was recently adopted by the provincial authority and has been translated into the Structural Concept of Noord-Holland 2040 (*Structuurvisie Noord-Holland 2040*) (Province of Noord-Holland, 2010a) and the Policy Framework for Landscape and Cultural History (*Leidraad Landschap en Cultuurhistorie*) (Province of Noord-Holland, 2010b).

10.1.2 Structure of the chapter

This chapter provides some background on the current landscape policy in the Province of Noord-Holland and its context (section 2), introduces the recently implemented physiognomic landscape framework and describes the methodology and approach (section 3). Subsequently the methods and techniques to determine the *form of the landscape* (physical space) are elaborated (sections 4, 5, 6), followed by a description of the methods and techniques used to describe and monitor the *appearance of the landscape* (visible space) (sections 7, 8). Finally, the chapter ends with discussion and conclusions.

10.2 LANDSCAPE POLICY IN THE PROVINCE OF NOORD-HOLLAND

The polder landscapes of Noord-Holland, as part of the Dutch lowlands, are typical Western-European landscapes that consist of flat, open lowland areas with an artificial water level, most often partly or fully surrounded by dikes. Polders are considered to be one of the most man-made landscapes and are characterised by a very high percentage of pasture and arable

land (Steenbergen et al., 2009; Meeus, 1995). The agricultural sector, formerly the icon of this landscape, is now often seen as a threat precisely because agriculture is becoming increasingly industrialised and is increasing in scale. Many see this as a degradation of the landscape. Urbanisation (incl. industrialisation), large infrastructures, large-scale wind energy projects, etc. are however increasingly changing the open character of the landscape. The attendant fragmentation and cluttering of the landscape has been the subject of public debate for a number of years and is specifically aimed at encroachments on openness (Hoogbergen, 2008; Boersma and Kuiper, 2006). The concept of spatial quality plays an important role in this debate.

10.2.1 National Landscape policy

In terms of spatial quality in Europe, the Netherlands has a widespread and well-regulated set of building appearance standards and codes for listed buildings, although this is primarily aimed at architectural quality and is linked to the building permit procedure (Nelissen and Ten Cate, 2009). This happens at the end of planning development, however, when urbanisation itself is no longer part of the discussion on quality. In response to this the Dutch Government presented the Landscape Agenda recently (LNV and VROM, 2009). The Landscape Agenda pushes forward the policy and administrative relationships as set out in the National Memorandum on Spatial Planning (*Nota Ruimte*) (VROM, 2004) and Agenda for a Vital Countryside (*Agenda vitaal platteland*) (LNV, 2004). It also highlights the importance of integral spatial planning in order to combat landscape cluttering and the decline of heritage landscapes. Alongside this, the new Town and Country Planning Act (*WRO*) came into force in the Netherlands on 1 July 2008. Under the new Act, the Government and provinces are responsible for protecting the core qualities and reinforcing the spatial quality for landscapes indicated as National Landscapes, and also includes World Heritage Sites, National Motorway Panoramas and National Buffer Zones [2].

The Province of Noord-Holland includes several National Landscapes that cover a large portion of the provincial landscape: Low Holland (*Laag Holland*), the Defence Line of Amsterdam (*Stelling van Amsterdam*) and the Green Heart (*Groene hart*). Parts of these landscapes and other designated areas have the exceptional status of World Heritage Site: the Wadden Sea, the Defence Line of Amsterdam and the Beemster polder. There are very strict requirements in these areas for preserving the current appearance of the landscape. The policy is conservation-oriented and aimed at preserving a number of characteristics of the current landscape appearance.

The governmental policy documents underline the responsibility of the province and municipalities to explore how core qualities of landscapes can inspire and give direction to spatial developments in the landscape. The tools to enforce the policy are however still under development.

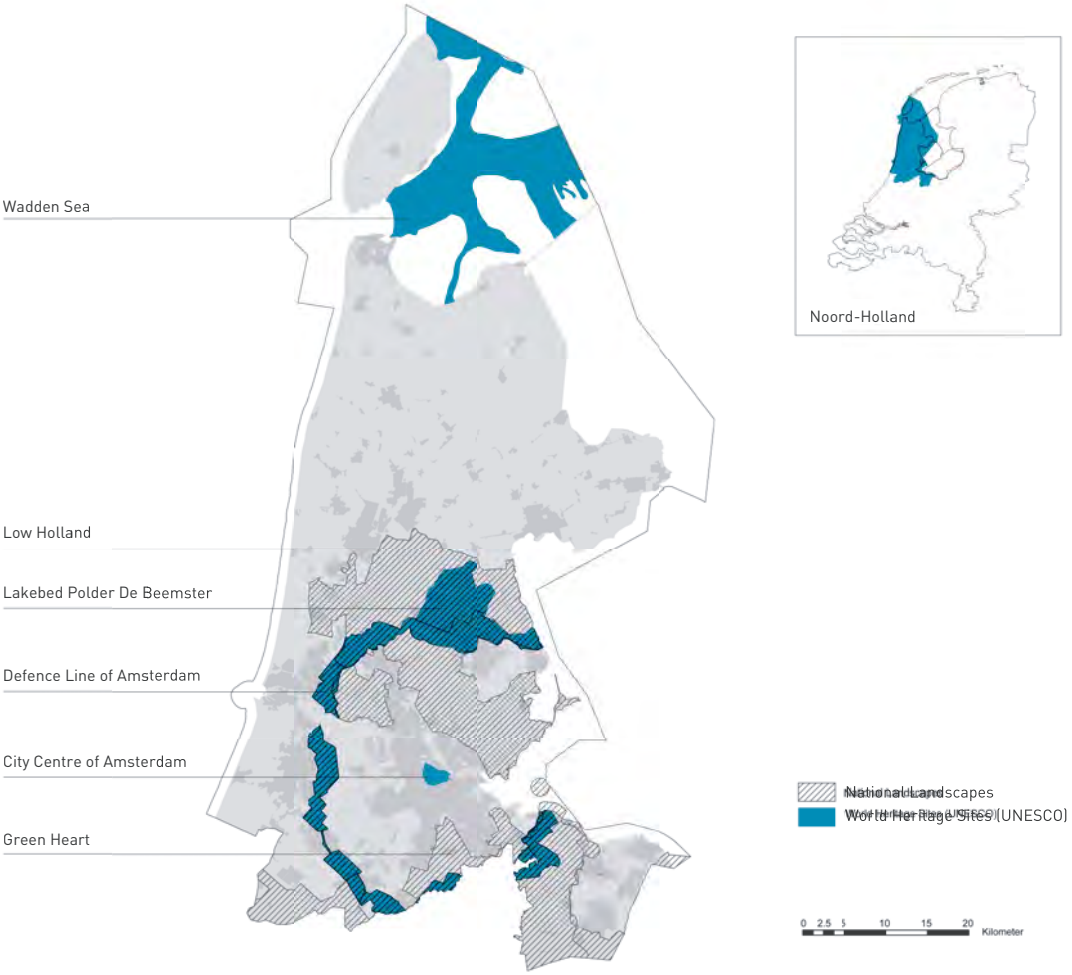


Figure 1
The province of Noord-Holland with the National Landscapes and the World Heritage Sites

10.2.2 Spatial quality as an objective

The Province of Noord-Holland recently adopted the Structural Concept of Noord-Holland 2040 and the associated Policy Framework for Landscape and Cultural History in order to enforce the governmental policy on spatial development. The documents identify spatial quality as a main policy objective. This means that the provincial authority is obliged to ensure and extend spatial quality. But what is spatial quality exactly? A general view (in the Netherlands) is that spatial quality is composed of three Vitruvian values: functionality (*utilitas*), beauty (*ve-*

nustas) and durability (*firmitas*). These can be augmented by other aspects of spatial quality: economic efficiency, social justice, ecological sustainability and cultural identity (Hooijmeijer et al., 2000). The Province of Noord-Holland uses the following definition: quality = identity = landscape + cultural history (De Vreeze, 2007). Although usually landscape itself is regarded as an expression of culture, this definition demonstrates that landscape and its history are essential from the province's perspective for defining the qualities (characteristics) of specific areas and serve as the backbone for their further development.

The policy of the Province of Noord-Holland is aimed at preserving the identity of the landscape by focusing on the current cultural and historical values of the landscape. The province intends to achieve this by encouraging densification in urban areas and by discouraging expansion into rural areas. In the case of new developments in the countryside, the initiators (e.g. project developers, municipalities etc.) will first be required to demonstrate the value and necessity of the proposed expansion and include a Visual Quality Plan (*Beeldkwaliteitplan*). If this is convincingly demonstrated, then the plans will be submitted to an independent advisory committee for spatial quality, the Advisory Committee for Spatial Planning (*Adviescommissie Ruimtelijke Ordening (ARO)*), which then reports its findings to the Provincial Executive. The ARO uses the Policy Framework for Landscape and Cultural History as its assessment framework.

10.2.3 Landscape classification as a basis

Landscape classification is the linchpin of provincial landscape policy and central to the assessment framework for spatial quality. According to Zonneveld (1995) landscape classification is a systematic typology that describes landscapes according to their form (morphology). Form and typology help in describing changes in time (chronology). Classification is abstraction. This implies that from the concrete tangible reality only a few of the many attributes are selected and are used to describe abstract units that are supposed to represent reality. The landscape attributes selected as diagnostic characteristics are chosen because of their ability to be recognised and measured (Zonneveld, 1995). So depending on the type of classification and its aim, each defined landscape unit (type) can be taken to mean a set of attributes that together explain the character of it.

In geography and related disciplines there is a strong orientation towards space and spatial form with regard to landscapes. From this perspective classification is basically an analysis of the landscape's composition (landscape attributes and their spatial pattern) in which the form of the landscape can be seen as the intermediary between the perception and the spatial organisation of the landscape attributes (Wassink, 1999).

In a landscape classification, a given landscape can be described in terms of (Berendsen, 2000):
1) a specific appearance (physiognomy): the visual landscape;

2) a specific structure and development: the spatial sequence and genetic succession (physical geography, historical geography, soil science, etc.);
3) an internal coherence between the landscape factors (biology, physical geography, landscape ecology, etc.).

The landscape classification used in the policy framework characterises landscapes with an emphasis on structure and evolution. It is therefore a historical-geographical and physical-geographical oriented description of the landscape that implicitly includes visual indicators. In this regard there was a need to develop a method to address aspects of the visual landscape and to make it a more explicit element of the landscape classification involved.

10.2.4 Landscape openness and spatial developments

Openness is a diagnostic characteristic for the landscape of Noord-Holland, but not uniformly throughout the province. The Province of Noord-Holland considers openness also to be an important indicator of spatial quality. At the same time, this very openness makes landscapes vulnerable to the impact of new developments. Preserving the same landscapes means finding new, vigorous economic pillars, such as a modernised agricultural sector or 'red for green' projects (i.e. where building in open space is allowed in exchange for an investment in the landscape) such as the *Bloemendaler polder* or the *Wieringerrandmeer* lake. In the latter case, new landscapes are being created. The growth of urban peripheries and high-rise buildings in cities influence people's perception of openness. In addition, Noord-Holland has ambitions for large-scale wind energy projects. These enormous wind turbines are visible from afar.

If we want to assess the effect of these goals, some of which may be contradictory, on the openness of the landscape, then we need a more inter subjective, verifiable and reliable framework to study the effect. The output should be descriptive rather then normative, and as a consequence it is about landscape's visual *character* rather than visual *quality* (Ode et al., 2008). The insights gleaned will constitute an important contribution to the public debate on the desirability of developments in the open countryside.

The present chapter is a report on the quest for finding a physiognomic landscape approach in order to describe, protect and develop the visual landscape and serve as an instrument for landscape policy, planning and design [3].

10.3 TOWARDS A PHYSIOGNOMIC LANDSCAPE APPROACH

Visual attributes of the landscape such as spaciousness and related indicators such as degree of openness, building density and the nature of spatial boundaries are important elements in the perception and preference of a given landscape (Nasar, 1998; Kaplan and Kaplan, 1989; Appleton, 1975). According to Coeterier (2000), visual aspects are themselves qualities of the landscape, including:

- *Unity:* the landscape as a whole, its individuality and clarity of character and boundaries;
- *Spaciousness*: the spatial pattern or spatial organisation, the spatial layout;
- *Appearance*: the comprehensive set of sensory impressions, especially 'seeing'.

Visual perception is therefore the basis for the experience and appreciation of landscapes (preference). So visual perception is an important theme in defining and assessing spatial characteristics. Although this is widely accepted, in practice we see that this theme is often only implicitly touched upon in policy documents. The assumption is that the visual landscape in itself is seen as an aspect that is difficult to deal with in a systematic and transparent way (i.e. it is not measurable), and that it is perceived differently by different people. It therefore can hardly be made explicit, if at all.

10.3.1 Methodology and approach

The present study is an attempt to make aspects of the visual landscape explicit as a major theme in the Province of Noord-Holland's set of policy instruments for spatial quality, and to develop the theme further. To do so, a practical expert approach was introduced (Zube et al., 1982; Dijkstra, 1991) in which the characteristics of the visual spaces (spatio-visual characteristics) of the Noord-Holland landscape were qualified and quantified using a number of GISc-based methods and techniques for physiognomic landscape mapping (De Veer et al., 1977; De Veer and Burrough, 1978; Palmer and Roos-Klein Lankhorst, 1998). The methods and techniques that were chosen are scale-dependent and complementary. None of them are new and they are already used in many areas. By cross-linking them, however, a dedicated approach to landscape policy is achieved that is practical applicable.

The approach is characterised by a description of the visual attributes and their pattern. Essentially the aim is to describe, analyse and map (physical) forms made by spatial patterns composed of open spaces, surfaces, screens and volumes in the landscape (Thiel, 1961). It addresses the morphology of space with landscape visibility and appearance as key elements. The potential of 'being able to see' is mapped out; this has to do with the plausible and/or probable visible space (Fisher, 1995, 1996; Weitkamp, 2010). The product is a morphologic description of elements and their position in their surroundings (the objective-intrinsic landscape attrib-

utes), removed to the greatest degree possible from symbolic, cultural and personal elements (the subjective-attributed landscape attributes).

This suggests two types of aesthetic variables that can describe a landscape: variables concerning the *form (shape)* of the landscape or variables concerning the *content* of the landscape. These are not black and white categories but rather a continuum. The study of the form of the landscape is often referred to as *formal aesthetics* or the *objectivist approach*, while the study of human response to the content is referred to as *symbolic aesthetics* or the *subjectivist approach* (Lang, 1988; Nasar, 1994; Lothian, 1999). Attributes of formal aesthetics are: shape, proportion, rhythm, scale, complexity, colour, order, hierarchy, spatial relationships, etc. and are considered to be intrinsic qualities of the landscape. Attributes of symbolic aesthetics refer to ascribing meaning and value (Nasar, 1994; Bell, 1999). In this case the quality of the landscape is determined by the viewer (it is 'in the eye of the beholder').

The expert approach used here focuses primarily on the form of the landscape and can therefore be seen as a formal aesthetic approach [4]. The psychological, psychophysical and phenomenological approaches are complementary to this, but have been excluded to promote workability in this study (Ervin and Steinitz, 2003).

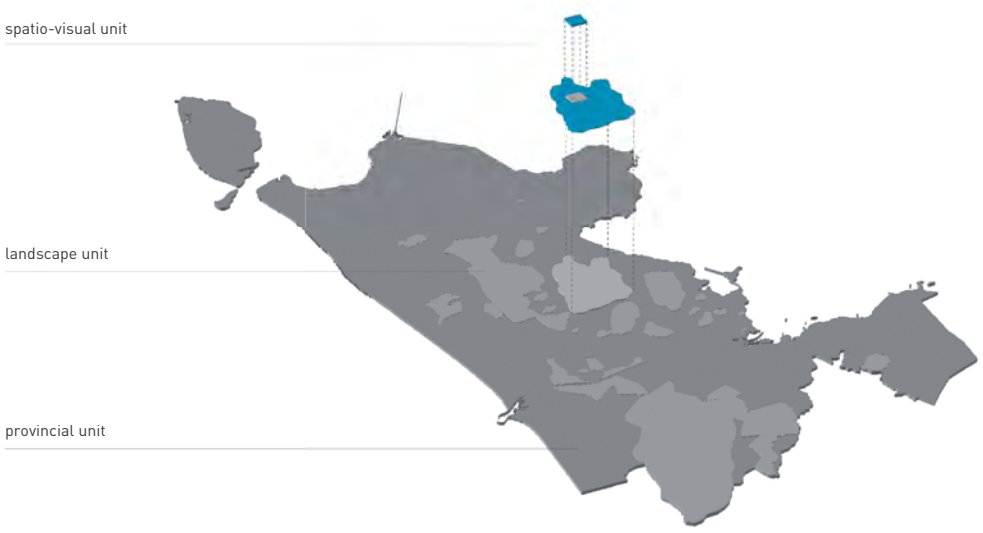
10.3.2 Scale-dependent description

Physiognomic landscape mapping is scale dependent (Vroom, 1986; Litton et al., 1974; Granö, 1929). It is important for the definition of the scope, grain-size and level of abstraction of the analysis. This aspect of scale refers to the *size of the object* under investigation. Scale is also important to the psychology of space (space conceptions). It has an important influence on how humans treat spatial information, and as a consequence several scale classes of space exist relative to the human body: e.g. small-scale, middle-scale and large-scale spaces. (Montello, 1993; Mark, 1993). So depending on their scale, certain systems of elements and spatial relations – relative size, shape and diversity – are explained and classified (Tversky, 2007). This aspect refers to the *scale of analysis*.

A unit as described in this study, contains three interrelated levels of space and involves three levels of perception: *the provincial unit*, *the landscape unit* and *the spatio-visual unit*, each with its own scope. The spatio-visual unit is apprehended from a single perspective (e.g. viewable area). The landscape unit is apprehended by locomotion, but spatial relationships can still be apprehended (e.g. line-of-sight). Spatial relationships within the provincial unit cannot be directly observed but must be constructed over time from movement through the region. These units share a hierarchical relationship with one another, and each has its own associated method of physiognomic landscape mapping. The connection between landscape, mapping method and the scale is summarised in the chart below. See figure 2.

In order to address the morphology of the visual landscape a distinction is made between the description of the *form of the landscape* (physical space) and the description of the *appearance of the landscape* (visible space). This is necessary because the physical space is not the same as the visible space. In other words, the landscape is different on the map from what it is in real life (Psarra, 2009; Rowe, 1976). The appearance is the way the landscape appears to the observer. In addition to form, other conditions related to visual observation also play a role in this regard, such as: position of the observer (altitude, proximity and angular size of the objects), viewing direction and atmospheric conditions (e.g. contrast threshold) (Duntley, 1948; Nicolai, 1971; Antrop, 2007). These aspects determine which forms can ultimately be observed. In addition, there are GISc-based principles available that are very suitable for analysing these two types of space: the physical space (form) and visible space (appearance).

Figure 2
The connection between landscape, mapping method and the scale



I Form (shape) of the landscape (physical space: grid based methods):

1 degree of openness (provincial unit)

2 proportion and size of open space (landscape unit)

3 classification of spatial form (spatio-visual unit)

II Appearance of the landscape (visible space: viewshed based methods):

4 visible space (spatio-visual unit)

5 visual urbanisation amd cluttering (all units)

The physiognomic landscape approach as described is elucidated further based on the following five themes:

- Degree of openness;
- Proportion and size of open space;
- Classification of spatial form;
- Visible space;
- Visual urbanisation and cluttering.

10.4 DEGREE OF OPENNESS

The visual landscape consists of many visible expressions that together constitute the image of the landscape (*landschapsbeeld*). This turns the job of bringing order to them into a seemingly impossible task. Nevertheless, there are certain visual concepts that make it possible to systematically name and sort the landscape images using indicators. In Ode et al. (2008) nine visual concepts were identified which together characterise the visual landscape. These were: complexity, coherence, disturbance, stewardship, imageability, visual scale, naturalness, historicity, and ephemera (Tveit et al., 2006). Because of the aims of this study and the available GISc-based analysis techniques, indicators of visual scale were used. Indicators of visual scale describe landscape rooms (perceptual units) in relation to their size, shape and diversity, and the degree of openness in the landscape (Ode et al., 2008; Piket et al., 1987).

The degree of openness is directly related to landscape preferences and is therefore an important indicator (Hanyu, 2000; Nasar et al., 1983). Explanations for that can be found in Appleton's prospect-refuge theory (Appleton, 1975) where prospect (openness) is used to describe the degree to which the environment provides an overview. This is related to the habitat theory which links aesthetic pleasure to fulfilment of biological need (Ode et al., 2008). Mystery, as put forward by Kaplan and Kaplan (1989), "describes the degree to which a viewer is drawn into a landscape by the intrigue of what lies ahead, which in turn is related to the ability of the viewer to see the landscape and hence a function of openness" (Tveit et al., 2006). However, landscape openness has a very low correlation with *scenic beauty*. So protection of open space through monitoring and management are largely unrelated to scenic beauty *per se* (Palmer, 1996).

The degree of openness can be understood as a derivative of patterns of screens and volumes in the landscape. In this regard, openness is an integrated concept. Each landscape room has its own characteristic open/closed ratio. This makes it possible to characterise landscapes according to their degree of openness (Buitenhuis et al., 1986; Dijkstra and Lith-Kranendonk, 2000). From the perspective of landscape physiognomy, open space is present where elements such as trees, houses, dikes etc. (visual limits) that rise above the observer's eye level are absent

throughout a specific surface area. In other words, openness is present where the landscape is 'empty' or 'open' (De Veer, 1977). One method for measuring openness is the grid landscape survey [5]. This method has been applied to the landscape of Noord-Holland on the scale of the province (provincial unit).

10.4.1 Grid landscape survey: measuring openness

The goal of the analysis is to visualise and quantify physiognomic landscape space, mapping the degree of openness using a grid landscape survey (Buitenhuis et al., 1986; Palmer and Roos-Klein Lankhorst, 1998; Dijkstra and Lith-Kranendonk, 2000). In doing so, GIS was used to quantify and visualise the open/closed ratio by using a horizontal grid of 500 x 500 metres squares over the landscape. This is based on the notion that characteristic elements of a landscape can be recognised within a distance of 500 metres (Van der Ham and Iding, 1971; Van der Ham et al., 1970). A recently prepared digital topographic map at a scale of 1:10,000 (TOP10NL, 2009) was employed to achieve accurate results. For the calculations, all items selected for the legend were those that were higher than eye-level (including ascending elements, buildings, trees and/or shrubbery) based on the definitions of the Topographical Service of the Land Registry (*Topografische Dienst Kadaster*). This selection was corrected where necessary based on recent aerial photography and field visits. GIS was then used to automatically calculate the contents of each grid cell to determine how many, and which, ascending elements are present. The results were classified by degree of openness using a classification method developed and tested by Palmer (1996) and Dijkstra and Lith-Kranendonk (2000). The resulting maps show the degree of openness and the character of the space defining elements. See figures 3 and 4.

10.4.2 Extremes in size of open spaces in the landscape

The landscape of the Province of Noord-Holland is characterised by degree of openness (size and proportion of open space). See figures 3 and 4. From large, open areas in the Wieringermeer and Schermer areas to small-size closed areas with lots of green, space defining elements, including Het Gooi and areas with an urban character. The landscape policy of the Province of Noord-Holland is aimed at preserving the characteristics of the landscape. The degree of openness and the associated extremes are important policy issues in this respect. Research into the degree of openness shows that the diversity in size is decreasing. There is currently a general trend towards the creation of mid-size spaces (Piket et al., 1987; Dijkstra and Lith-Kranendonk, 2000). The province's large-size, characteristic open spaces are under threat from encroaching densification. This has a levelling effect on the characteristic differences in open spaces that contribute to the identity of the various landscape units. It follows that areas with a very open character need special protection from advancing visual densification. Based on this under-

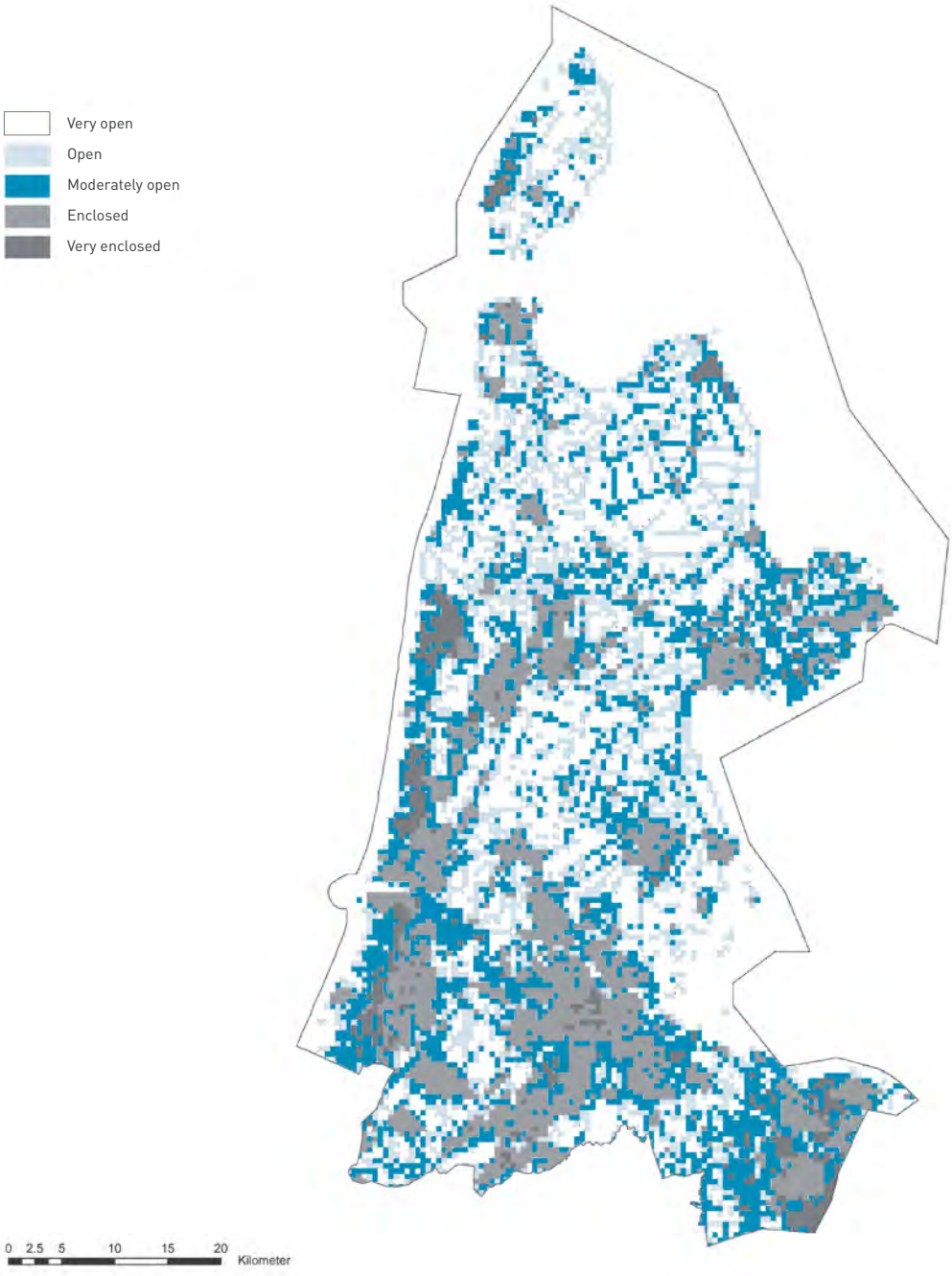


Figure 3
Degree of openness

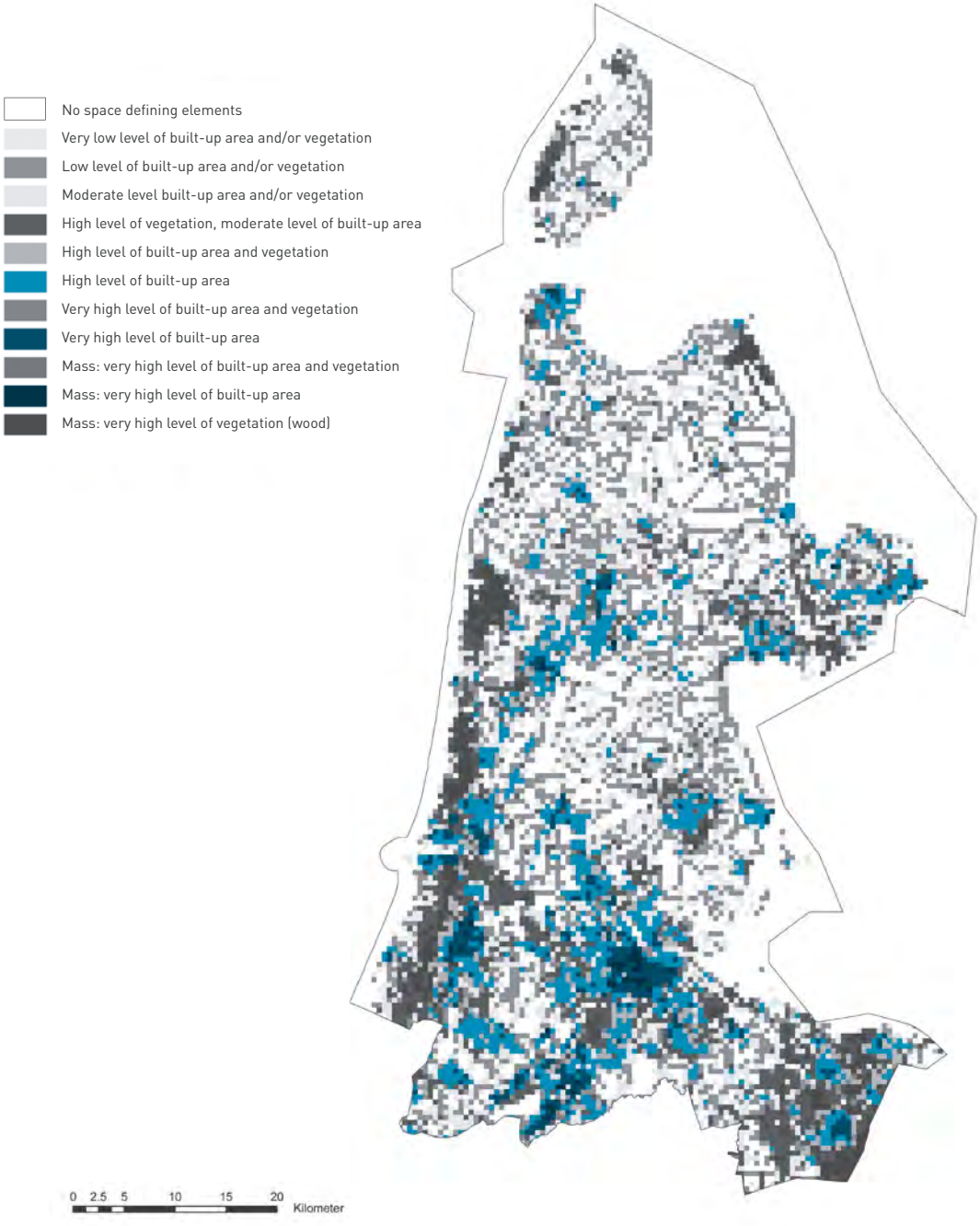


Figure 4
Character of the space defining elements

standing, provincial planning policy offers protection from this densification in the largest and most substantial of the open spaces in the province. These particular open spaces were designated as a result of a political process based on this analysis. See figure 5.

10.5 PROPORTION AND SIZE OF OPEN SPACE

As mentioned before, landscape classification is an important element in the present spatial quality assessment framework of the province. In addition, there is a wide variety of landscape units in the province, each with its own characteristics in degree of openness. The size and proportion of open spaces within the landscape units is an important variable in describing landscape identity (Farjon et al., 1999; Dijkstra et al., 1997). Based on this notion, it makes sense to analyse and describe the characteristic open/closed ratio for each landscape unit. This direct link with the existing landscape classification makes a qualitative interpretation of the concept of openness possible on the level of the landscape unit. The form of the landscape is thus not only described in terms of spatial structure or development, but also in terms of characteristic degree of openness. Different landscape classifications can be used, but the types described in the Policy Framework for Landscape and Cultural History have been chosen in order to link directly to provincial policy. See figure 6.

10.5.1 Quantification of openness by landscape units

The goal is to visualise and quantify the degree of openness at the level of the landscape unit. The grid analysis of the entire province as described above served as the basis for this work. Using GISc-based overlay techniques, the results of the individual landscapes were assigned and aggregated. The resulting degree of openness and change could then be determined for each type of landscape (Dijkstra et al., 1997). As a derivative of the openness analysis that covers the entire province, this method allows the characteristic openness for each landscape to be identified. It provides a valuable tool for describing landscape units more precisely and for future monitoring purposes. By determining the increase or decrease in differences in openness, it is possible to see whether landscapes are becoming more homogeneous or heterogeneous. The result of this analysis is a diagram that shows the openness classes for each landscape unit. See figure 7.

10.5.2 Landscapes with the largest degree of openness

In the quantitative description it is striking that reclaimed land (*aandijkingenlandschap*) can be classified as a landscape unit with the largest degree of openness and that ice-pushed ridges (*stuwwallenlandschap*) are the landscapes with the lowest degree of openness. Also other

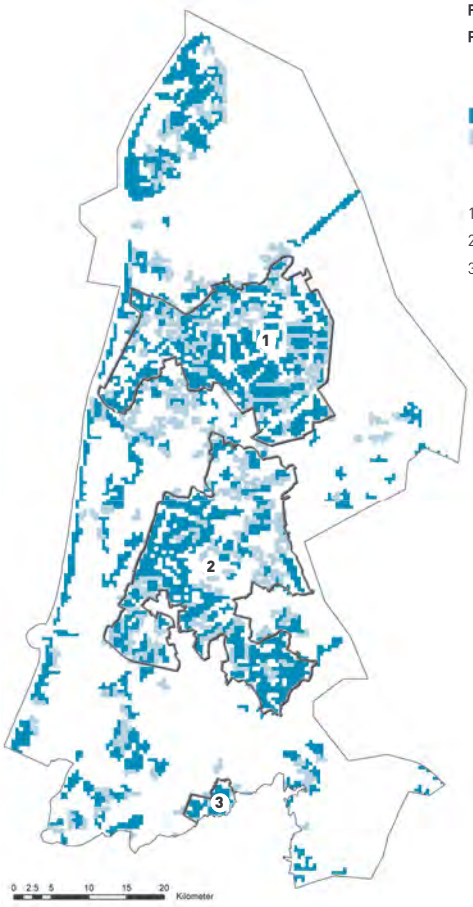


Figure 5
Policy protected open areas

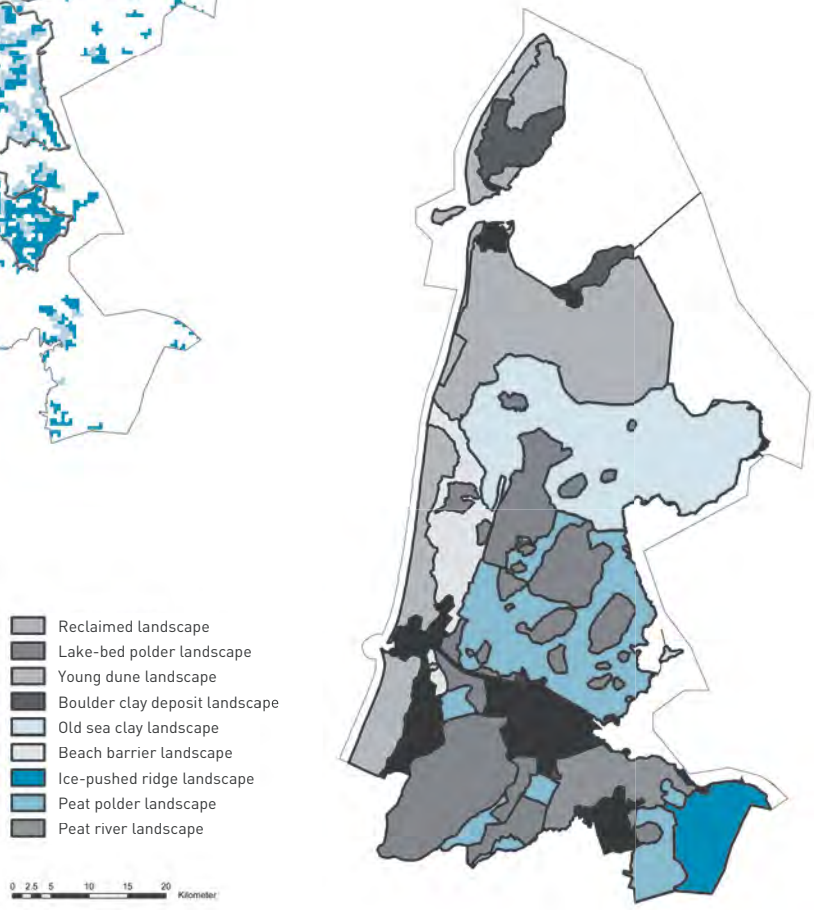


Figure 6
Landscape classification of Noord-Holland (source: Province of Noord-Holland)

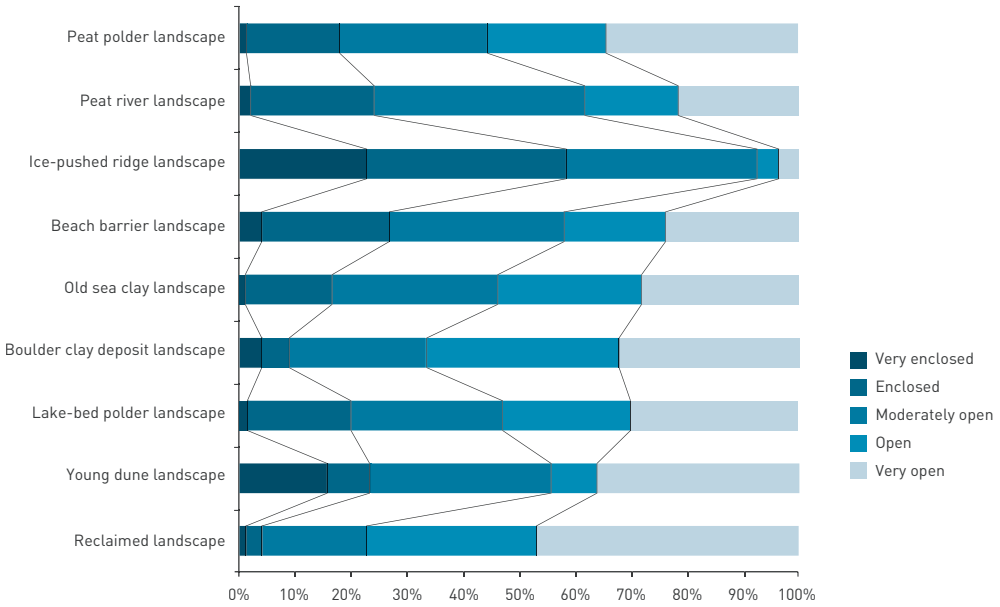


Figure 7
Differences and stratification of openness within the landscape units

landscape units have a high degree of openness, such as peat polder landscapes (*veenpolderlandschap*), lake-bed polder landscapes (*droogmakerijenlandschap*), boulder clay deposit landscapes (*keileemlandschap*) and young dune landscapes (*jonge duinlandschap*). So, there are relatively many open landscapes, but they vary widely in terms of composition and appearance. Although it is generally possible to characterise landscape units in terms of openness, the difference in form and appearance of the space within the chosen landscape unit makes it difficult to use openness alone in a qualitative sense. This may be problematic, especially at a lower level of scale because this description covers aspects of space having to do with patterns, whereas structural aspects of the area are the ultimate determiners. A lower level of scale, the level of the spatio-visual unit, provides better opportunities for analysing and describing structural, three-dimensional aspects of the landscape (Wassink, 1999; Vroom, 1986). Taking these limits into consideration, policy that is geared toward ensuring the characteristic openness for open landscape units should be based on qualitative requirements with regard to densification (buildings and afforestation). Further study into the relationship between the degree of openness and the form and appearance of the space will be essential: classification of the spatial form is an important theme.

10.6 CLASSIFICATION OF SPATIAL FORM

As mentioned previously, openness may be considered to be a derivative of landscape elements, which function as surfaces, screens and volumes. In this regard it is important to ascertain whether these landscape elements also act as space-defining elements (spatial boundaries). Spatial boundaries include all linear and two-dimensional landscape elements that reach above eye level. These may be hedgerows or woods, wooded banks, ribbon developments, villages, towns, cities and dikes. The natural terrain also plays a role in giving form to space: areas that are relatively higher than the surroundings afford views. The location, orientation and density of the elements that function as spatial boundaries determine the openness of the landscape. This is why openness must also be described in terms of the composition of the spatial elements as well. The key to doing so is to classify the spatio-visual units according to the spatial form in each individual landscape (Wassink, 1999; Curdes, 1993; Thiel, 1961). The spatial form is then described based on the spaces (size and form) as they are determined by the spatial boundaries.

10.6.1 Determining the form of space

There is no reliable and workable GISc-based method for analysing categories of spatial form. Clues can be found in e.g. Patch-analyst (McGarigal and Marks, 1994), but this needs further research. Expert judgment has therefore been used. This is based on cartographic research, interpretation of aerial photography, field visits and Street View imagery (Google Earth, 2009). Space can thus be designated at the level of the spatio-visual unit. The primary resource was the digital topographic map at a scale of 1:10,000 (TOP10NL, 2009), which also served as the basis for a map of the entire province showing spatial categories. See figure 8.

It is possible to classify spatial form according to a number of different classifications. The classification and description of Wassink (1999) is used here by analogy. This is based on the work of Thiel (1961), McCluskey (1979) and Curdes (1993). Wassink arrives at five spatial types, see figure 9:

- Fully confined spaces;
- Bilaterally confined spaces (on two sides);
- Divided spaces;
- Continuous spaces;
- No space, mass.

Fully confined spaces have boundaries on all sides. This means that they are turned inward; they encourage restfulness. The essence of fully confined spaces is that there is an ‘inside’ and an ‘outside’, and that the boundary between inside and outside is unambiguous. Fully confined

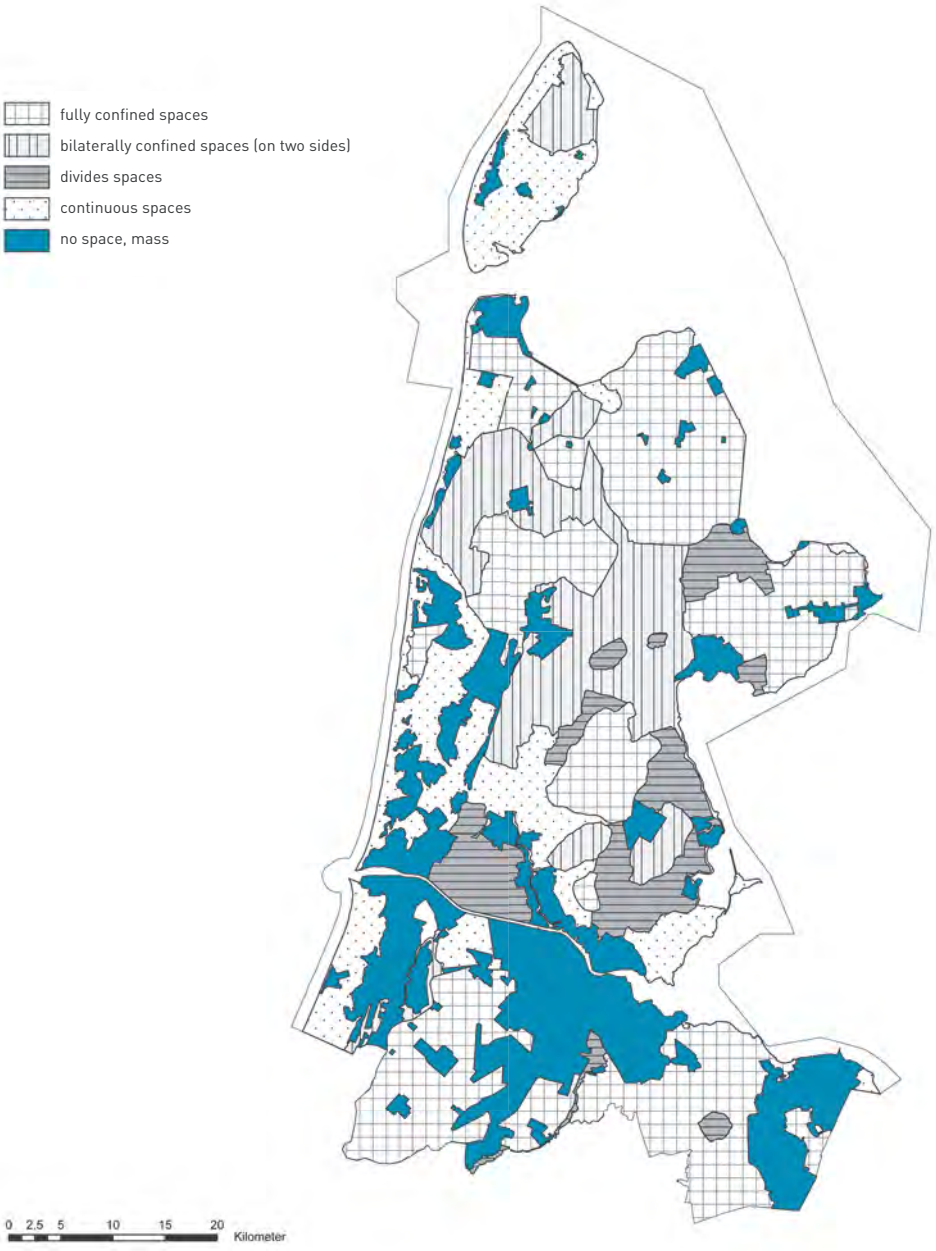


Figure 8
The form (shape) of space in the landscape of Noord-Holland

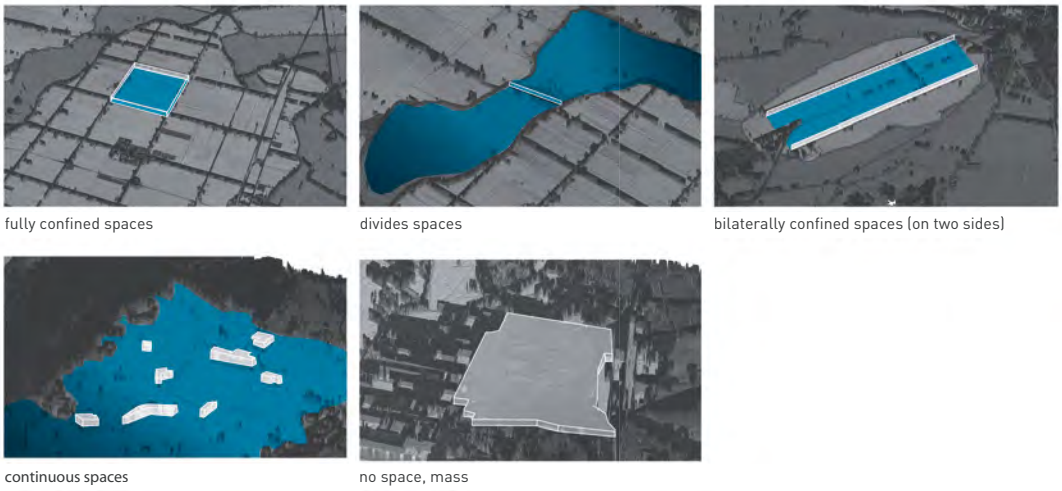


Figure 9
The classification of spatial form

spaces are also called *Static Spaces* or *Space-contained* (Thiel, 1961; McClusky, 1979). An example of this is the reclaimed land in the Beemster polder.

Bilaterally confined spaces are characterised by being elongated. The beginning and end of the space can often not be seen from a single position. These spaces encourage movement and therefore an outward orientation. The boundary between inside and outside is fixed in its width but not in its length. Bilaterally confined spaces are also known as *Dynamic Spaces* (Thiel, 1961). An example of this is the reclaimed land in the Wijde Wormer polder.

Divided spaces are characterised by the space being divided into two sections. There is no inside or outside: space exists on either side of the spatial elements. This space is bordered on just one side. *Divided spaces* are also known as *einseitig gefaßte Räume* (Curdes, 1993). An example is the landscape around the Schermerhorn peat polder.

The hallmark of *continuous space* is that spatial elements do not confine the space. Any landscape elements present exist as separate elements in a continuous space. Continuous space is also known as *Vagues* or *diffuser Raum* (Thiel, 1961; Curdes, 1993). Polarised spaces known as *Space attracted* can develop around the individual volumes. An example of this is the area west of Alkmaar in the polder landscape / barrier dune and plains landscape.

Finally, certain situations may be distinguished where there is *no space, but mass*. An example of this is a landscape that is covered with forest. This is of course also dependent on the organi-

sational level at which the landscape is considered. Looking at the forest in detail may reveal paths and open spaces. Examples can be found in the woodlands of *Het Gooi*; the lateral moraine landscape.

10.6.2 Spatial form as structural carrier

This detailed classification of spaces within a landscape unit is a useful way of identifying openness more precisely and arriving at a qualitative description of openness. In this respect spatial form is a vehicle to describe, analyse and map the landscape formed by the composition of surfaces, screens and volumes and the resulting spaces. We consider the spatial form as the structural carrier of openness: the spatio-visual structure. The character of an open space could then be described in terms of the shape, size and extent of the visual space. This would make it possible to explain and describe the relationship between the degree of openness and the form of the space. These spatial units could then be used as a basis for continued spatial development. The spatio-visual structure of the landscape can thus be safeguarded (or expressly ignored) when designing new housing tracts, ecological developments etc. In the province of Noord-Holland the way landscape space is managed has certainly become an important guiding principle when it comes to discussing and assessing plans for spatial development.

10.7 VISUAL SPACE

Visual space is the way the landscape appears to the observer. As previously discussed, visual space is something quite different from physical space. Not only the three-dimensional aspects of space play a role in visual space; other conditions related to visual observation are also involved, such as: the position of the observer (altitude, proximity and angular size of the objects), the viewing direction and the atmospheric conditions (e.g. contrast threshold) (Duntley, 1947; Nicolai, 1971; Antrop, 2007). These aspects determine which shapes are actually observed. The observer's position is an important factor in methods for analysing the appearance of the landscape. Space appears to the observer in various ways. Dijkstra (1991) distinguishes three ways of analysing the appearance of space to the observer:

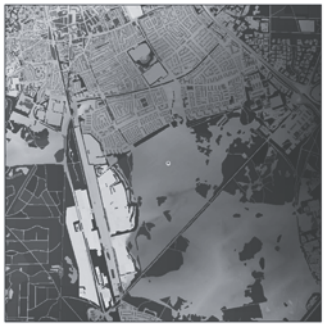
- Analysis from observation points;
- Analysis from routes;
- Analysis from areas.

Viewsheds are a valuable method for analysing the appearance of a space in its current or in a future appearance. Viewsheds make it possible to portray a landscape objectively from the perspective of the viewer (Tandy, 1967; Lynch, 1976; Smardon, et al., 1986).

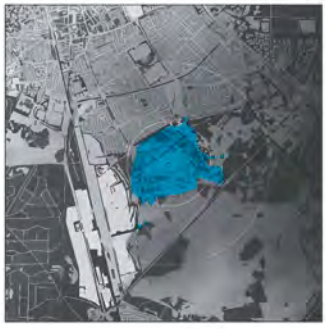
10.7.1 Viewsheds: measuring visibility

The goal is to analyse and portray the appearance and visibility of physiognomic landscape space. A GISc-based viewshed method may be used for this purpose, in which the observer's field of vision can be analysed from many different angles (Llobera, 1996 and 2003; Fischer, 1995 and 1996). The visual landscape can be analysed from observation points covering the entire 360 degrees of the viewing circle or any part thereof. The visible portion of the viewing circle is therefore calculated. The part that is immediately visible to an observer is called the breadth of view, or viewshed. See figure 10. Viewing angle, viewing distance and eye level (viewing height) may all be set as variables in the analysis. The following assumptions were used: a viewing height of 1.60 metres above ground level and a viewing angle of 360 degrees (the entire viewing circle). The stereographic viewing limit is 1,200 metres; this means that an observer can perceive depth up to 1,200 metres. Beyond this distance everything merges together (Van der Ham and Iding, 1971; Nicolai, 1971; Antrop, 2007). The maximum visual range depends on atmospheric circumstances and is referred to as the meteorological optical range [6]. To put it more precisely, the visual range of objects in the landscape depends on: the apparent contrast between the object and its background, the angular size of the object, its shape and vertical area, the contrast threshold at the level of luminance (type of day), the conditions and techniques of observing and, the eyelevel and related curvature of the earth (Dunt-

1. Acquisition of accurate topographic data includes heights and terrain heights (DEM)



2. Construction of a Digital Landscape Model by combining 3D topographic data and DEM



3. GIS-based Viewshed analysis (360° at eye level)

Figure 10
Principle of the viewshed analysis

ley, 1948; Middleton, 1952). It is possible to carry out the analysis from individual positions (viewsheds), from routes (incremental viewsheds) and/or areas (cumulative viewsheds). See boxes 1, 2 and 3 for examples of application.

To achieve reliable results, an accurate digital barrier model was constructed consisting of a digital elevation model (DEM) combined with topographic data. This is based on a high-resolution elevation model, the *Actueel Hoogtebestand Nederland* (AHN-1, 1997-2003), which is precise to about 15 centimetres per square metre. The DEM's density, distribution and planimetric accuracy is such that topographic objects with a size of two by two metres can be identified clearly and with a maximum deviation of 50 centimetres (AHN, 2010). The model has been supplemented with recent topographic data: the digital topographic map at a scale of 1:10,000 (TOP10NL, 2009). All legend items were selected that were higher than eye-level (including ascending elements, buildings and trees and/or shrubbery) based on the definitions of the Topographical Service of the Land Registry. The resulting digital landscape model (DLM) or barrier model was corrected using recent aerial photographs, field visits and Street View imagery (Google Earth, 2009). The viewshed analysis results were tested for reliability through field visits and photos.

10.7.2 Visual effects on the landscape image (landschapsbeeld)

The viewshed method can be used to simulate the physiognomic space visible to the observer. The observer's position plays a crucial role and field of vision or visibility can be analysed from specific points, routes and areas. This makes it possible to analyse and describe the way in which the landscape appears to the observer on the scale of the spatio-visual unit. Also, future interventions can be assessed based on their visual impact as part of a visual impact assessment. The policy of the province of Noord-Holland now requires that explicit attention must be paid to the visual impact of the intervention in addition to the requisite Visual Quality Plan (Province of Noord-Holland, 2010a). An example of such a Visual Impact Report with regard to the physiognomic landscape approach is the Quickscan on the visual impact of the landscape plan Bergen (*Quickscan visuele effecten landschapsplan binnenduingebied Bergen*) (Nijhuis, 2010a), see also box 1.

10.8 VISUAL URBANISATION AND CLUTTERING

The term 'visual urbanisation' is used when the city, and related objects like wind turbines and communication towers are visible from non-urban areas. Strictly speaking, visual urbanisation is the process that creates this visibility, but the term is often used to signify the result of this process (De Veer, 1978). Cluttering is a concept that is closely related to visual urbanisation.

Box 1 Quikscan on the visual impact of the landscape plan Bergen

Spatial interventions in the landscape usually have a significant influence on the landscape image (*landschapsbeeld*). By portraying these effects systematically and transparently, it is possible to make informed choices that promote spatial quality. A visual impact assessment is a tool that can be used to reliably map the visual impact of planned spatial interventions. This has also been done for the landscape interventions proposed in the Visual Quality Plan for Bergen and the associated development plan as an application of the policy described in the Structural Concept of Noord-Holland 2040 and the Policy Framework for Landscape and Cultural History. The Quickscan on the visual impact of the landscape plan Bergen (*Quickscan visuele effecten landschapsplan binnenduingebied Bergen*) (Nijhuis, 2010a) follows the methodology as described in this chapter and addresses the following themes: scale extremes in the landscape, the characteristic open/closed ratio, the space and the visibility/perception of the space. Cumulative and individual viewsheds were applied in order to measure the visual impact of the proposed development respectively, shown in the map and chart. See figure 11.

Summary of the results

The visual impact assessment shows a densification of 3.5% (total of approx. 54 ha). The majority of the densification (approx. 49 ha) is due to foliage: bushes and trees. In this sense there is hardly any petrifaction because most new construction is covered or shielded by greenery and the number of red elements is relatively small (approx. 5 ha). The character of the open area also changes: agrarian pasture largely makes way for natural grassland, which has a significant influence on the perception of the landscape. The new arrangement of the landscape means that the characteristic continuous space is transformed into a number of fully confined spaces. Correspondingly, the proposed density serves to decrease the relative openness by 108 ha (approx. 4%), which means that the spatio-visual characteristics of the area are significantly impacted as shown on the map and diagram. The characterisation of the open space changes from a 'varied open space with distant vistas' into a 'uniform open space without views'.

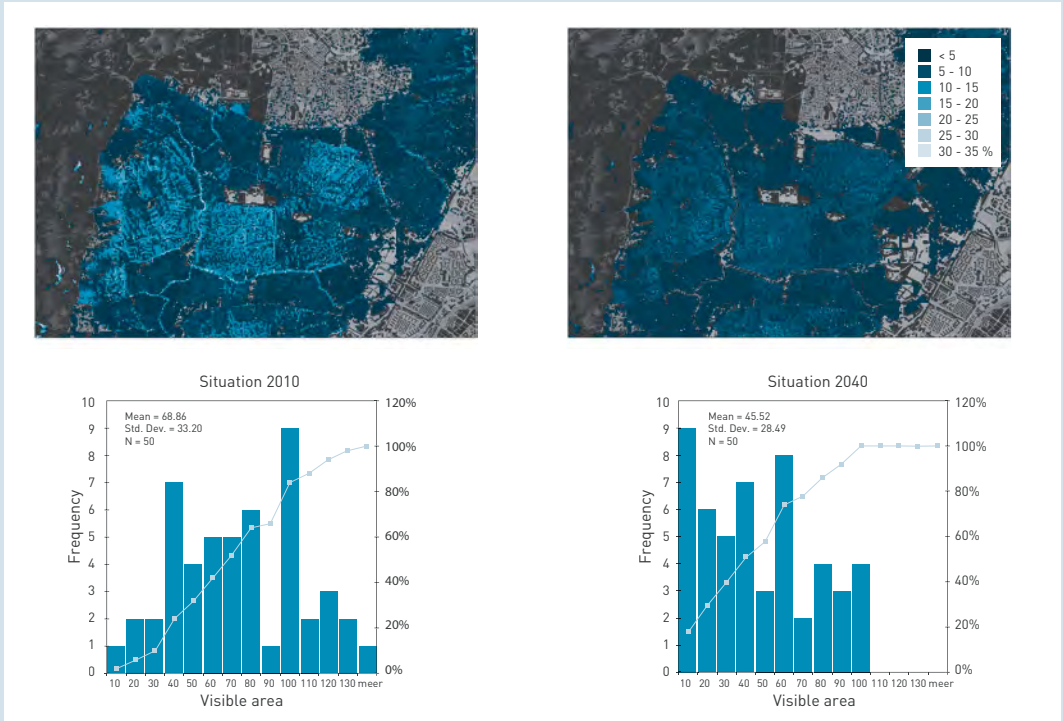


Figure 11
Visual impact analysis using cumulative viewsheds (maps) and individual viewsheds (charts)

It has to do with the deterioration of the landscape (Hoogbergen, 2008; Boersma and Kuiper, 2006). Cluttering occurs when elements in the landscape such as housing (high-rise and low-rise), greenhouses, industrial estates, wind turbines, etc. are perceived to be disturbing (Van der Wulp, 2009; Boersma and Kuiper, 2006; Roos-Klein Lankhorst, et al. 2002). Nevertheless it must also be stated that buildings, urban boundaries, high-rises and elements such as wind turbines can contribute positively to the identity of the landscape and its orientation in space and time (as long as they are thoughtfully designed and positioned). Visual urbanisation of the landscape can therefore be perceived positively and negatively. The cluttering of urban boundaries (Burrough et al, 1982; Nicolai, 1971), the allocation of high-rise buildings (Rød and Van der Meer, 2009) and the positioning of wind turbines (State Advisor for Landscape, 2007) are therefore important issues that require extra diligence. Mapping the visual impact using sound simulation techniques is a notable principle in this regard (see e.g. Smardon, et al., 1986; The Landscape Institute, 2003).

10.8.1 Appearance of visual urbanisation

Areas exhibiting visual urbanisation generally have an open character and are located near cities or in metropolitan areas. These are often agricultural areas, open water or other natural expanses. The amount of visual urbanisation in the province of Noord-Holland is increasing. Reasons for this include increasing physical urbanisation (intrusion, i.e. lengthening of urban boundaries), and especially, changes to the structure of the city and its boundaries. Growing numbers of wind turbines are also being installed. The visual urbanisation of the landscape is generally regarded as undesirable, although there are significant differences of opinion on this topic, depending on the nature and extent of the elements involved and contextual considerations of the landscape (Van der Wulp, 2009; Thayer, 1994). Results from environment-reliant research emphasise the resistance to 'seeing the city in the landscape' (Roos-Klein Lankhorst et al. 2002; Coeterier, 2000). Other studies show that high-rise buildings and urban boundaries can play a role in defining the identity of areas (e.g. urban parks), or that they can function as landmarks. Think of the acclaimed ribbon villages that are such an integrated element in the polders, or of historic townscapes. They can make a positive contribution to the landscape in terms of identity and its orientation in space and time as long as they are thoughtfully designed and positioned. When visual urbanisation has a negative effect on the appreciation of the landscape, various forms of shielding can be considered (such as greenery), but again this must be diligently designed.

There are several methods available for analysing visual urbanisation or the city's sphere of visual influence (see e.g. The Landscape Institute, 2003; Burrough et al., 1982; Nicolai, 1971). See also chapter twelve for an example. Criteria applied include type, height, (vertical) size and location of buildings, the degree of openness of the surrounding landscape, the terrain and

Box 2 High-rise buildings in the province of Noord-Holland

High-rise buildings have a significant visual impact in the province of Noord-Holland due to the open character of the landscape (Nijhuis, 2009, 2010b). The taller and larger the buildings, the greater the impact. This does not mean that high-rise developments are undesirable or impossible. High-rise buildings can function as markers for certain areas, thus serving as landmarks similar to prominent church towers, smokestacks etc. High-rise buildings can play an important role in the landscape as a point of orientation in time and space. They can also bolster the identity of a landscape. They especially reinforce the character of urban parks when located at their edges; these parks function as regional landscape parks with an emphasis on recreational use. Examples of areas where this is the case include Amstelscheg in the Arena area, Omval, the Zuidas business district, parts of Waterland, the southern part of Laag Holland, etc. Coastal high-rise development can also serve as a landmark, as is the case in Zandvoort. See figure 12. High-rise buildings can therefore make a positive contribution to the character of the landscape as long as sufficient consideration has been given to the location and design of the development. High-rise buildings do not always positively impact their surroundings, after all. High-rise buildings are likely to have a negative effect on the appreciation of landscapes in areas lacking a metropolitan character, such as in the northern part of Noord-Holland and in the Schermer, Beemster and Zeevang areas. The study on *Hoogbouw in Noord-Holland* (high-rise in Noord-Holland) was used for locations and height (Zandbelt&Vandenberg, 2008). See also chapter twelve.

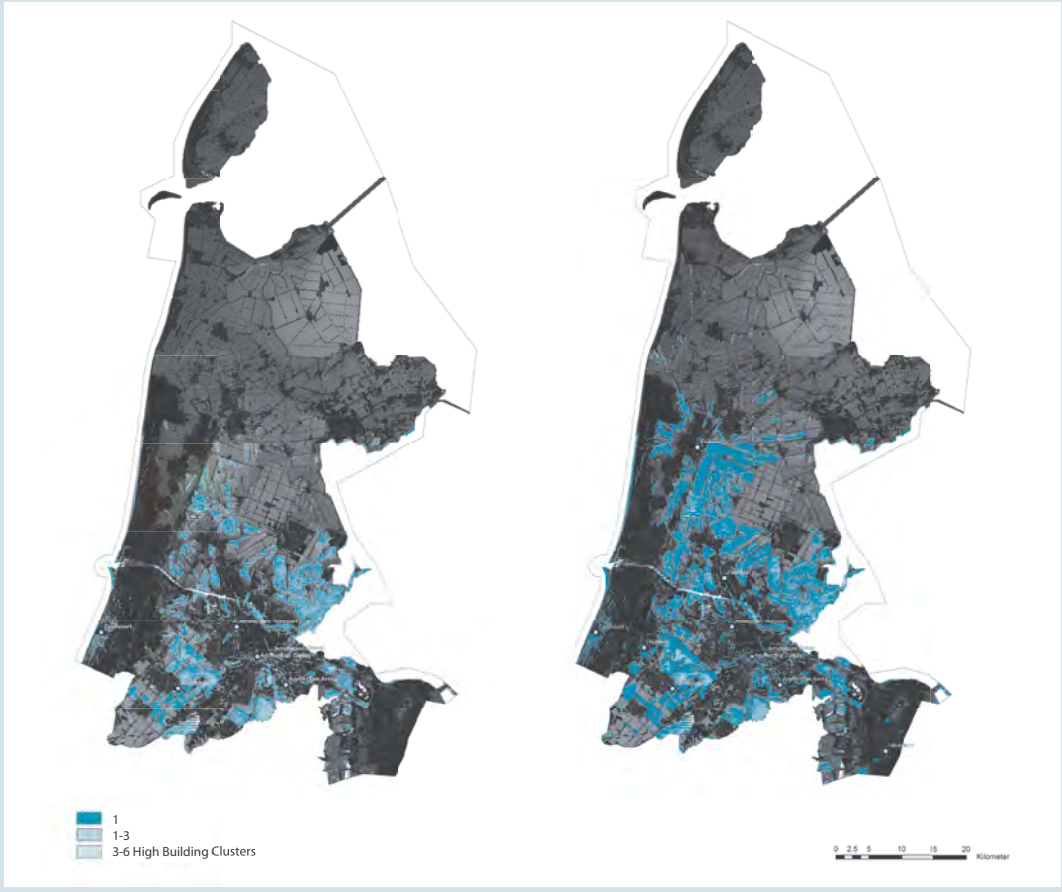


Figure 12
Visibility of high-rise in Noord-Holland (now and in the future)

Box 3 Visibility of wind turbines

The number of wind turbines in the Netherlands is increasing rapidly and the turbines themselves keep getting larger. There is a great deal of enthusiasm for this method of generating power, but criticism is also on the rise. One sees windmills looming in the landscape seemingly willy-nilly. It requires us to pause and ask ourselves what this means for our landscape. The cluttering and degradation of openness are important themes. The latest wind turbines have totally different dimensions than we are accustomed to. They are much taller and they generate more power. This not only presents opportunities but also threats. This jump in scale requires us to reflect on the consequences that these new wind turbines will have on the visual landscape, the spatial framework and the wind turbines that are currently in use (a large part of which are due to be replaced in the years to come). It is therefore crucial to develop policies for wind turbines that take the landscape into account. Design research and research-by-design will be invaluable for determining the best locations for wind turbines and for establishing zones that are apparently turbine-free. As the example illustrates, research methodology into visual effects can play a vital role. The image shows the current situation. The visibility of the 68 wind turbines in the extract has been mapped according to mast height and power generating capacity. This results in turbine visibility of 98,564 ha (47.3% of the extract, excluding large bodies of water). Design exercises show that this figure can be greatly reduced by careful placement of new wind turbines in conjunction with the replacement or removal of the current generation of wind turbines (Uum et al., 2010). See Figure 13.

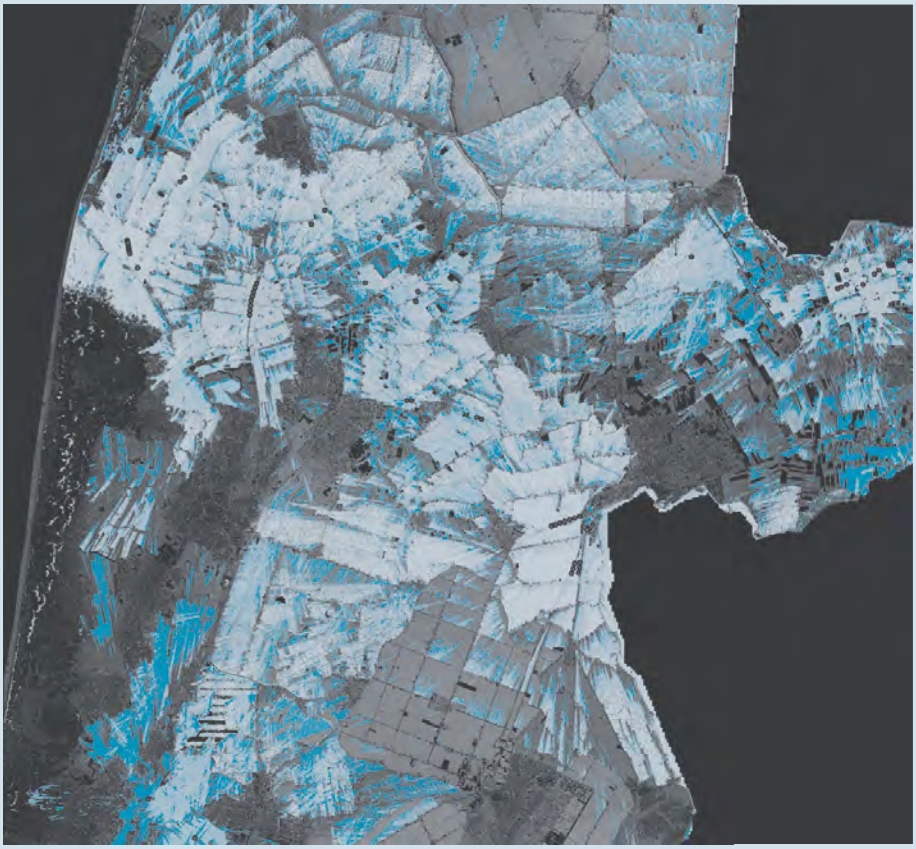


Figure 13
Visibility of wind turbines

the maximum distance (threshold) where the buildings can still be clearly perceived. As part of this study, a GISc-based viewshed analysis was applied to two examples (Nijhuis, 2009, 2010b; Uum et al., 2010); see also Box 2 and 3.

10.8.2 Visual urbanisation as a design brief

Urban boundaries and high-rises can contribute to the identity of the landscape and to its orientation in space and time (as long as they are thoughtfully designed and located). The cluttering of urban boundaries is an important issue that needs special attention. High-rise development is a hot topic and the subject of on-going research. In this regard it is important that any proposals for high-rise buildings are analysed using scientifically sound simulations to determine their visual impact. The examples demonstrate that the viewshed method can be a useful analytical tool, making it especially valuable when it comes to preserving highly sensitive open landscapes from visual urbanisation and cluttering. At the same time, and especially in urban areas, high-rise buildings can bolster the character of a given area and its orientation in space and time. When these kinds of interventions are mapped out, real-world options can be discussed and visual urbanisation becomes a true design brief.

10.9 IN CONCLUSION

The Province of Noord-Holland can serve as an interesting case study of how regional authorities deal with matters of spatial quality in landscape policy. Besides the use of other landscape value types (e.g. biophysical, socio-economic-technical, and political) in landscape characterisation and monitoring, the implementation of the physiognomic landscape framework described here offered the Province of Noord-Holland a hands-on approach to elaborate aspects of spatial quality, such as openness. It illustrates that the application of GISc-based methods and techniques in combination with expert knowledge offers governmental authorities new policy instruments and practical landscape assessment and monitoring tools.

As we have seen, the Province of Noord-Holland attaches great importance to spatial quality. The parameters for the Policy Framework for Landscape and Cultural History are formed by the current landscape when it comes to new developments, preservation and modernisation. The province is using this principle to create a new set of tools to ensure landscape quality. Research into the visual effects (e.g. openness) of the changing use of the landscape can have a major impact on the way judgments are formed on this topic, both by government authorities and by members of the public who are involved in the process in one way or another. The use of GISc-based methods and techniques provides added value because, on the one hand, it promotes an transparent and systematic approach to problems, facilitates analysis of large amounts of data

and paves the way for a smooth exchange of knowledge (resource for design, planning and policy). On the other hand, it makes it possible to visualise research results in a variety of ways (presentation tool). This latter factor is exceptionally valuable as a tool in the public debate on spatial quality especially because of its descriptive, rather then normative, nature.
The scale-dependent description of the visual landscape proved to be useful because it organises the scientific knowledge available in relation to the GISc-based methods and techniques. Although the physiognomic landscape framework as applied is composed of methods and techniques rooted in a wide variety of (international) scientific research, there are of course some considerations for the further development of the methodology. Due to its applicability, the methodology as presented is primarily a formal, aesthetic approach and it could be easily complemented by psychological, psychophysical and phenomenological approaches. Most of the research used to compose the methodology, however, is founded in empirical research (e.g. the openness map legend). The accuracy of the datasets used can be tested more accurately by making use of questionnaires completed by laypeople, rather than depending solely on the assessment of experts.

The provincial policy (and especially the assessment of new plans in rural areas) is unprecedented in the area of the administrative preservation of spatial quality and the encouragement of the same. The province is a true pioneer in the way it has envisaged its self-imposed responsibility for spatial quality. Until today, assessments like these were reserved for municipalities when they were assessing building permit applications under the auspices of the Housing Act. In the current period of deregulation, this provincial assessment can be considered to be a counter-movement. Time will tell if these kinds of assessments will truly lead to widespread support for spatial quality, which is why this is so very important from a nationwide perspective but also in a European context. By adequately visualising landscape interventions, the debate is opened up to a wide audience, which is a prerequisite for societal involvement.

ACKNOWLEDGEMENTS

I like to acknowledge Reinoud Bakker and Corine Meijer of the Province of Noord-Holland, and Miranda Reitsma, Provincial Advisor for Spatial Quality Noord-Holland for making this research possible. Miranda Reitsma made also an important contribution to the description of the spatial policy of the Province of Noord-Holland in this chapter.

NOTES

[1] The text of the European Landscape Convention was adopted by the Committee of Ministers in July 2000 and came into force 1 March 2004. For an overview of European landscape policies see Wascher, 2000 and Antrop, 2007.

[2] This is also the purpose of the Cooperation Agenda for an Attractive Netherlands (*Samenwerkingsagenda Mooi Nederland*) (VROM, et al., 2007) and the Structural Concept for the Motorway Environment 'A good view of the Netherlands' (*Structuurvisie voor de Snelwegomgeving 'Zicht op mooi Nederland'*) (VROM, 2008) which are integral parts of the Governmental policy on landscape.

[3] The chapter is partly based on: Nijhuis, 2008, 2009; Province of Noord-Holland, 2010a, 2010b.

[4] Although this is an expert-approach intrinsic variables that were used for a landscape perception validation are used.

[5] An overview of methods and techniques is provided in the introductory chapter of this book.

[6] Research from the Royal Netherlands Meteorological Institute (KMNI) shows that the meteorological optical range varies from nearly zero up to several tens of kilometres. However, the ranges of 12 kilometres (50%), 20 kilometres (25%) and 28 kilometres (10%) are typical for Dutch circumstances. See also chapter twelve on this matter.

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