Possibilities for new estates in West Brabant

A GIS-based planning study

A. Tisma

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ABSTRACT

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This research proposes the re-use of parts of agricultural land in urban fringes for building houses combined with nature development. In this report the new type of housing is referred to as 'new estates'. The case study was West Brabant, which has been analysed by means of a geographical information system (GIS). It was found that about 6000 hectares were suitable for 'new estates', out of which three locations were chosen for sample designs. The designs were made using two typologies: of plant communities and of housing. Environmental impact of one of the designs was assessedated in the final stage of this research.

Keywords:environmental impact, housing, nature development, physical planning.

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PREFACE

This research was a joint project of the Faculty of Architecture (Delft University of Technology) and the DLO Winand Staring Centre (SC-DLO).

It started on 1 September 1993 and was completed after 10 months on 1 July 1994. It was part of the post-graduate course Design, Planning and Project Management of Building and Built Environment ('OPB') at the Faculty of Architecture and was supervised by Prof. Ir. C. Duijvestein and Prof. Ir. D.H. Frieling. Within the scope of 'OPB' subjects the main task was to produce a design instrument suitable to implement in practice.

At that time Geographical Information Systems (GIS) wasnot included in the regular and post-graduate curricula of the Delft Faculty of Architecture , andwasn't much applied in research projects. Therefore, the goal was to investigate and try out the suitability of GIS for land-use evaluation and land-use planning.

The data bases for the GIS analyses were taken over from SC-DLO, who also supported the research project by providing two members of the institute's staff as the project supervisors - J. Roos-Klein Lankhorst and L. M. van den Berg.

On the other hand, the idea was to explore techniques of computer visualisation other than the CAD systems commonly used, such as computer-aided photo montage and multimedia.

Owing to its complexity, this research aimed at more than one goal and consequently it has dual results:

1. It gives:
   - the scope for an alternative use of parts of agricultural land in the Netherlands.
2. It shows:
   - how GIS may be used for land-use analyses
   - how computer-aided photo mounting may be used for the presentation of designs
   - how different computer programs may be incorporated in a design instrument.

SUMMARY

The changing agricultural activities in the European Community might lead to the different usage of land in the Netherlands now being used for agricultural production. This could provide conditions for realisation of one of the goals stated in 'The Fourth Report on Physical Planning Extra' ('VINEX') which is the improvement of environmental quality. This can be realised by converting agricultural land for nature development.

Documents on physical planning in the Netherlands divide the land into two categories: urban and rural areas. New housing is always planned in urban areas, whereas rural areas are reserved for agriculture, forestry, recreation and nature. The usual suggestion made in academic debates on alternative uses of cultivated land is to develop forestry, nature, recreation or environmentally friendly forms of agriculture, or any combination of these activities. Development of housing in rural areas, some years ago concerned as undesirable, is recently getting more and more attention.

Areas in the Netherlands which could provide the best opportunities for such a development are the 'rural-urban' fringes. This research proposes the re-use of parts of agricultural land in urban fringes for the building of houses combined with nature development. In this report the new type of housing will be referred to as "new estates".

The case study of this research was the area of West-Brabant, which has been analysed by means of the Geographical Information System (GIS) in order to find the most suitable locations for the "new estates". In the GIS analyses the following environmental components were taken into account: types of soil, level and quality of ground water, presence of surface water, forests and natural areas, distance from a built-up area, and types of land-use. The following served as background information: types of landscape, ecological infrastructure, ownership, historical sites and the type of city fringe.

The result of these analyses proved that about 6.000 hectares were the most suitable locations for "new estates". Three locations were chosen for example designs, using the two typologies especially developed for this purpose: the typologies of plant communities and of housing. The example designs were meant to achieve a harmonised relationship through careful integration of contradictory functions. The designs were visualised by means of computer-aided photo montage.

Environmental effects of one of the designs were evaluated by expert judgement in the final stage of this research. The methodology applied has been especially developed in view of obtaining a transparent design instrument which gives step by step insight in the design process.

1 INTRODUCTION

These days agriculture in Europe is facing many problems. On the one hand production has reached a secure level as regards amount and quality; on the other hand, however, the costs of agricultural policy are rising dramatically. Subsidised surpluses of products and increasing environmental problems resulting from today's intensive cultivation are the main reasons to think about new scenarios for agriculture in the EC countries in the coming years. Because production must be reduced some part of agricultural land will become free. This would provide conditions for one of the tasks stated in the 'Fourth Report on Physical Planning Extra' in the Netherlands (VINEX) that is the improvement of environmental quality.

For centuries people in the Netherlands have put much effort into reclaiming arable land from the sea and marshes; for the same reason forests were largely cleared. These days there is enough agricultural land, and parts may be restored to their previous use.

The re-use of agricultural land is under discussion at various levels in the Netherlands: the national level ('VINEX', the 'WWR' report 'Ground for Choices', 1992, Discussienota Visie Stadslandschappen, 1995), the regional level (Harms et al., 1994), and the local level (Wezel and Milieu, 1994).

Documents on physical planning in the Netherlands distinguish a spatial division of urban and rural areas. Housing is mainly planned in urban areas, whereas rural space is designated for agriculture, forestry, recreation or nature development. In their debates on the re-use of previously cultivated land, academic circles prefer the development of forestry, nature, recreation, environmentally friendly forms of agriculture, or any combination of these activities, while development of housing areas is recently receiving more attention (see for instance Beukema, 1994; Van Herk, 1994).

1.1 Definition of the problem

Parts of arable land where production will be discontinued could be reused, combining traditional urban and rural functions - housing together with nature development. This idea is the result of a growing awareness that there is very little nature in the Netherlands, and that housing needs are growing rapidly; the number of houses in the Randstad required by 2015 ranges from 700 000 to one million (Gans en Oskamp, 1992), most of which are to be built within the city fringe. Within European community, after Ireland and Portugal the Netherlands has the lowest number of houses per thousand inhabitants (Bosma et al, 1994). Also, the Netherlands is one of the least forested countries in Europe. Less than 10% of its total surface is covered with forests, which is very low in comparison with, for instance, Germany's 29%. Under forest is meant all the green areas larger than half a hectare and broader than 30 metres ('Atlas van Nederland', 1986).

New movements in agriculture may provide the land that may be available for nature development, but it tends to involve double costs: discontinuing the production causes a fall in income, and nature development

will increase costs; furthermore, potential economic and social benefits of nature development have not yet been quantified. Nature has few chances in times of economic depressions.

Therefore in this research a more profitable solution is suggested: the combination of nature development with low density housing, which will result in so called 'new estates'. For this a balance must be found between two contradictory activities, in particular with regard to the exploitation of nature. The most suitable locations for 'new estates' are city fringes, because these heterogeneous areas have potentials for both building and nature development.

1.2 Study area

Geographically, and given its natural characteristics, West Brabant is an interesting region.

It is situated between two highly urbanised areas - Rotterdam and Antwerp (Figure 1). Because it is a relatively quiet and mainly rural area, it forms a buffer between these two large ports. Within the international city network West Brabant will become increasingly important in the years to come.

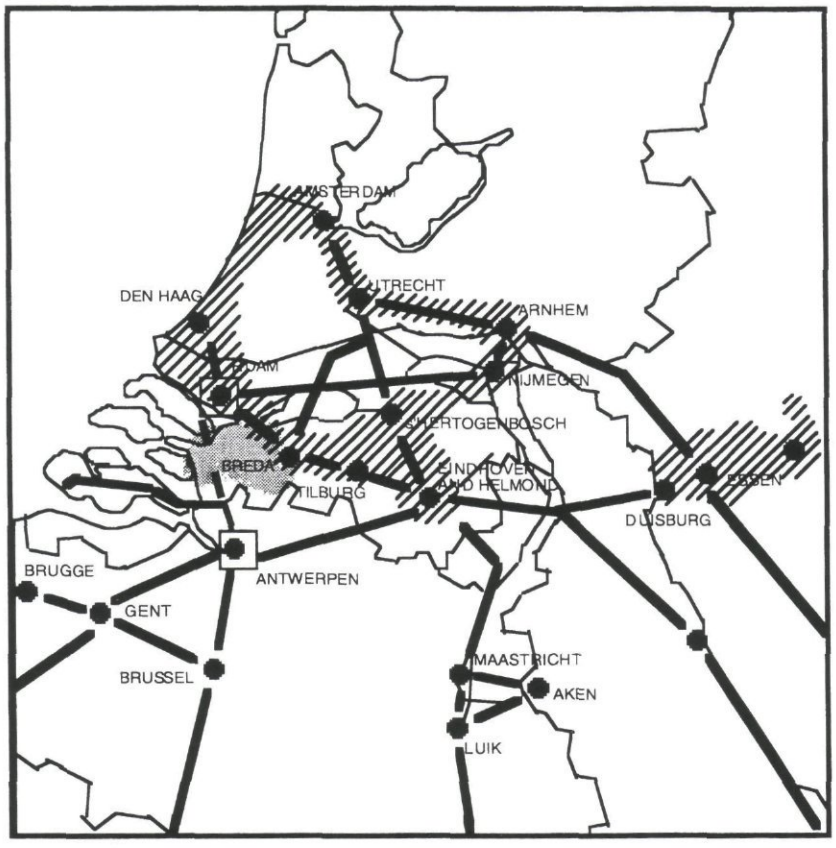


Figure 1. Position of West Brabant in the international city network.

On a national level it is of interest within the context of the allocation of housing needs in the Randstad (according to 'VINEX', part of the housing needs in the Randstad may be transferred to neighbouring regions).

West Brabant's most valuable natural quality is its characteristic landscape, which has been shaped on the transitional area of aeolian sandy reaches

and the tidal planes of Zeeland. From a regional point of view two kinds of landscapes may be distinguished: in the clay area and in the sandy area, with a clear identity of their own. Unity and contrast between these two types of landscape make West Brabant attractive from an aesthetic as well as a recreational point of view. (Figures 2a and 2b).

Figure 2a. Landscapes in West Brabant: small-scale landscapes on sendy soil.

The uniformity of bigger units is connected to geomorphologic and hydrologic characteristics of the soil. The north-west part is a clay area and the south-east part is sand, the transitional area still shows traces of peat, most of which was exploited in earlier centuries.

Figure 2b. Landscape in West Brabant: open, large-scale in clay area.

The clay area is in the lower part of the region and has large fields surrounded by dykes. These fields, ranging from about ten to over one hundred hectares, give the landscape its open character. The network of brooks and creeks is also a major natural element which gives the landscape its dynamic feature. The type of soil determines agricultural production, therefore potato, sugar beets and maize are the commonest agricultural products.

The sandy area, with a more closed and small-scale character, is

found in higher parts of the region, where agriculture is more varied - for instance: market gardening, nurseries, grasslands, cattle breeding and dairy farming. Rivers and brooks flowing in a south-north direction divide this area into several different parts. This division is further emphasised by complexes of forests in the higher parts of the sandy area.

From early times the transitional area between the sandy and clay regions has been urbanised, and it is here where the biggest settlements in the region (Bergen op Zoom, Roosendaal, Etten-Leur and Breda) can be found today. And this region is chosen as the study area for the case-study.

1.3 The 'New Estates'

In the following text the term 'new estates' will be used for the type of housing proposed in this study: a combination of housing and nature development.

According to Webster's New World Dictionary "an estate is landed property, individually owned piece of land containing a residence, especially one that is large and maintained by great wealth".

There are some points of similarity between the 'new estates' and the 'old' ones, such as low-density housing, a high percentage of green spaces, decentralisation from the city, and private ownership. What makes these 'new estates' different from the old ones is that they will not be for high income groups only, owing to the variety of housing types other income groups will also be able to afford them. The 'new estates' should be open to the public but the number of visitors will have to be in accordance with the carrying capacity of the ecosystem. Ownership may range from 100% of privately-owned homes to 100% of public housing with various transitional combinations of public/private partnership. As proposed in the 'Bosbeleidsplan' and 'Structuurschema Groene Ruimte' there is some financial scope for projects based on public/private cooperation with regard to the extension of afforested areas. The money can be spent on increasing and maintaining green spaces in the estate.

Maintenance of green spaces is the responsibility of estate residents, which implies that prospective occupants should be willing to accept this responsibility.

Other characteristics of 'new estates' are:

- the size of parcels of land for new estates in West Brabant ranges from 2 to 150 ha,
- a minimum of 80% per parcel of land should be used for nature development,
- the built-up area will be used only for housing
- designs of the homes are based on different densities (inhabitants/ha and dwellings/ha) and different concentrations (one or more housing units in one or more buildings).
- functions of green spaces can be placed in the following categories:
  a. ecological: to be realised by the restoration of former biotopes, support of nature development in core areas, wet or dry connections, the development of biodiversity and creation of protected zones bordering on adjacent natural areas;
  b. economic: apart from some marginal wood production to be realised by

the integration of housing;
c. recreational: areas for passive forms of recreation such as walking, experiencing a landscape, relaxation, education in nature and environment, and volunteer work;
d. aesthetic: by improving the image of the landscape.

1.4 Goals

The primary goals of this research were:
- to find locations in West Brabant with the best potential for 'new estates'
- to make example designs which would give an idea how 'new estates' could be created
- to give an idea of how some parts of surplus agricultural land in the Netherlands may be re-used
- to find more profitable ways of nature development than the usual ones
- to contribute to solving part of the housing needs.

Secondary goals were:
- to show the possibility of implementing GIS in land evaluation and land-use planning
- to implement computer visualisation techniques in the design process
- to develop a prototype of a design instrument which in practice can be applied in planning and education.

1.5 Delimitation

This research does not aim at solving all the housing needs. It only shows examples of new estates as a new means to solve part of the housing needs. Social and political aspects of the implementation of plans for new estates have not been dealt with in this research. Neither does it give a solution and quantification of land to be cleared of original agricultural production. It focuses on the suitability for new estates, not on the question of how many of these new estates should be created, and how much of the area should be used for other purposes (nature development, forestry, recreation, etcetera).

This research was not to result in a regional plan for West Brabant, e.g. new locations for conventional housing have not been considered. It does not provide final designs for the locations selected. Whether or not these housing locations would be available has not been checked with the local government. Only physical suitability has been considered.

2 METHODOLOGY

The methodology has been developed during the research and consists of four steps given in Table 1.

	STEPS	TECHNICS	SCALE	CRITERIA	PRINCIPLE	RESULT
1	**Choice of location**	GIS	1:50000	type of soil ground water level (GWT) form of land use presence of surface water wider than 20m presence of nature reserves presence of forest distance from a built-up area	objectivity	network of locations
2	**Reduction**	analyses of maps GIS site studies	1:50000 1:25000	patterns		
				effect on landscape and nature effect on housing and living environment	improvement	evaluation of designs
3	**Design**	2D sketch computer aided photo-montage	1:5000	housing densities housing concentrations patterns	variants	designs of example locations
4	**Evaluation**	analysis of environmental effects	1:25000	effect on landscape and nature effect on housing and living environment	improvement	evaluation of designs

Table 1. Methodology of the research.

2.1 Choice of Location

This step was to define all the locations in the study area of West Brabant with a high potential for housing and for nature development.

The 'high potential' for housing and nature development has been defined on the basis of GIS criteria (for further details see Figure 8 in the chapter on Results).

The technique used in this step was GIS, scale 1:50 000. The input digital maps were divided into four sections (Figure 3). Input maps of soil, water-table classes (GWT) and land use were in raster form with a cell resolution of 25 metres (Figures 4, 5 and 6). The maps shown here serve to illustrate the process of GIS analyses, but only with regard to section 49w; the same procedure, however, has been used for the whole area. The original soil map and GWT map have been digitised, the land-use map has been derived from satellite photographs. The databases were originally in ARC/INFO, and were explored as raster maps, suitable as input for the GIS software that was used for the analyses, MAP II for Macintosh.

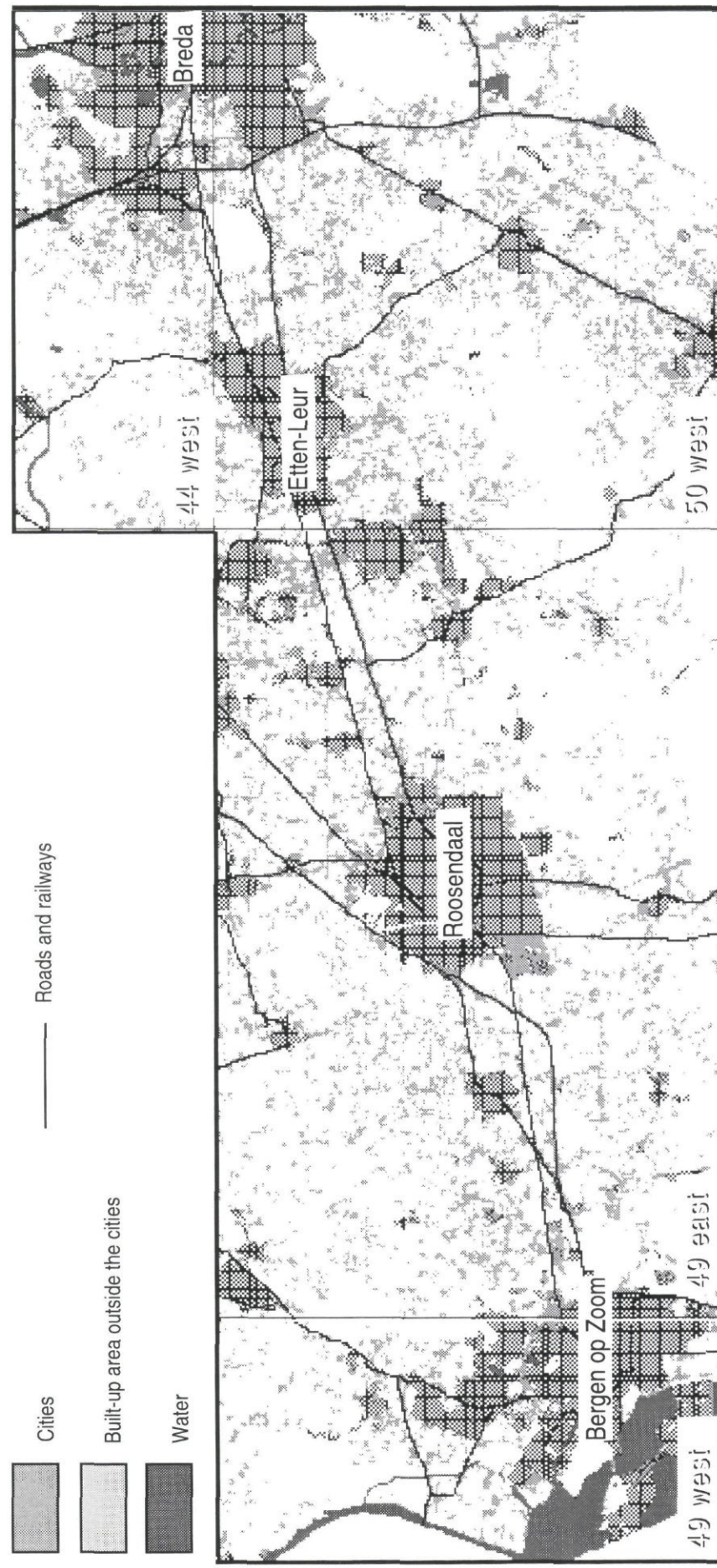


Figure 3. Case-study area of West Brabant. Distribution of cities and division into four sections.

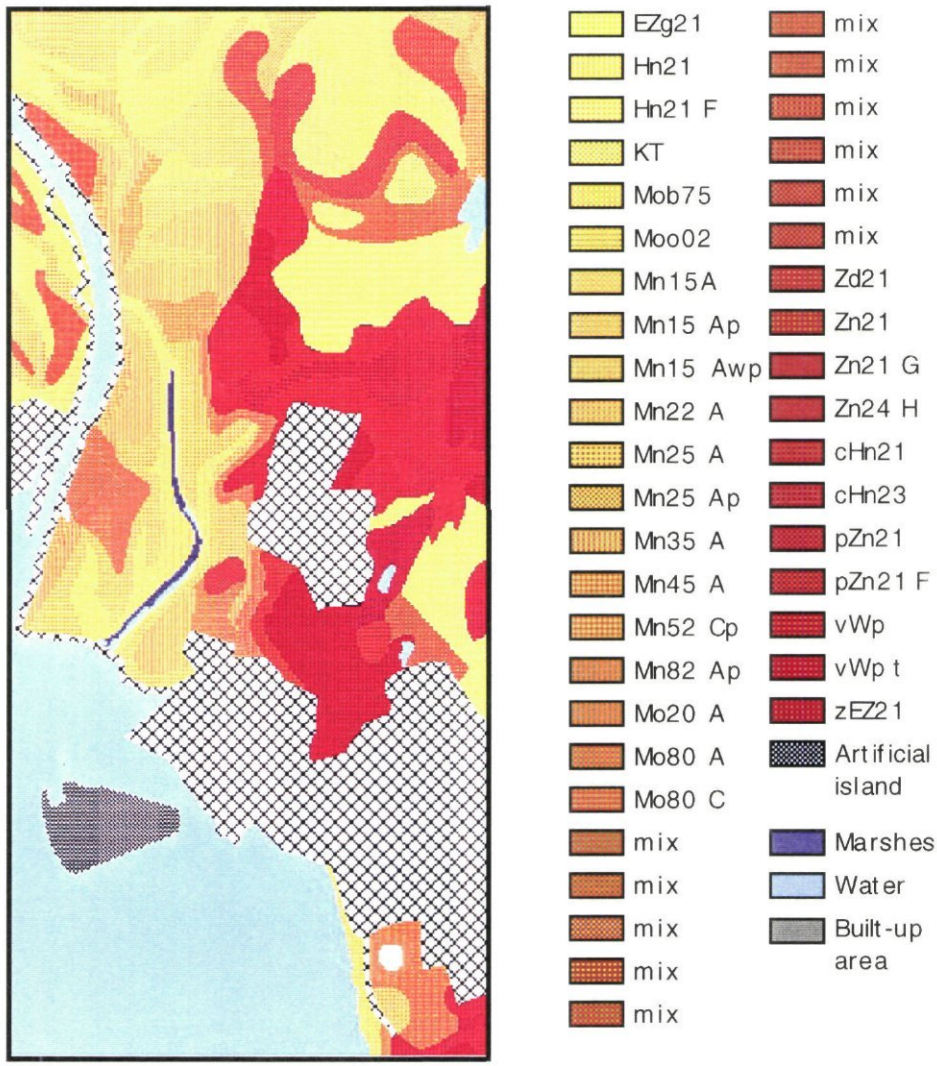


Figure 4. Soil categories represented within section 49 w.

On the basis of natural and environmental qualities locations were chosen as objectively as possible. In accordance with the specified criteria the result of the GIS intersections is a network of locations which satisfy these criteria, thus indicating that they are suitable for housing and for nature development.

2.2 Reduction

Further information for a more detailed analysis of the locations was obtained from non-digital sources (traditional analyses of maps and visits to the area), as well as from other GIS databases, such as the digital map of 'nature core areas' of the province of Noord Brabant (Figure 7).

All the digital data were compared to the topographical map. In this way many other data were added, such as altitudes above sea-level, the vicinity of historical sites, the types of neighbouring built-up structures, etcetera. Research reports covering the same field were also studied, such as Renes, 1985, Streekplan West Brabant, and various documents of the province of Noord-Brabant.

Professor Dr F.M. Maas, Henk Ullenbroeck (from the province of Noord Brabant, 'Ruimtelijke Statistiek en Informatieonderzoek'), Sybrand

Figure 5. Map of ground water levels.

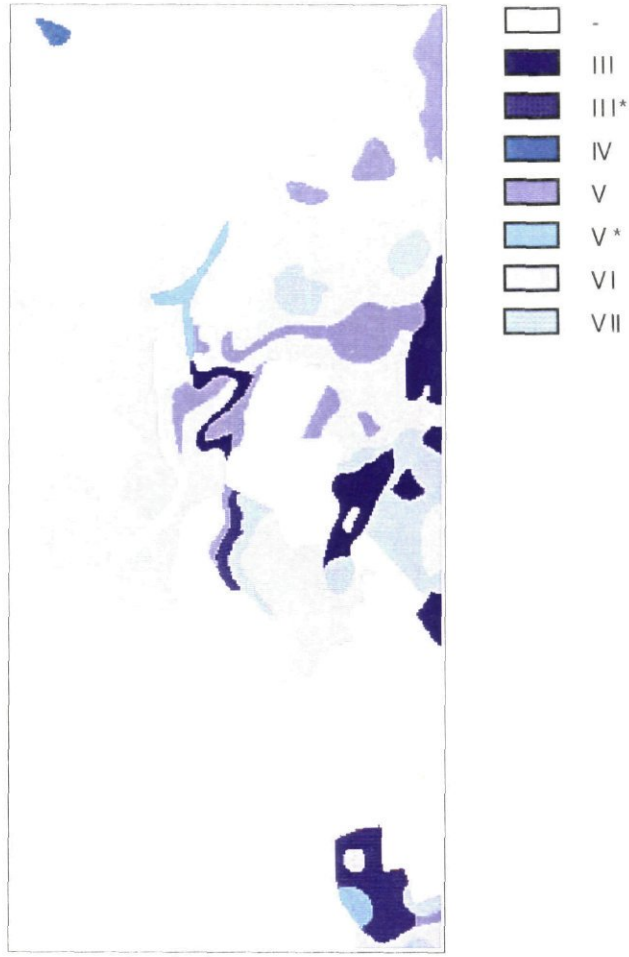
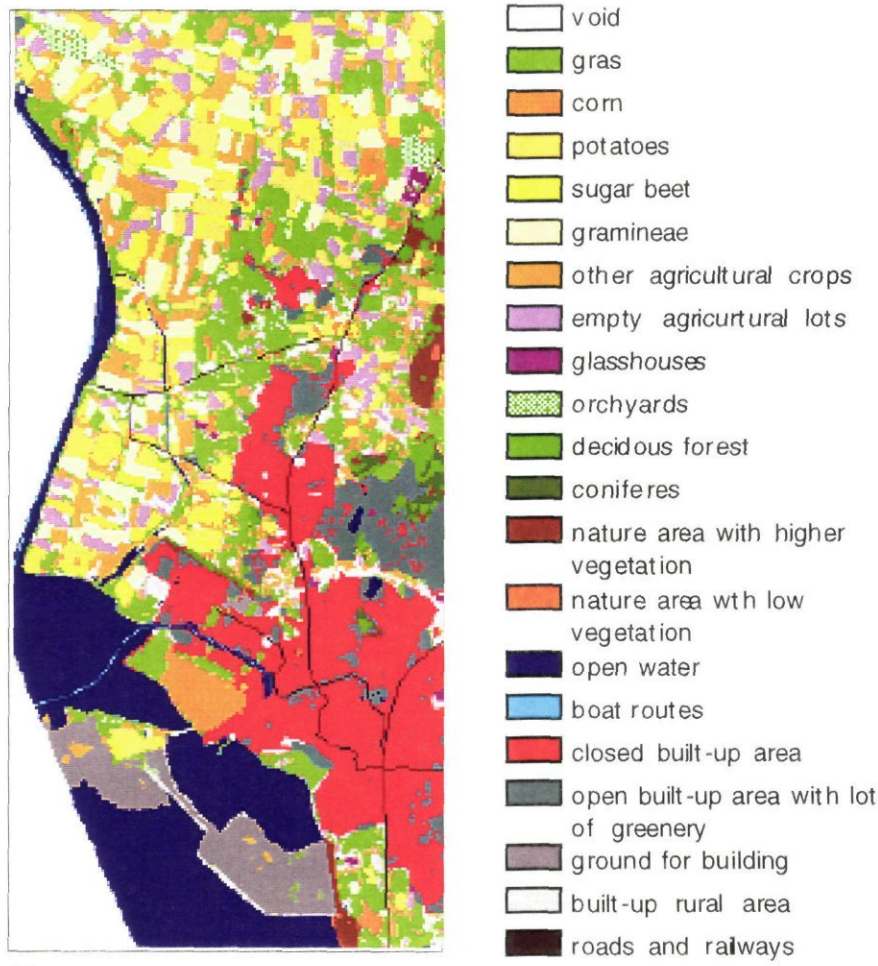


Figure 6. Land use map from 1990. Interpretation of satelite photo.



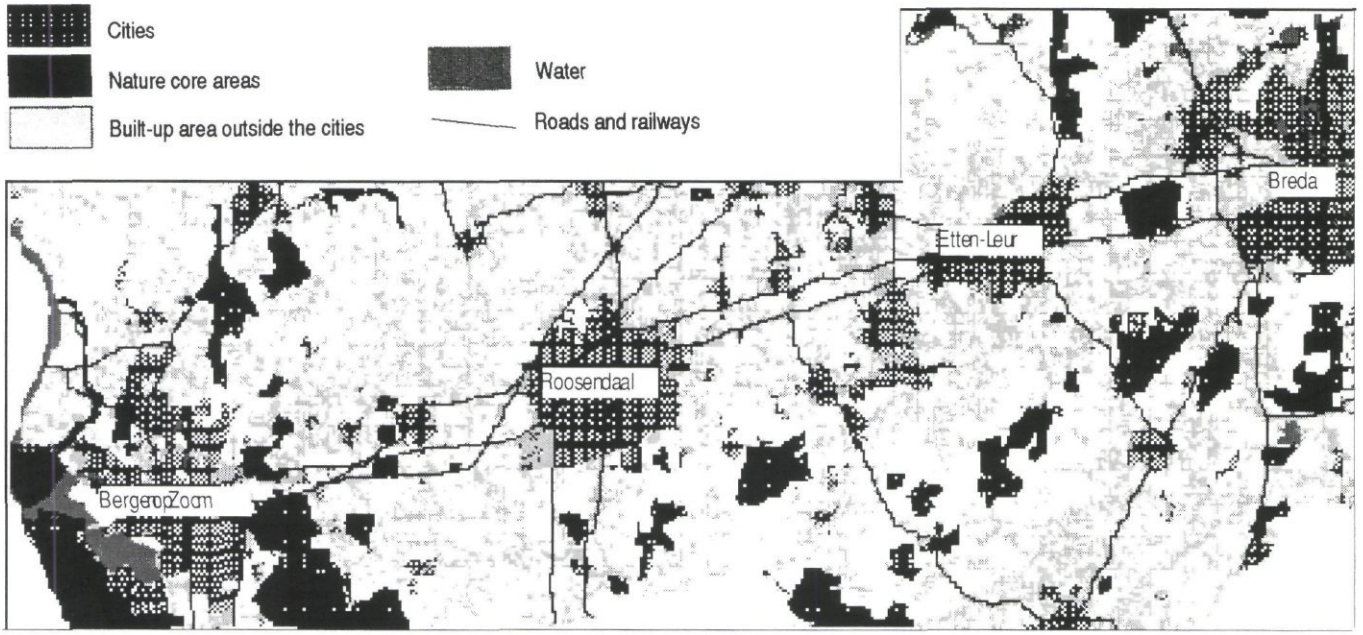


Figure 7. Nature core areas in West Brabant.

Tjallingii and J.W.M. Langeveld (IBN-DLO, Wageningen) were consulted. The area was visited several times in the autumn of 1993 and the spring of 1994.

On the basis of this information the number of locations to be chosen for example designs was reduced, on the criteria: landscape type, height above see level, type of the neighbouring historical site, type of city fringe and connection to ecological infrastructure.

This resulted in the selection of 12 locations, all of them within the city fringe of the largest cities in the area: Breda, Etten-Leur, Roosendaal, and Bergen op Zoom (see Chapter 3.4).

2.3 Design

This step was meant to give an example of how different types of houses could be incorporated in different natural surroundings. Briefly, this stage gives an idea of the image of 'new estates'. Brabants Landschap, Natuurmonumenten and Staatsbosbeheer were consulted.

Two typologies were made for design purposes, to be used as 'catalogues' a typology of housing and a typology of plant communities.

Visits were made to West Brabant to find out if similar housing in natural areas had been realised (for example, 'De Blauwe Kamer', Haagsche Beemden, and the district of Ruitersbosch in Breda).

After visiting the 12 locations, three locations were selected for the example designs. Each of these the designs is made by combining a house and a plant community chosen from 'catalogues', in accordance with the type of city fringe and characteristics of the particular location.

In this step computerised drawing techniques on a 1:5 000 scale and computer-aided photo montage with Canvas and Photoshop software programs were applied.

2.4 Evaluation

In this phase two people evaluated the design for the location Bouvigne with regard to its influence on wider surroundings. The evaluation was based on expert judgement and not on any real analyses. The criteria for evaluation were derived from environmental analyses studies (see Table 10, chapter 5). Several reports on environmental effects analyses were used as source material. The impact was studied on a 1:25 000 scale, and consequently the design area was investigated in the context of larger spatial structures.

3 RESULTS

3.1 Implementation of GIS in Land-use Evaluation

By definition GIS is an integrated system for collecting, storing, manipulating and presenting spatial data. The general characteristics of all the GIS systems (Peuquet and Marble, 1990) are:
- A data input sub-system which collects and/or processes spatial data derived from existing maps, remote sensors, etcetera.
- A data storage and retrieval sub-system which organises the spatial data in a structure enabling a quick retrieval for subsequent analyses, and for making rapid and accurate updates and corrections in a spatial database.
- A data manipulation and analyses sub-system which can execute a variety of tasks, such as changing the structure of data through user-defined aggregation rules or estimating parameters and constraints to optimise various space-time or simulation models.
- A data reporting sub-system which can display all or part of the original database, manipulated data and output of spatial models in a tabular form or as maps.

Already GIS is known world-wide, it is used by geographers, planners, environment scientists and others who commonly use spatial data. GIS was the basic technique used for quick analyses of the West Brabant case study, an area of 56 875 hectares. A set of criteria, mainly based on the natural characteristics of the area, has been defined for housing and for nature development.

3.1.1 Definition of Criteria

Starting point was the model of environmental components, initially developed by Tomasek (1979), based on three groups of components:
- abiotic components (A): soil, water, air, climate, bedrock, etcetera.
- biotic components (B): man, animals, plants, and microorganisms.
- technical components (T): the built environment with buildings, roads, canals, railways, bridges, etcetera.

Later this 'ABT' model was changed into the 'ABC' model by T. de Jong (1992) and C. Duijvestein (1993): the term 'technical' was replaced with 'conceptual', thus adding the world of ideas (such as culture or religion) to the material and technical components in the previous model (Figure 8).

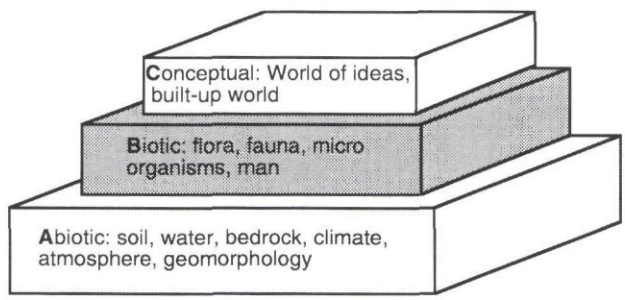


Figure 8. ABC model of environmental components.

These three groups have a causal relation: abiotic components are the precondition of biotic components, and in turn biotic components are the precondition of conceptual ones.
By means of selecting the most important components with regard to this particular case, the model was translated into criteria, on the basis of which locations could be chosen. For this purpose a detailed checklist of environmental components was used (see Table 2).

1. Bedrock characteristics and geological processes
1.1 Bedrock properties and lithology
1.2 Occurence of distinct geological formations
1.3 Volcanoes and areas of volcanic activity
1.4 Geotectonics and geophysical features

2. Atmospheric properties and climatological processes
2.1 Chemical composition of the atmosphere
2.2 Concentration of atmospheric dust
2.3 Concentration of water vapour/air humidity
2.4 Precipitation/drought
2.5 Clouds
2.6 Solar radiation input
2.7 Temperature
2.8 Occurence of lightning/fire

3. Geomorphological processes and properties
3.1 Topography (slope/relief/altitude)
3.2 Presence of distinct landform units
3.3 Type and structure of surface area
3.4 Albedo
3.5 Weathering/erosion
3.6 Sedimentation and fossilization

4. Hydrological processes and properties (at the surface)
4.1 Water reservoirs/availability (volume, area, depth)
4.2 Interactions with atmosphere
4.3 Runoff and river discharge
4.4 Tides and ocean currents
4.5 Ground water table
4.6 Water quality

5. Soil processes and properties
5.1 Soil depth
5.2 Texture/structure (physical characteristics)
5.3 Organic matter (humus content and litter)
5.4 Mineral content (fertility)
5.5 Soil moisture/humidity/drainage
5.6 Chemical characterisrics/chelation
5.7 Biological characteristics

6. Vegetation characteristics
6.1 Height, structure, density and roughness
6.2 Succession stage/age/maturity
6.3 Standing biomass/chrolophyll
6.4 Surface covering/leaf area index
6.5 (Evapo)transpiration/water use efficiency
6.6 Litter-production
6.7 Root system and nutrient uptake/recycling

7. Characteristics of flora and fauna (species properties)
7.1 Species composition and diversity
7.2 Population size (rarity) and distribution (endemism)
7.3 Population viability/vunerability (genetic diversity)
7.4 Population dynamics (increase, decrease, etc.)
7.5 Dispersal and migration
7.6 Special functional properties
- edibility/nutritious value
- useful genetic and biochemical properties
- role in biochemical cycles
- indicator value
- other (e.g. aesthetic value)

8. Life community properties and food chain interactions
8.1 Biomass production/photosynthesis
8.2 Consumption and respiration
8.3 Decomposition
8.4 Food-chain characteristics
8.5 Deposition of calcareous material
8.6 Bioturbation/activity of soil communities

9. Ecosystem parameters
9.1 Naturalness/Integrity/Heritage value
9.2 Uniqueness/Distinctiveness
9.3 Diversity/Richness
9.4 Minimum critical size
9.5 Carrying capacity (Ecological Fragility)
9.6 Replacability/Renewability
9.7 Informational value
- amenity value/aesthetic qualities
- historical/cultural values
- inspirational/spiritual value
- scientific/educational values

Table 2. Checklist of environmental characteristic (parameters) which influence the capacity of given ecosystem or natural area to provide certain functions (de Groot, 1992).

Certain elements in the list were selected on the same logical basis as described in 'Design with Nature' by McHarg (1969): not all the elements, but only those which were important in the context of his research.

Slope
Surface drainage
Soil drainage
Bedrock foundation
Soil foundation
Susceptibility to erosion
Land values
Tidal inundation
Historic values
Recreational values
Residential values
Forest values
Wildlife values
Institutional values

Table 3. Components treated in evaluation of the costs of construction of motor way on Jersey Shore (McHarg, 1969).

In his evaluation of the costs of the construction of a motor way on Jersey Shore, McHarg considered the components shown in Table 3.

According to McHarg, the principle of the analyses of the metropolitan Washington region is that: "...certain types of land are of such intrinsic value, or perform work for man best in natural condition, or finally, contain such hazards to development that they should not be urbanised. Similarly, there are other areas that, for perfectly specific reasons, are intrinsically suitable for urban uses."

When eight natural features are selected and ranked in their value to natural processes, they will conversely constitute a cross reference as to the suitability for urbanisation. These features are shown in Table 4.

Surface water
Flood plains
Marshes
Aquifer recharge areas
Acquifers
Steep slopes
Forests and woodland
Unforested land

Table 4. Order of natural features important for sustainability for urbanisation (McHarg, 1969).

In the exploration of locations for 'new estates' the criteria in Table 5 were used.

Type of soil

This is important in relation to building and nature development.
Sub-criteria: Only areas of sand and clay were considered because:
- peat causes building problems
- most of the field crops which are intensively produced in The Netherlands grow on sand and clay; these are the areas with over production and therefore in the context of this research they should be reduced
- sand and clay are very suitable for both building and nature development.

Table 5. GIS criteria for selection of locations for new estates, output maps and applied GIS operations.

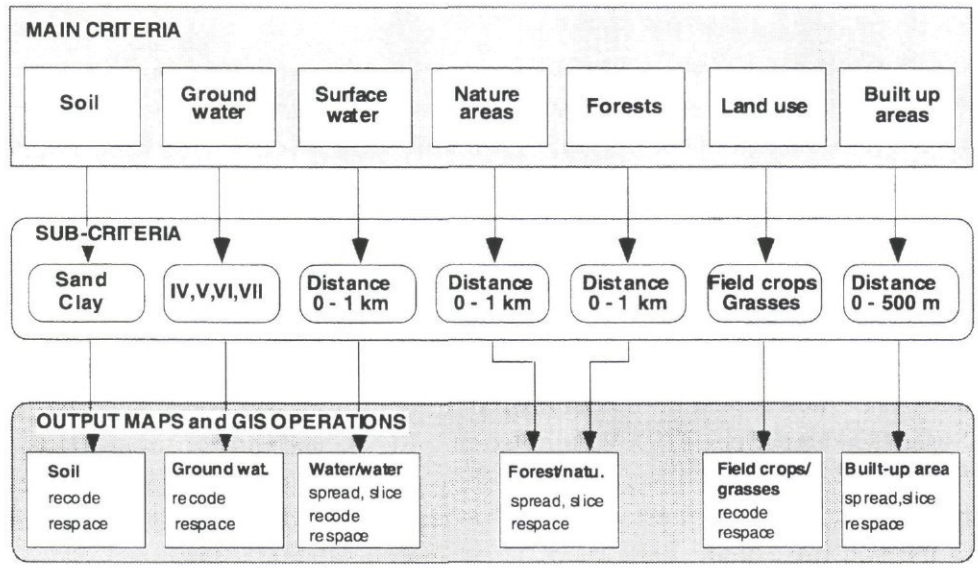
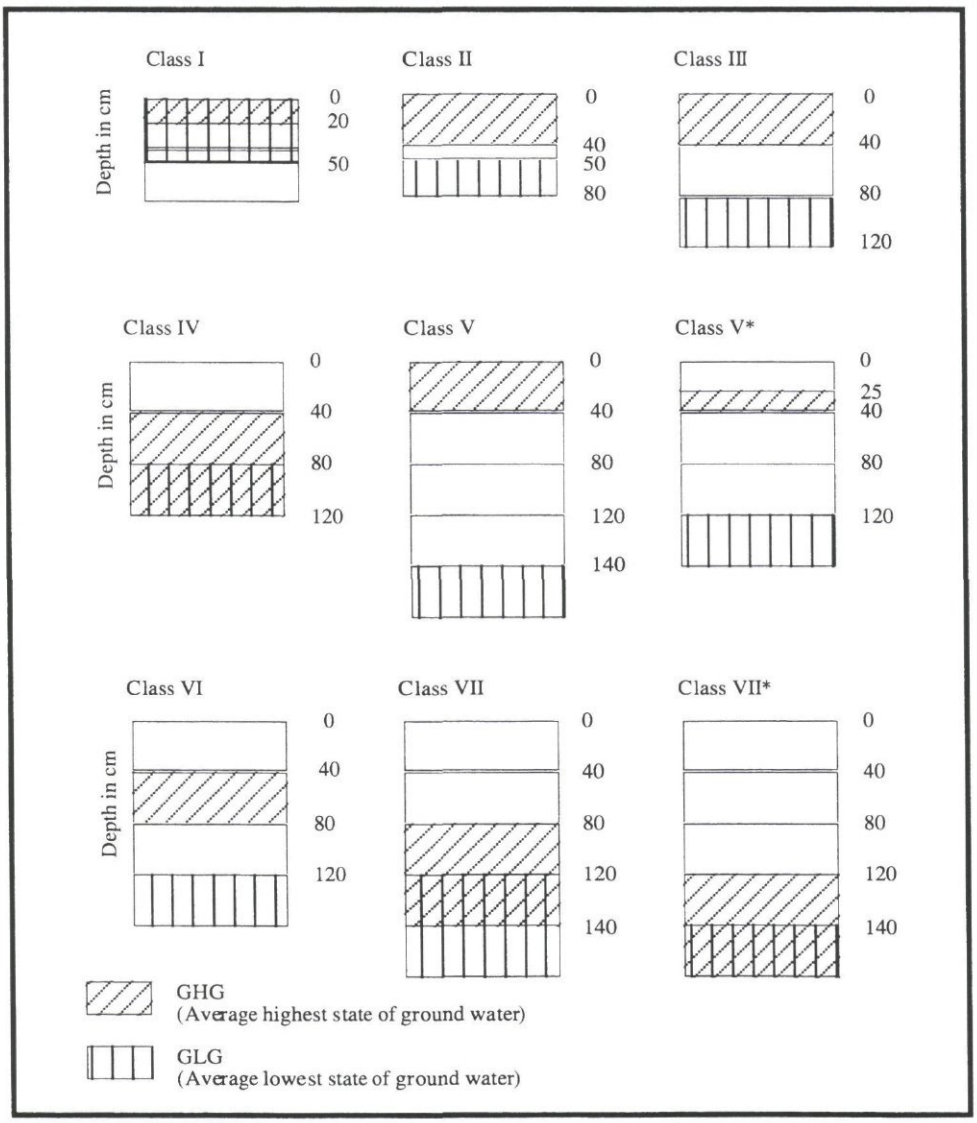


Figure 9. Clasification of ground water levels (Bodemkaart van Nederland, 1983).



Ground water table (GWT)

The ground water level effects nature and building activities.
Sub-criteria: Only drier locations with GWT more than III (see Figure 9), have been considered because higher ground water levels will increase building costs.

Presence of surface water

Water enables the development of various ecosystems, thus contributing to biodiversity. It is always an important element in a landscape because it adds to the aesthetic qualities of the environment (see pattern 'Pools and to Streams' Alexander 1977). Water also provides possibilities of recreation.
Sub-criteria: A body of surface water should not be farther than one kilometre, so it will be within easy reach of pedestrians, and may be incorporated in the housing estate.

Nature areas

Nature areas in the vicinity could involve:
- extension of these areas by means of building 'new estates'
- areas with a low-density housing estate and surrounded by nature which may serve as a 'buffer'/protection zone of an important nature reserve.

Sub-criteria: Nature areas should not be farther than one kilometre from the location.

Forests

Forests in the vicinity are important because they have:
- a positive effect on the environment
- aesthetic and recreational values, and
- because forests may be extended into the housing area, thus increasing the total surface of woodland in this area.

Sub-criteria: Forests should not be farther than one kilometre from the location.

Land-use

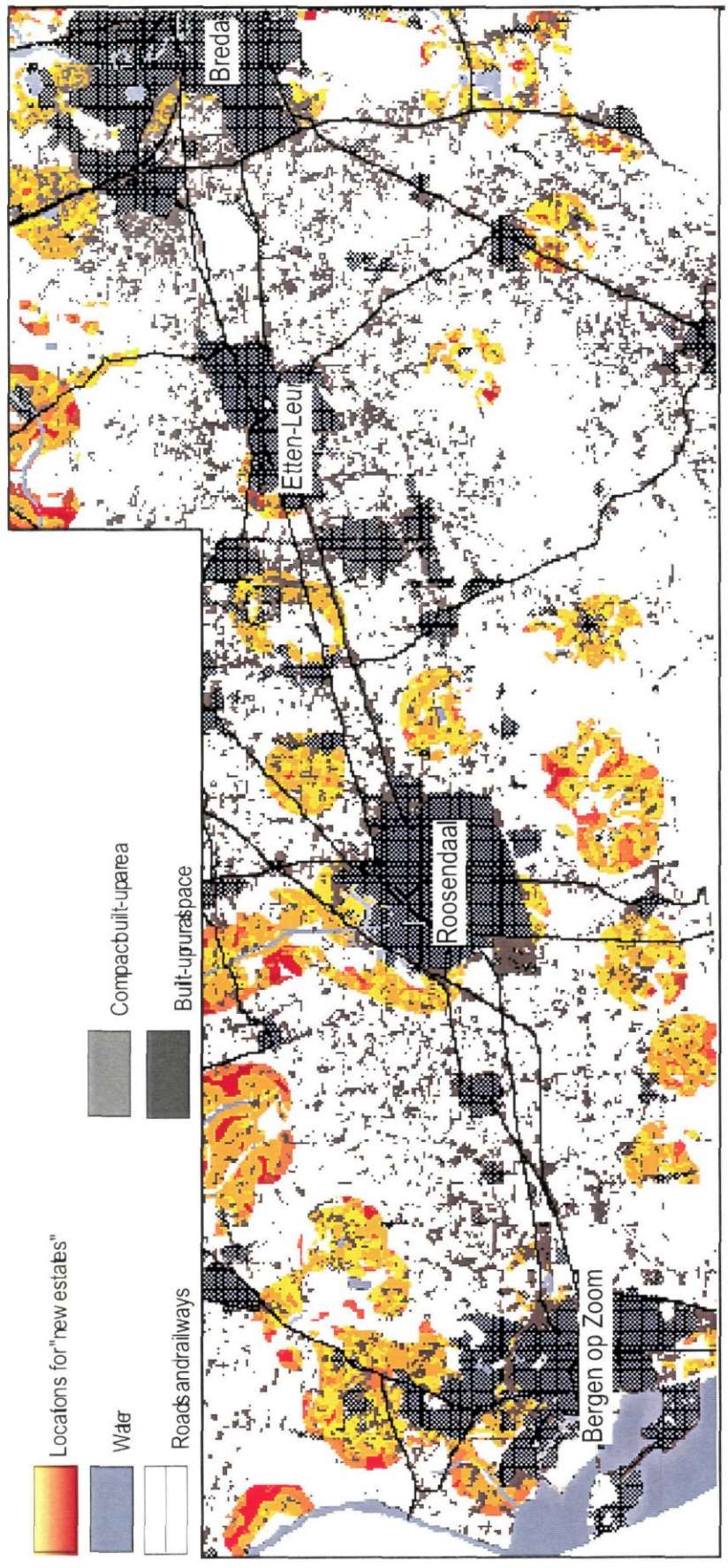
Emphasis here is on agricultural usage.
Sub-criteria: Only arable land and grassy areas are to be redesignated, because agriculture on arable land in particular will have to be discontinued (see WRR report 'Ground for choice', 1992).

Distance from the built-up area

The idea is to link the new housing area to existing urban infrastructure in order to minimise new investments.
Sub-criteria: New housing areas should not be farther than 500 metres from existing larger or smaller housing complexes (within a city as well as in rural area) or from roads.

Digital maps contained all the data required for the GIS analyses;

Figure 10. West Brabant with the network of locations which are suitable for rising of 'new estates'



these data have subsequently been processed in the MAP II program by using the operation of 'recode' (to retrieve specific sets of objects from a thematic map), of 'respace' (to change the cell resolution of a map), of 'spread' (to calculate distances from specific points along outlined paths), and of 'slice' (to reduce the number of zones on a map to a manageable level). This way output maps (Figures A1-A6 Annex A) were created, which were used for a series of intersections (Figures A7-A17 Annex A). Intersections were found by using the operation 'cross'.

The final map with all the intersections (Figure 10) shows all the places in the West Brabant area which satisfy the criteria determined, they amount to 6 611 hectares or 11.62% of the surface surveyed.

The spread of locations largely corresponds with the network of former estates in West Brabant. The criteria selected for this system unintentionally linked past and present aims of creating a better place to live in. Figure 10 is neither a regional plan nor a scenario for urbanisation. It only represents the potential of these sites, which, of course, may be used for different purposes; however, it is useful for planners to know that these are the best sites to integrate natural and residential uses.

In this particular case the implementation of GIS showed great accuracy, which was checked by comparing the GIS maps with the topographical maps, by using aerial photographs, and, finally, by visiting the area. One problem in the process was that the criteria of surface water did not work properly as the input map had a resolution of 25 metres and smaller areas of water such as brooks and creeks were not recognised. This could have been avoided by digitising the map of surface water.

3.2 Other Analyses

In addition to the GIS analyses, four traditional analyses of the area were made (Table 6). The author's opinion is that only GIS analyses ware not sufficient for understanding of the real situation. Other analyses were also necessary to check the accuracy of the computer system and because the data obtained by the system did not suffice to make successful designs for example locations. They finally led to a further reduction of the area which satisfied GIS criteria and resulted in 12 most suitable locations for 'new estates' (see Figure 13).

3.2.1 Landscape analyses

The image of the West Brabant landscape is the result of its division in areas of sand and clay with a transitional zone in between (described in Chapter 3: Study Area).

More detailed analyses on a 1:50 000 scale (see Figure 11) have shown that a rural landscape in sandy or clay areas is not homogeneous, but a complex consisting of the following components:

- Higher woody areas on aeolian sand
- Brook valleys
- Open polders
- Landscape formed by peat extraction
- Landscape formed by turf extraction

Landscape analyses	Urban structure
	Industry and recreation on the city border
	Historical city core
	Other historical cores slightly changed since 1900
	(Remains of) castle or house surrounded with a moat
	Rural estate
	Brook valleys
	Wooded higher areas of aeolian sand reaches
	Landscape with farmsteads
	Small-scale agricultural landscape on former heather and wooded areas
	Agricultural landscape formed on former turf exploitation areas
	Agricultural landscape formed on former peat extraction areas
	Open polders (new land)
	Open polders (old land)
Ecological network	Core areas
	Nature development areas
	Wet ecological corridors
	Dry ecological corridors
	Multifunctional woodlands
Ownership	Private 100%
	Private/public
	Public/private
	Public
Analyses of city fringes	Sharp border
	Diffuse fringe
	Green wings
	Leap-froging
	Annexations

Table 6. Other - non GIS analyses.

- Small-scale agricultural landscape
- Landscape with farmsteads
- Country estates
- Remains of castles with a moat

Here we can see that nature's forces have given the area its main shape, although man has also had great influence. Large spatial patterns such as stretches of aeolian sand and a network of rivers, brooks and creeks are the most important natural elements in the landscape, whereas polders, dykes and the shape of the coastal zone predominate as man-made elements. Taking a closer look will reveal much more of man's influence. The exploitation of natural resources for the purpose of forestry, agriculture, the extraction of peat, the regulation of water systems, etcetera clearly has effects on the landscape, causing a continuous change in its characteristics. However, a number of these large natural patterns remain as they are and therefore they should certainly be considered and incorporated in designs.

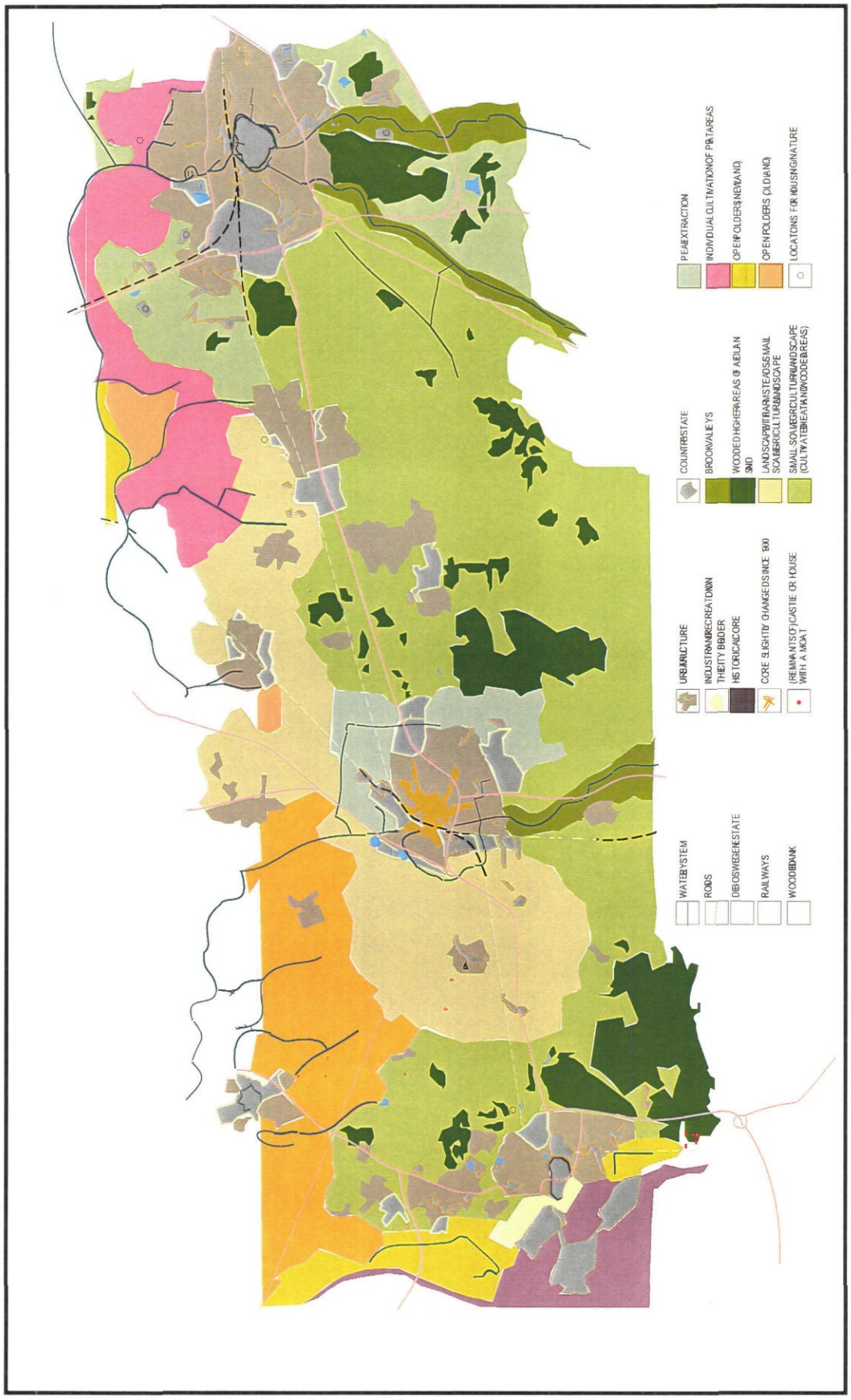


Figure 11. Landscape analysis. (source: topographical map; soil map; Renes, 1985)

3.2.2 Ecological Infrastructure

The ecological network of West Brabant is made up of core areas, areas of nature development, ecological corridors and multifunctional woodland. For further details see 'Ecologische bouwstenen voor de groene hoofdstructuur', province of Noord Brabant, 1993.

It is beyond any doubt that the 'new estates' and the ecological infrastructure should be connected, because they may serve to develop nature areas as well as ecological corridors. For this reason digital maps of the core areas as well as 1:50 000 paper maps of the ecological network were studied and plans for development of ecological infrastructure were incorporated in the designs (for more information see chapter on designs).

3.2.3 Ownership

A number of existing housing locations in nature areas, mainly in West Brabant, were studied for the purpose of finding out various possibilities of ownership.

These locations, some of which were also visited, were:

- The old estate 'Blauwe Kamer' - Breda, now converted into a boarding school for handicapped children. Next to it are two old farmhouses owned by Brabants Landschap, they are privately rented. This part of the estate is open to the public.
- The old estate 'Mattemburg' - Bergen op Zoom is owned by Brabants Landschap, which is responsible for the maintenance of its park and the facade of the building; it is privately rented and its occupiers are responsible for the upkeep of its interior. This estate is closed to the public.
- The old estate 'Dassenberg' - Steenbergen, a private house and park, closed to the public.
- The old estates 'Buitenlust' and 'Klein Loo' - Bergen op Zoom, converted into a psychiatric clinic, closed to the public.
- The new housing are a Haagsche Beemden - Breda, having two old estate 'Burgst' and 'IJzeren Hek' incorporated in the design, which are open to the public; they are privately-owned.
- Flats for elderly people - Wassenaar. Privately-owned dwellings, the grounds are open to the public.
- A former farm - Heteren, converted into houses accommodating five families of which two are owner-occupiers, three families rent their homes. The surrounding grounds are part private, part public.

Of all the places visited only the last two corresponded with the idea of 'new estate' as seen from the perspective of this research.

3.2.4 Analyses of city fringes

Since their origin in the 17th and 18th centuries estates have been located in the outskirts of cities or neighbouring areas with high natural and landscape qualities. During the process of urbanisation some of them were made

accessible to the public, others remained private and closed to the public, some were divided into smaller parcels of land and others transformed into suburban zones, natural monuments, amusement parks, hospitals or government institutions. But despite time, changes in society and urban sprawl the estates remained one of the most stable elements within city fringes.

The typology of city fringes has been based on the analysis of the main morphological characteristics, activities within the fringe and their spatial consequences. It was explored because the type of city fringe may have an effect on the type of housing designed for a particular location in a later stage. It is a visualised translation from a study of the 'Natuurbeschermingsraad': 'Op de grens van stad en land' (Table 7).

This table shows that the types of city fringe may be divided into either *sharp* or *diffuse*. This rough division has many variations which, in practice, show different spatial images of an area.

According to the 'Natuurbeschermingsraad' (1993) *sharp* borders are chiefly found in peat or clay areas, where the expansion of a city requires additional treatment, such as levelling up an area with sand, water regulation or particular methods of building. These borders indicate where man's building activities have ended, which is why they are sharp. Roads or waterways quite often emphasise these borders, and consequently there is no relationship between city and countryside. These tangential linear patterns resulted in a number of undefined spaces in between, which were later used for various purposes, such as a mixture of housing, industry, recreation or agriculture.

Another type of sharp fringe appears as a consequence of roads and waterways which radiate from a city centre and divide it into compartments. Arteries such as these link up with the countryside, along which industries, companies and former estates can be found nowadays.

A *diffuse* border is mostly found in sandy areas, where building can take place without any problems, which, combined with a refined network of roads results in a diffuse border. A diffuse city fringe gives a city an amoebic shape, mainly characterised by a transitional zone which is in fact a mixture of urban and rural functions, for example housing and agriculture.

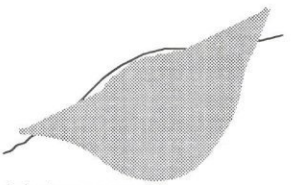
There are various ways to fill in the transitional zones:

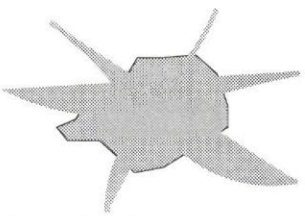
- the green wings of the countryside with its forests and river valleys can penetrate deeply into the city, improving its ecological quality
- 'leap-frogging' is another possibility: a built-up area may end at a park, a forest or a lake, and then continue, which will result in a varied environment.
- when a city develops from its old centre to its newly built-up periphery it will sometimes extend to parts of old settlements, thus forming annexations and resulting in a diversity of architectural styles.

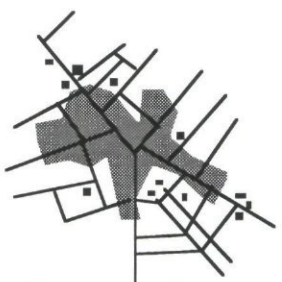
The combination of GIS analyses and 'other analyses' gave the overall insight in the spatial properties of the locations. These properties were then crosschecked against the characteristics of new estates (see page 4, The 'New estates') which gave the guidelines for the design.

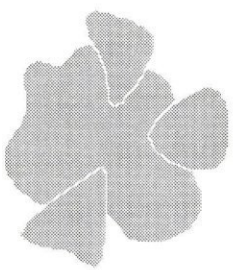
After visiting these 12 locations, three were selected for the example designs (see Section 3.4).

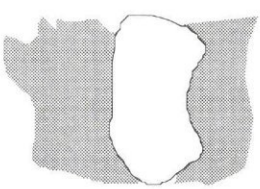

SHARP BORDER

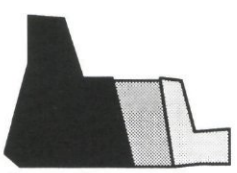

Inbetween space


Compartments


DIFFUSE FRINGE


Green wings


Leap-frogging


Annexations

TYPE OF BORDER	TYPE OF SETTLEMENT	MAIN MORPHOLOGICAL CHARACTERISTICS	SPATIAL CONSEQUENCE	ACTIVITIES
SHARP	Closed settlement without relationship to surrounding	Tangential road and water ways	In between spaces	Mixture of activities (housing, industry, recreation, agriculture)
	Closed settlement with relationship to surrounding	Radial road and water ways	Compartments	Specific activities along the roads (industry, companies, estates)
DIFFUSE	Open settlements	Ameboic shape	Transitional zone a. Green wings (ecological progress) b. Leapfrogging (variation in environment) c. Annexations (diversity in building styles)	Complexity in land use (mixture of urban and rural functions)

Table 7. Typology of city fringes.

3.3 Typologies for design purposes

As the word typology says - it is "the study of types or symbols. Type means a person, animal or thing that is representative of or has the distinctive characteristics of, a class or a group; typical individu or instance. So a type is a perfect example, model, pattern or archetype".

In order to have the process of creating new estates become more functional and operative, two typologies were made to serve as 'catalogues' from which, once the properties of the location are known a corresponding natural plant community and a type of home can be chosen.

3.3.1 Typology of Plant Communities

In order to make sure that the 'new estate' is integrated into the natural environment and is in line with policies on ecological infrastructure, the nature development in a new estate has to be focused on the restoration of original local plant communities.

The typology is based on Van Leeuwen's (1959) classification of natural vegetation in the Netherlands, representing the development of indigenous associations which used to grow here before agriculture was introduced. It is chiefly based on conditions related to soil and ground water, and lists the main woody and herbaceous plants.

From Van Leeuwen's classification only plant communities which correspond to the characteristics defined by the GIS criteria are shown in Table 8 (for a more detailed catalogue of most alliances see Annex B).

Natural plant community will be restored on the basic principles of 'creative restoration' (Wright, 1982) which adds continuity to the ornamental value and function of green spaces, taking into account modern usage as well as maintenance and management factors of the new estate. In this way the aesthetic values of natural plant communities which, for example do not have a great variety, can be improved by adding new varieties or forms of the same species such as pendula, dissecta, aurea, purpurea etcetera.

CLASS	ORDER	ALLIANCE	SUB-ALLIANCE	ASSOCIATION
Querceto-Fagetea	Populetalia	1. Salicion		2
		Alno-Ulmion	*2. Alnion incanae*	5
			3. Ulmion	4
	Prunetalia	*4. Rubion*	*Sambuco-Rubion*	1
			Carpino-Rubion	1
		Berberidion	5. Sambuco-Berberidion	4
			6. Carpino-Berberidion	1
	Fagetalia	*7. Carpinion*	*Querceto-Carpinetum*	1
Querceto-Picetea	Quercetalia roboris	*Quercion roboris*	*8. Violeto-Quercion*	3
			9. Vaccinio-Quercion	1
		10.Betulion pubescentis	Betuletum pubescentis	1
Alnetea glutinosae	Alnetalia glutinosae	Alnion glutinosae	11. Sphagno-Alnion	3
			12. Irido-Alnion	2

Table 8. System of woody plant communities (source: Leeuwen and Doing, 1959).

3.3.2 Typology of Housing

As already described in Chapter one the new estates will be different from the old ones, which had one main prestigious building in that they will have a variety of housing types which all income groups can afford.

The typology of housing is based on four principles: variation, density, concentration and ownership.

The specific purpose of this research required implementation of criteria related to energy saving, environmentally friendly housing with possibilities for do-it-yourself activities, and low costs. On this basis the catalogue of buildings was compiled, which at a later stage was used for the designs. The catalogue shows several sets of existing buildings, which met these criteria, in different densities and concentrations.

The different densities were based on inhabitants per hectare. It was recommended to stay below 200 inhabitants/ha.

However, other categories derived from this number are:

0-5; 5-20; 20-40; 40-80; and 80-160 inhabitants/ha

The principle of various concentrations is based on homes spread across an allotment or concentrated in one or a few buildings (see Figure 12). Different categories of ownership have been defined by means of several forms of private-public partnership, for instance:

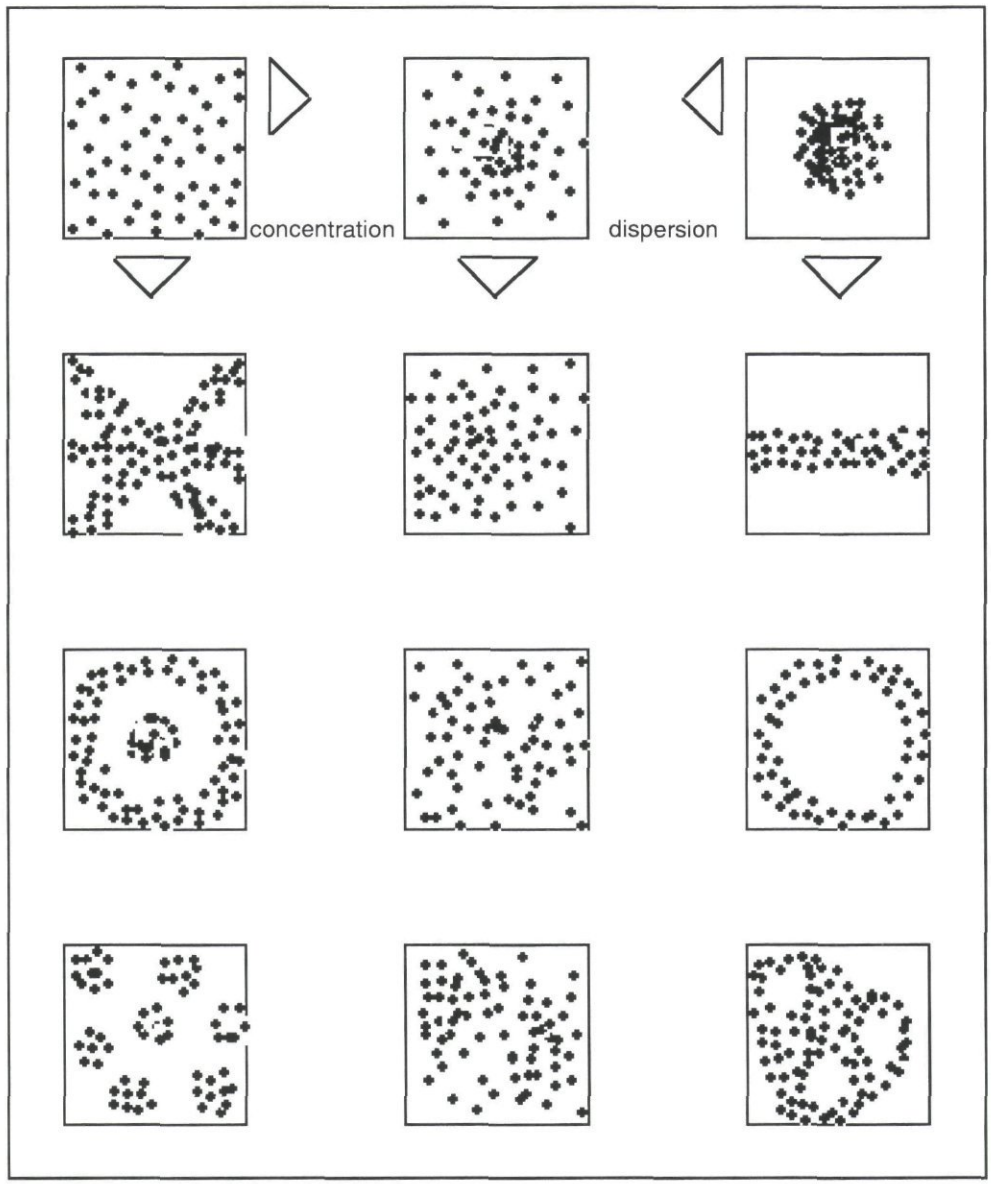


Figure 12. Different concentrations and dispersions of houses within one allotment (de Jong, 1992).

- privately-owned houses with private allotments
- privately-owned houses with a commonly owned allotment which is not spatially determined
- private-owned houses with public ownership of the allotment
- rental public housing with public grounds, etcetera.

Housing should not include more than 4 storeys and should range from cheap to expensive. The grounds are to be open to the public, but within limits and set conditions (for the catalogue see Appendix 3).

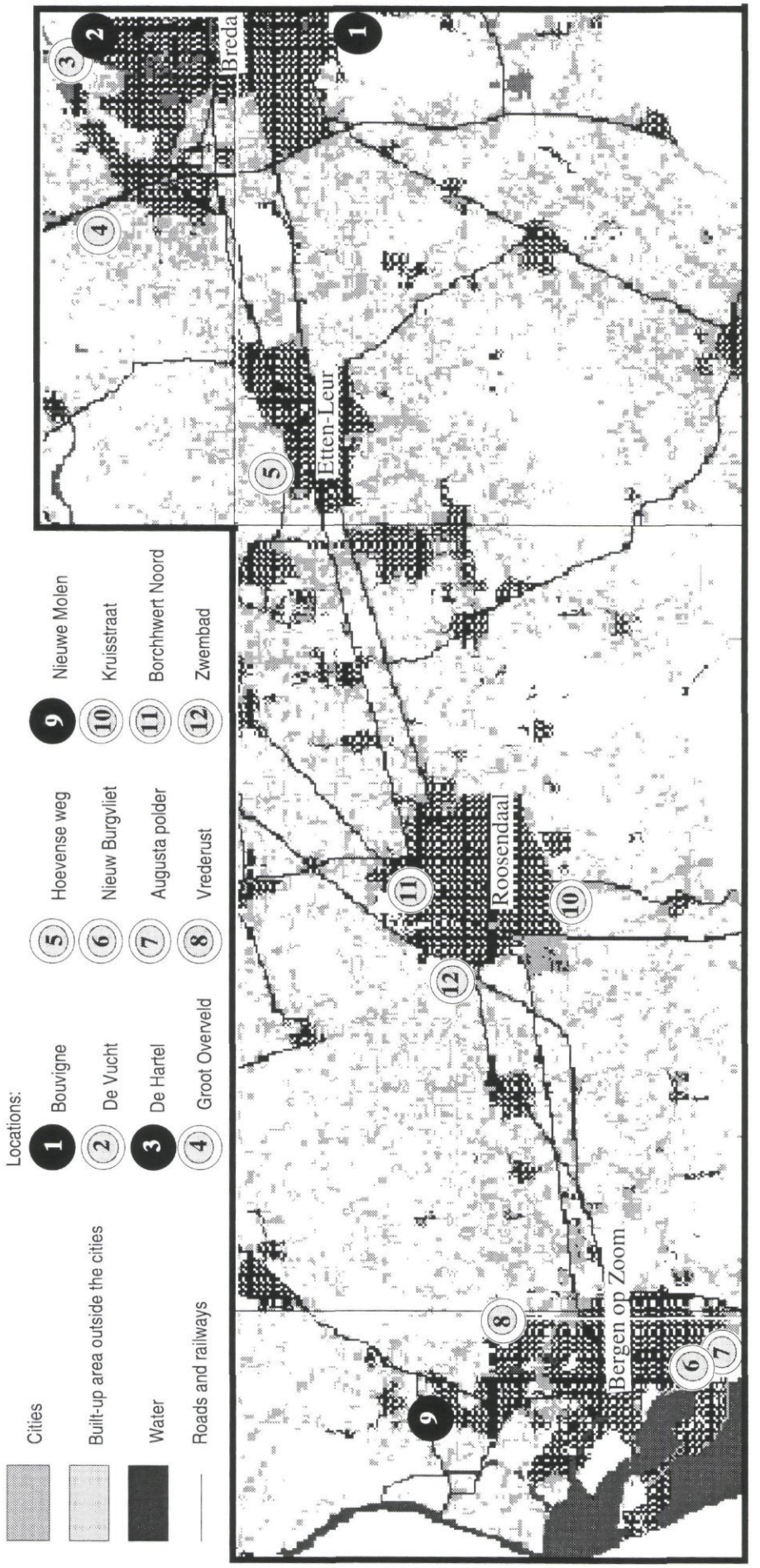


Figure 13. Distribution of example locations within the study area

Table 9. Process of selection of six locations for example designs.

LOCATION	LANDSCAPE TYPE	HIGHT (m asl)	HISTORICAL SITES	CITY FRINGE	ECOLOGIC INFR.	TYPE OF SOIL	SELECTION REASONS
BREDA							
1.Bouvigne	transition forest/brook valley	5	castle	sharp/radial roads/compart.	yes	sand	**yes, speciffic, disputable, provoking**
2.De Vucht	forest and turf exploitation	0.7	fort	sharp/radial roads/compart.	core area	sand	**yes, quiet, idyllic, rural, open**
3.De Hartel	forest and turf exploitation	0.1	fort	sharp/radial roads/compart.	core area	sand	**yes, quiet, idyllic, rural, open**
4.Groot Overveld	small-scale, agricultural	2	estate	diffuse/transition	no	sand	**no, existing glasshouses**
ETTEN LEUR							
5.Hoevense weg	small-scale, agricultural	3.7	-	diffuse/transition	no	sand	**yes, small-scale, rural**
BERGEN OP ZOOM							
6.Nieuw Burgvliet	open polder/new land	1.4	-	sharp/tang. roads/ibtwe. speces	no		**no, parts of newly built housing**
7.Augusta Polder	open polder/new land	1.6	estate	sharp/tang. roads/ibtwe. speces	core area	clay	**yes, only one on clay, two nat. areas**
8.Vrederust	aforested sandy reaches	4.2	estate	sharp/tang. roads/ibtwe. speces	yes	sand	**no, too close to road and clinic**
9.Nieuwe Molen	transition Brabantse wall/open polder	9.2-0.6	estate	open/diffuse/leapfrogging	core area	sand	**yes, interesting surroundings, rural**
ROOSENDAAL							
10.Kruisstraat	brook valley	6.6	-	green wing	no	sand	**no, building started**
11.Borchwert Noord	turf exploitation	1.8	-	sharp/tang. roads/ibtwe. speces	no	sand	**no, industrial zone**
12.Zwembad	small-scale, agricultural	1.8	-	leapfrogging	no	sand	**no, too dense infrastructure**

3.4 Designs of Example Locations

As already mentioned, the aim was to make three example designs for three different locations to give an idea of what is meant in this research by 'new estate'. Computer-aided photo-montage is used to show what it would look like in a real situation. Of the 6000 hectares of available sites rendered by GIS intersections twelve locations were visited (see Figure 13) which also met the criteria of the non-GIS analyses of landscape, ecology and different types of city fringe. Six of them were found not to be suitable for 'new estates' (for the reasons see Table 9). Of the other six, three were randomly selected for example designs.

Each of the three example designs was made by using data from previous GIS and 'other' analyses which together defined the site characteristics of the location. These were then cross-checked against the characteristics given in the definition of 'new estates' (Chapter 1). The typology of plant communities was used to incorporate into the design the vegetation which corresponded best to the site characteristics, e.g. type of soil, level of ground water, type of neighbouring natural areas and the selected buildings. The typology of housing was used for the homes, and special care was taken with regard to type of the landscape, type of city fringe, size and orientation of the site, and aesthetic values of the design (Figure 14).

In the designs a number of patterns (Alexander, 1977) were followed, such as: The Countryside, Sacred sites, Access to water, Green streets, Network of paths and roads, Accessible green, Common land, Cluster of houses, Cascade of roofs, Roof gardens, etcetera.

The basic 1:5 000 drawing depicts the spatial arrangement of the buildings in the parcel of land, and their main connection with the surrounding network of roads.

The computer-aided photomontage illustrates what the site may look like after the buildings have been completed and vegetation has matured.

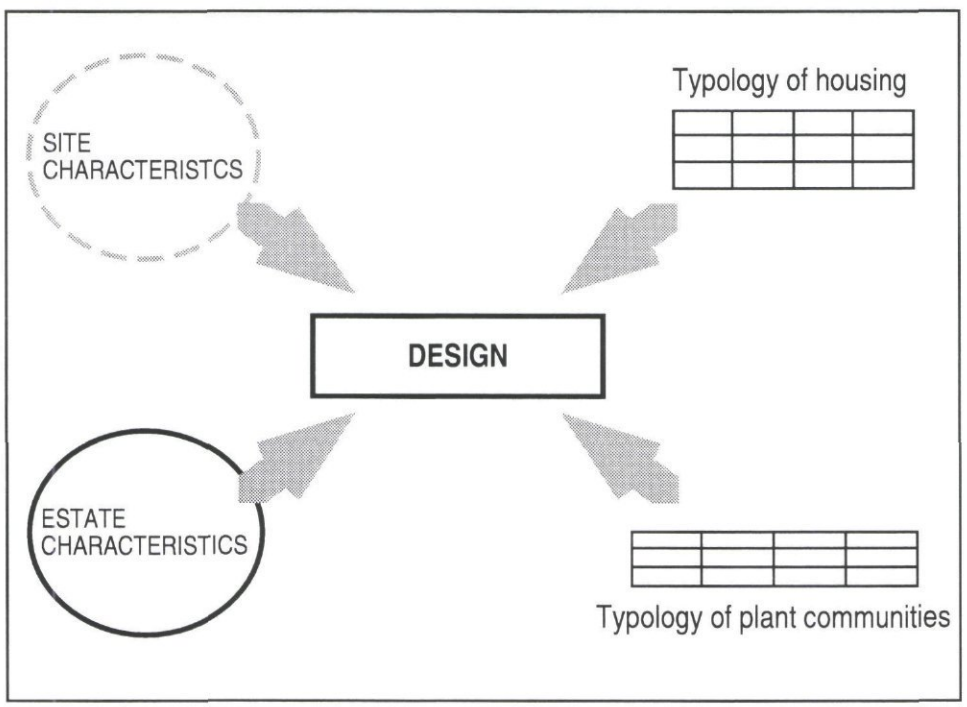


Figure 14. Process of design making for each location.

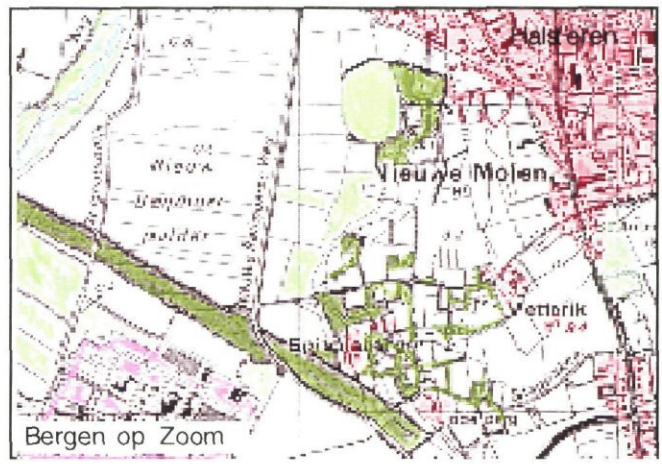
3.4.1 Location 'Nieuwe Molen'

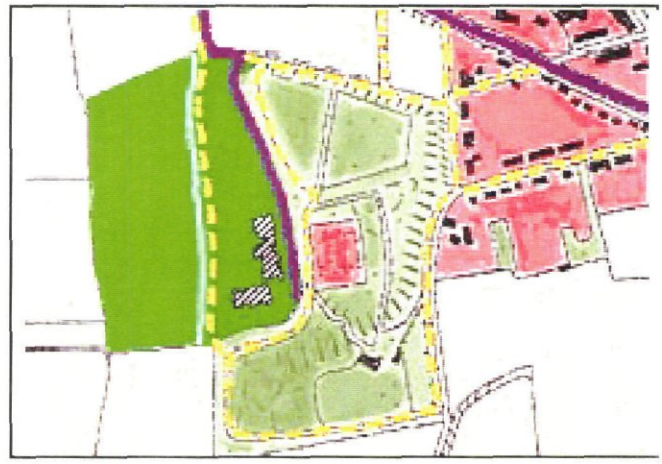
Geographically, the location of 'Nieuwe Molen' is situated south of Halsteren on the diffuse city fringe of Bergen op Zoom, on the slope of the Brabant embankment of sandy soil; it has a view of the large open polder landscape in the clay area (Figure 15). There is an estate in a park right next to the pasture designated as the location. Nearer to the house, which is situated on the highest part (10 metres above sea-level), the park is densely wooded with a mixture of fully matured ornamental conifers and deciduous trees. A woodland of deciduous saplings and undergrowth has been added recently. The location belongs to the nature core area which is important for the development of vegetation.

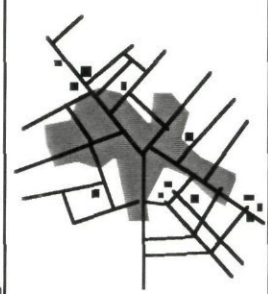
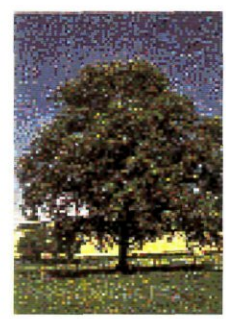
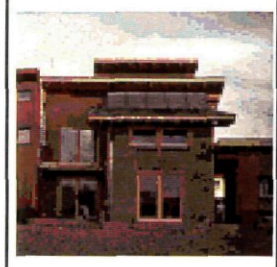
Diffuse spread of houses in the surrounding area suggests spread housing type; the shape of the parcel of land is suitable for terraced houses, of which the Blumhof residential complex (Cologne, Germany) is a good example. Its buildings have been constructed of 80% clay bricks and have wood facades in bright colours. They have solar panels for hot water and facilities for collecting rain water. They have grass roofs which improve isolation and indoor climate, the roofs also contribute significantly to improving integration with the natural environment. The houses have been built in part by the inhabitants themselves on a do-it-yourself basis.

In accordance with the typology of plant communities Ulmion woodland in the lower parts of the area would be very appropriate for the 'Nieuwe Molen' estate. The space in front of the houses will be open as high vegetation could drop a shade on solar collectors and therefore this space can suit as courtyard with pasture and meadow. The paved road will be extended to the houses, and new footpaths will be added to the existing ones.

Figure 15. Example location Nieuwe Molen





	LOCATION	LEGENDA
EXISTING	- Type of soil: Zn21 - Vlakvaaggronden, leemarm en zwak lemig fijn zand - Ground water level: VII - Altitude: Slope from 10 to 0.6 m etres above sea-level - Type of landscape: a transitional area between a smal-scale agricultural landscape and an open polder landscape - Neighbouring forest and nature areas: Estate with a park - Size of the site: 4.1ha - Size of the allotment: 4.1 ha - Number of allotments: 1	Pasture Existing forest Industry Built-up area Ecological network Natural grassland Ulmion forest Local, paved roads Footpaths Water New housing complex
PLAN	- Surface of built-up zone: 900m2 - Percentage of built-up area: 2.19 - Density in number of dwellings/ha: 3.41 - Density in number of inhabitans/ha: 13.66 - Connection to Ecological network - Gross floor surface: 2520 m2 - Number of dwellings: 14 - Average gross surface of dwelling: 180 m2 - Average number of inhabitans/dwelling: 4 - Cost of dwellings: 1800 DM/m2 - Ownership: 14 private dwellings 1 common allotment	CITY FRINGE  DIFFUSE NATURE  ULMION HOUSE  BLUMHOF

3.4.2 Location 'Bouvigne'

South of Breda, on the sharp city border where Mastbosch forest begins, is a corn field which used to have poor sandy soil, but because it has been cultivated for over 100 years now has rich sandy soil (Figure 16). The road leading to the south runs parallel with the river Mark lying east. This low-lying valley is used for agriculture. Mastbosch (750 ha) was laid out in 1514 as the first forestation project on desolated ground. It was then that white pine was first introduced in the Netherlands, a species which was to become of major importance in Dutch forestation projects. Today, Mastbosch is a forest of about 160 years old with a mixture of deciduous trees, white pine and douglasia. Its dark colour in those parts with a dense growth of douglasia contrasts sharply with the light and open area of the river valley. Along the road radiating from the city of Breda various buildings can be found, for instance government institutions, recreational facilities, old estates converted into boarding schools, a hospital and office buildings. Near the city are sparsely spread residential areas with expensive villas surrounded by green areas with occasionally very old and ornamentally valuable species.

At first glance the arable land opposite Bouvigne Castle on the edge of Mastbosch is a perfect parcel of land which will not require any intervention. For this reason a type of concentrated housing has been chosen, of which the 'Zwan' building in Voorburg served as an example. In order to avoid closing off this space and thus losing the view of Bouvigne Castle, low vegetation is suggested. A natural meadow with a variety of flowering herbs and white-coloured buildings will enhance the contrasting dark background of the douglasia forest.

The network of footpaths which is to cross the road at certain points will help walkers understand the dynamics of change in the landscape as they walk from the forest, past the meadow to the river bank or vice versa.

The type of ownership could be 100% publicly-owned housing with flats for rent. The conservation of the meadow is to be supervised by an organisation with adequate knowledge of the preservation and development of nature (Brabants Landschap, Natuurmonumenten, Staatsbosbeheer, or a similar smaller organisation). Residents will have to comply with the rules for nature preservation areas.

Figure 16. Example location Bouvigne

LOCATION

EXISTING

- Type of soil: cHn21 - Laarpodzolgronden, leermarm en zwak leming fijn zand
- Ground water level: VI
- Altitude: 3.5 metres above sea-level
- Type of landscape: a transitional area between forested stretches of aeolian sand and the valley of the river Mark
- Neighbouring forest and nature areas:: Mastbosch as the core area and the river valley as a wet ecological corridor
- Historical site: Castle Bouvigne
- Size of the site: 12.4 ha
- Size of the allotment: 1/6.4, 1/3.9, 1/2.1 ha
- Number of allotments: 3

LEGEND

- Grassland
- Existing forest
- Natural meadow
- Old estate
- Built-up area
- Corn field
- New housing
- Paved roads
- Bycicle paths
- Footpaths
- River Mark
- Nature development area
- Ecological corridor

PLAN

- Surface of built-up zone: 2850m2
- Percentage of built-up area: 2.3
- Density in number of dwellings/ha: 13.8
- Density in number of inhabitans/ha: 42
- Connection to EHS
- Gross floor surface: 27000 m2
- Number of dwellings: 171
- Average gross surface of dwelling: 162m2
- Average number of inhabitans/dwelling: 3
- Cost of dwellings: 136000 fl/woning
- Ownership: 171 rental dwellings allotment statsbosbeheer

CITY FRINGE

SHARP BORDER

NATURE

NATURAL MEADOW

HOUSE

ZWAN VOORBURG

3.4.3 Location 'De Hartel'

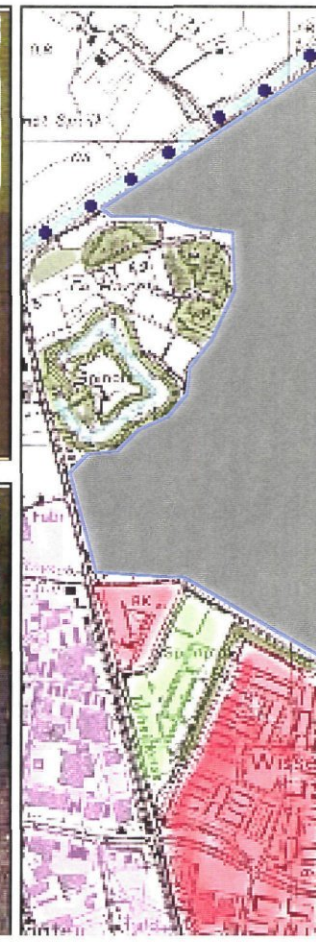
Compared with the two locations mentioned before, location 'De Hartel' is more complex (Figure 17). It has two interconnecting parts with clusters of houses, sparsely spread, because they are to be situated in a completely rural area. The sharp city border of Breda is visible but not connected with the location; however, it forms a striking feature of the built-up structure on the southern horizon. The location is situated in a nature development area for plants and plant associations, and borders on a wet ecological area for amphibians and reptiles.

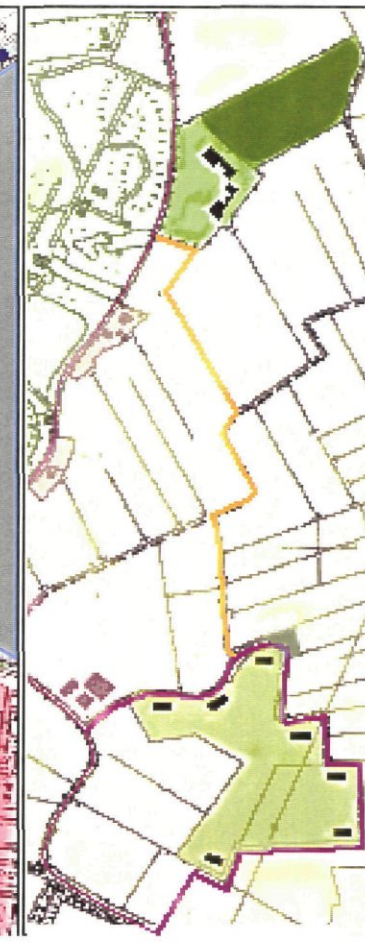
The type of housing could be for single persons or suitable for two families, as in Laher-Wiesen (Hannover, Germany), which is an experimental housing project based on the idea of community living, learn-and-work principles and a healthy home environment; its houses are made of wood and have grass roofs.

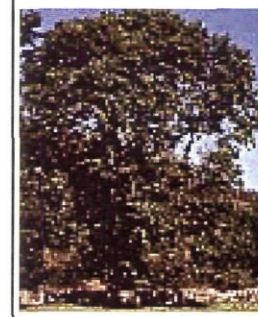
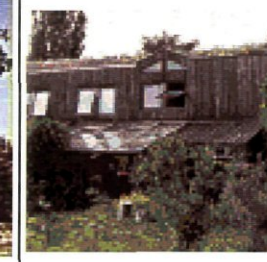
The vegetation in the north part of 'De Hartel' could be a combination of Alnion (in more humid soil) and Ulmion, with natural grass in the parcel of land and on the roofs. The area in the south will be divided into eight parcel of lands with different vegetation. In order to bring about more biodiversity certain treatments may be necessary, for instance removing the top layer of the soil or adding calcium. Houses will be privately-owned, and the parcel of land either privately or commonly owned.

The network of existing paved roads will be extended to the dwellings. The two parts of the complex will communicate with one another by means of footpaths laid out as loops around them.

Figure 17. Example location De Hartel





	LOCATION	LEGEND
EXISTING	- Type of soil: Hn21 - Laarpodzolgronden, leemarm en zwak lemig fijn zand - Ground water level: VII - Altitude: 0.3 m etres above sea-level - Type of landscape: Small-scale agricultural landscape, which has been developed thr-ough the extraction of peat in earlier times - Neighbouring natural area: Remnants of the fortress walls, marsh vegetation, woodland - Historical site: Spinolaschans, a Spanish fortres built in1620 - Size of the site: 3.4 + 4.5 ha - Size of the allotments: 1x1, 1x3.4, 7x0.5 ha - Number of allotments: 9	Grassland Alnion forest Natural grassland Ulmion forest Mixed vegetation Corn field Industry Built-up area Paved roads Footpaths River Mark Nature development area Ecological corridor New housing
PLAN	- Surface of built-up zone: 2500m2 - Percentage of built-up area: 3.11 - Density in number of dwellings/ha: 2 - Density in number of inhabitans/ha: 7.82 - Gross floor surface: 5060m2 - Number of dwellings: 15 - Average gross surface of dwelling: 340m2 - Average number of inhabitans/dwelling: 4 - Cost of dwellings: 1800 fl/m2 - Ownership: 8 private dwellings on common allotment + 7 private dwellings on 7 private allotments	CITY FRINGE  SHARP BORDER NATURE  ALNION HOUSE  LAHER-WIESEN

4. EVALUATION OF DESIGNS FOR 'NEW ESTATES'

The purpose of this phase of the research was to have the designs evaluated by expert judgement with regard to their influence on a wider area. Only the location of Bouvigne was evaluated.

Maps of the existing situation and spatial patterns of the landscape were designed and analysed on a 1:25 000 scale, these were the basis for evaluation of the design for the location Bouvigne (Section 3.4.2.).

A list containing 5 groups of possible effects (Table 10) was compiled for this particular purpose; it was based on environmental effects reports and an overview of evaluation methods for spatial plans (OSPA, 1992). The values in the table range from -2 to 2 and indicate the following:

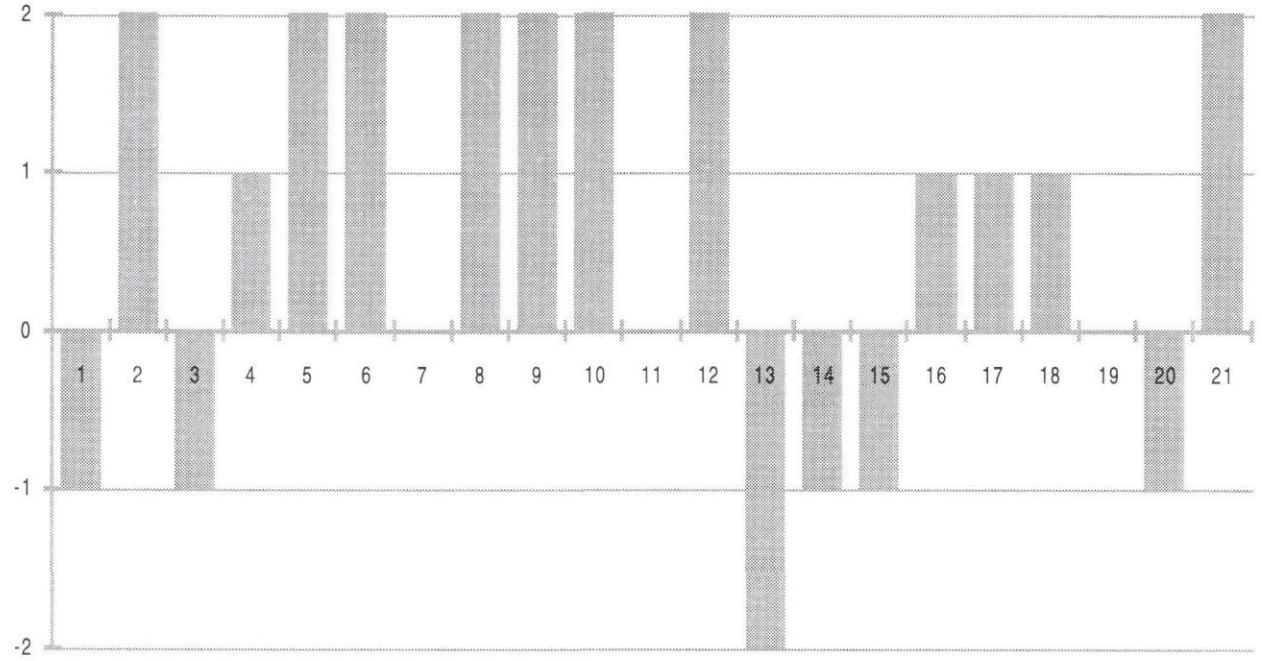
-2 very negative effect
-1 negative effect
0 without influence
1 positive effect
2 very positive effect.

Using the above mentioned analyses and previous knowledge about location and plan, two people, Frieling and Tisma, filled in the list. The results of their judgement are shown in Figure 18.

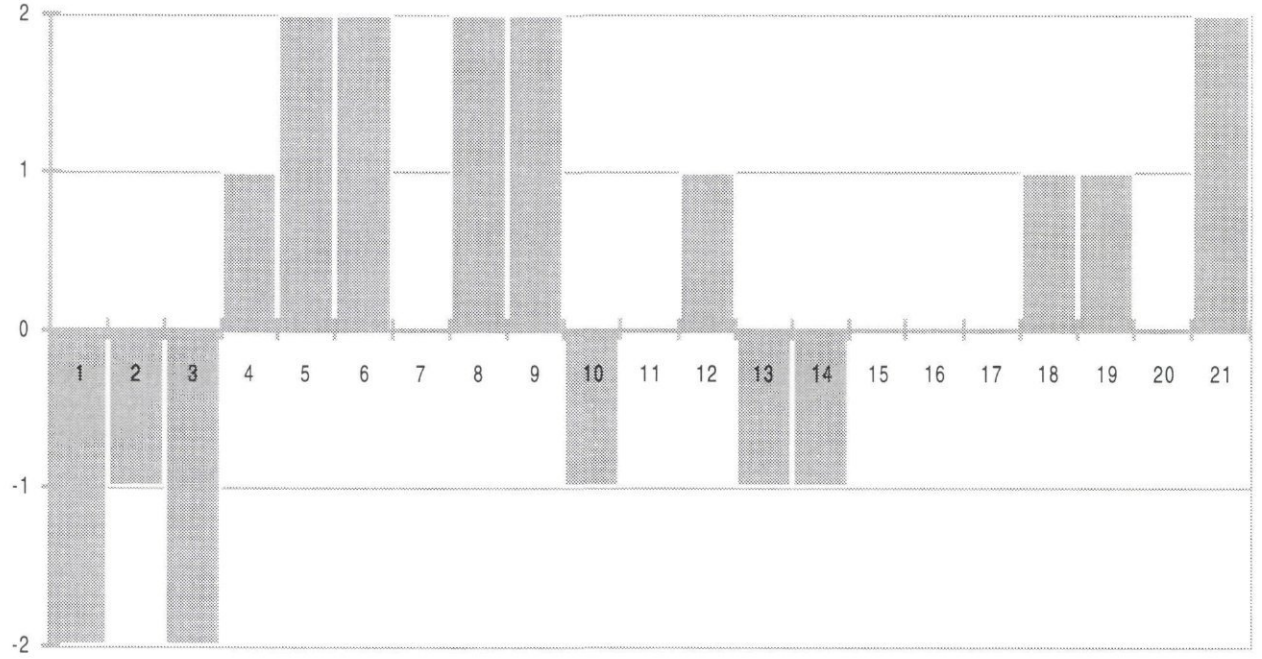
Although the total score of judgements has not been calculated because the arithmetic mean is not the proper way of quantifying this special case due to its orientation towards qualitative characteristics of the plan, it is clear (from Figure 18) that subjectivity plays an important role in judgements (Tisma's is much more positive than that by Frieling). The evaluation method therefore needs to be improved in a follow-up research. At this stage, however, it was meant to give an idea about criteria which should be borne in mind when designs are judged. The checklist shows elements appropriate to this particular type of housing. In this example all the groups of effects have the same value; it does not imply that this should always be the case because different groups may also be given different multiplication factors. For example, if landscape and cultural history are considered more important elements than transport, they may be given factor 2, indicating that all the values given to the four categories (effects on historical patterns, on spatial and visual images, etcetera) are to be multiplied by 2.

Table 10. Check list for evaluation of environmental effects of the design Bouvigne..

	EFFECT ON LANDSCAPE AND CULTURAL HISTORY	Values (-2,-1,0,1, and 2)	
		Sascha	Frieling
1	Influence on historical patterns and elements	-1	-2
2	Influence on spatial and visual image	2	-1
3	Influence on natural landscape patterns	-1	-2
4	Influence on unity of landscape components	1	1
	SOIL AND WATER		
5	Effect on soil quality	2	2
6	Effect on ground water quality	2	2
7	Effect on surface water quality	0	0
	FLORA FAUNA AND ECOLOGY		
8	Effect on vegetation surface	2	2
9	Effect on biotope for flora and vegetation	2	2
10	Effect on biotope for fauna	2	-1
11	Disturbance in ecological structures	0	0
	TRAFFIC		
12	Accessability	2	1
13	Increase in car kilometres	-2	-1
14	Increase in noise along existing roads	-1	-1
15	Growth of congestion	-1	0
	HOUSING AND LIVING ENVIRONMENT		
16	Energy exploitation	1	0
17	Sustainable energy	1	0
18	Wind nuisance	1	1
19	Sunlight	0	1
20	Social security	-1	0
21	Recreation (extensive), perception of green and nature	2	2



EVALUATION OF DESIGN BOUVIGNE - A.TISMA



EVALUATION OF DESIGN BOUVIGNE - D. FRIELING

Figure 18. Evaluation of environmental effects of the design Bouvigne by A. Tisma and D. Frieling.

5 CONCLUSIONS

The conclusions are written in the same order as the steps taken in the methodology.

Choice of location

For the purpose of choosing a location the implementation of GIS has proved to have a big advantage compared with the traditional analysis of maps. Thanks to the fact that the input of data into the GIS system had already been taken care of by SC-DLO and only a few days were needed to convert the data from ARC-INFO to MAP II system, various maps could soon be created, changed, placed one on top of another, combined or crossed, automatically obtaining numerical data about surfaces of the new features. It was easy to produce new maps with a high degree of accuracy. The digital map completely corresponded with a topographical map of the same year and was even more accurate in a few cases, for instance in the classification of field crops.

Map II software is user-friendly, can be easily learned within one week, and it has the most important functions of GIS applications. Some inaccuracies, for instance not recognising narrow linear structures such as brooks and creeks in land-use maps, are the result of applied techniques of remote sensing, which may be avoided by creating extra thematic maps, such as a digitised map of surface water.

The definition of the criteria was not meant to be holistic, since this would make the experiment with GIS too complicated to be carried out in the few months available for this research. The applied criteria in this research were based on natural characteristics, since its specific goal was the re-use of agricultural land, aimed at the improvement of environmental quality, and at keeping investments to a minimum as to modifications in the landscape and new infrastructure.

The focus was neither on anthropocentrism nor on environmentalism, but on sustainable use of nature which means that "human activities (economic development) should remain within the limits set by the carrying capacity of the natural ecosystems that support these activities" (Groot, 1992).

Reduction

GIS is not adequate enough to really understand an actual situation. As a technique it is suitable for preliminary large-scale analyses. It requires the use of additional sources of information, such as different (topographical, historical and tourist) maps, other research projects in the same or related fields, visits to the area and consultations with institutions and people having competence in this field.

Design

Designing was not the main assignment of this research. It has only been used to illustrate the idea of 'new estates'.

They may be introduced as a new category of housing within the city fringe in particular, but also anywhere else in a rural area.

Computer aided photo montage is an enormously powerful tool, because it clearly shows a change in an existing situation when a new element is introduced. It opens the gate for discussion that is based on almost real image of a planned situation and in that way it contributes to a better assessment of the future situation. Computer montage enables different variants in design to be more easily implemented, because it is a quicker method than drawing or making a physical model.

Evaluation

The evaluation aimed at judging the effect of 'new estates' on landscape and nature, as well as on housing and environment, in other words effects on both the natural and human environment.

The checklist needs to be further developed. The system of points used here is very simple and needs refinement.

At most the current evaluation method is adequate enough to understand the main effects or the impact of a design, which should be considered in design or in its evaluation.

Owing to its complexity, this research may be placed 'in the middle of' three categories of human activity: policy, research and design (Figure 19). Transparency is the main characteristic of the design instrument connecting these three spheres. It is aimed at improving the quality of decision-making in the use or re-use of land, and at contributing to an objective evaluation of the environmental effects of designs.

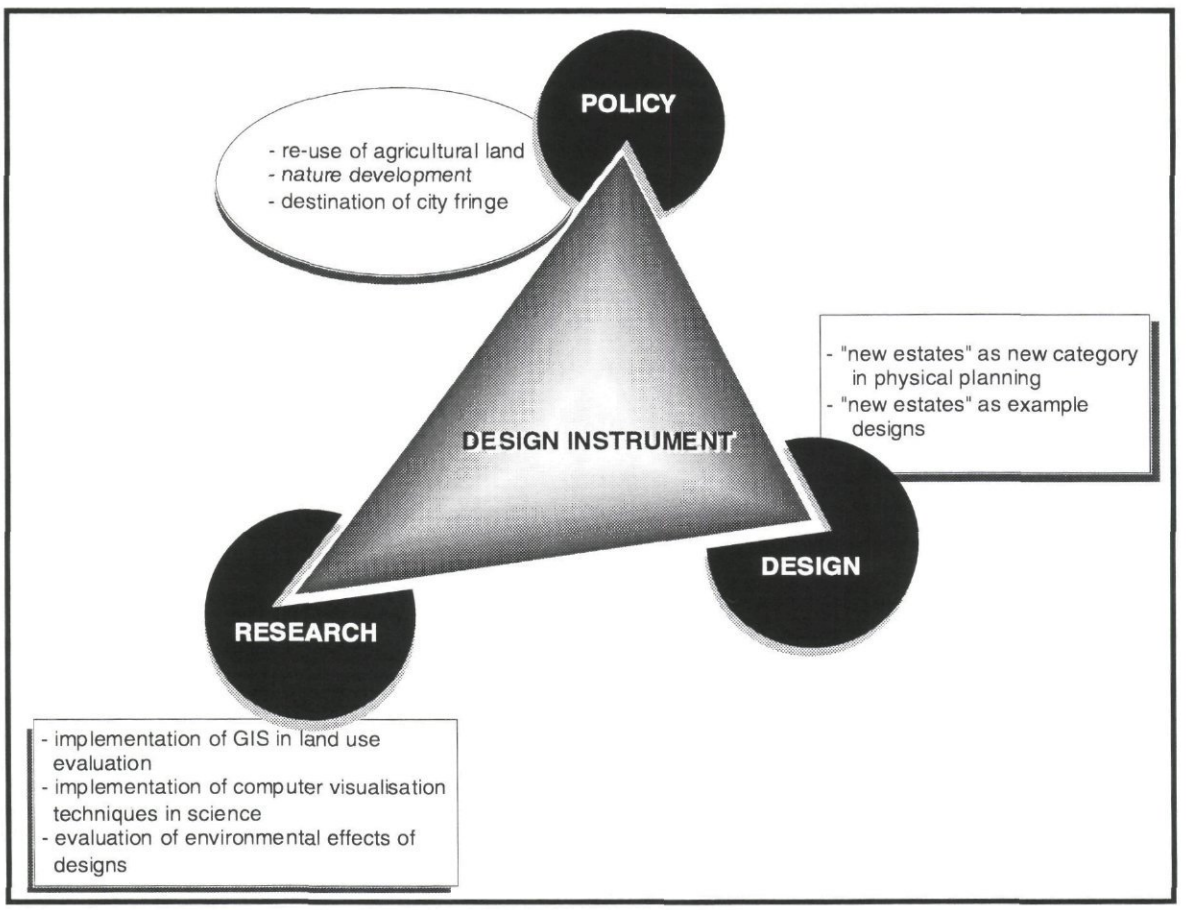


Figure 19. Aspects of the research.

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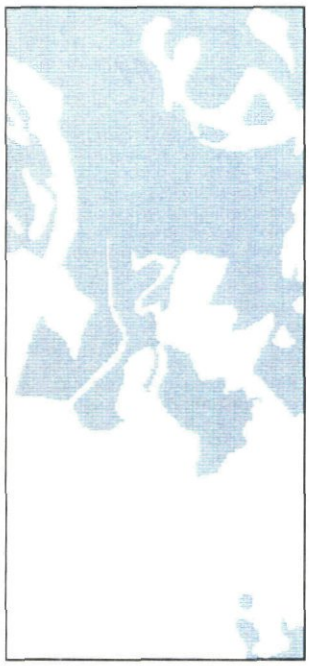
ANNEX A

GIS operations and intersections maps

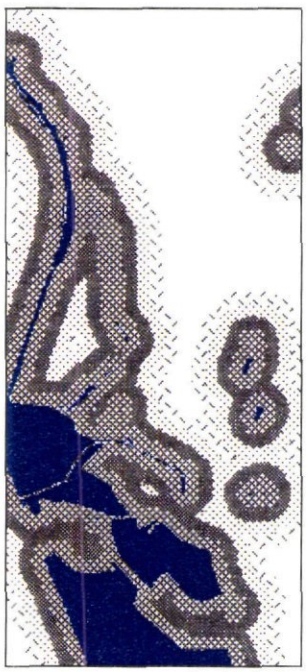


VOID

1

IV = GHG > 40 cm - mv.
V = GHG < 40 cm - mv.
V* = GHG 25-40 cm - mv.
VI = GHG 40-80 cm - mv.
VII = GHG 80-140 cm - mv.

Figure A1. Ground water (GW) recode respace.



VOID
1 water
2 25 - 268m distance from water
3 269 - 512m distance from water
4 513 - 756m distance from water
5 757 - 1000m distance from water

Figure A2. Water/water spread slice recode respace.

Figure A3. Water/water spread slice recode respace.

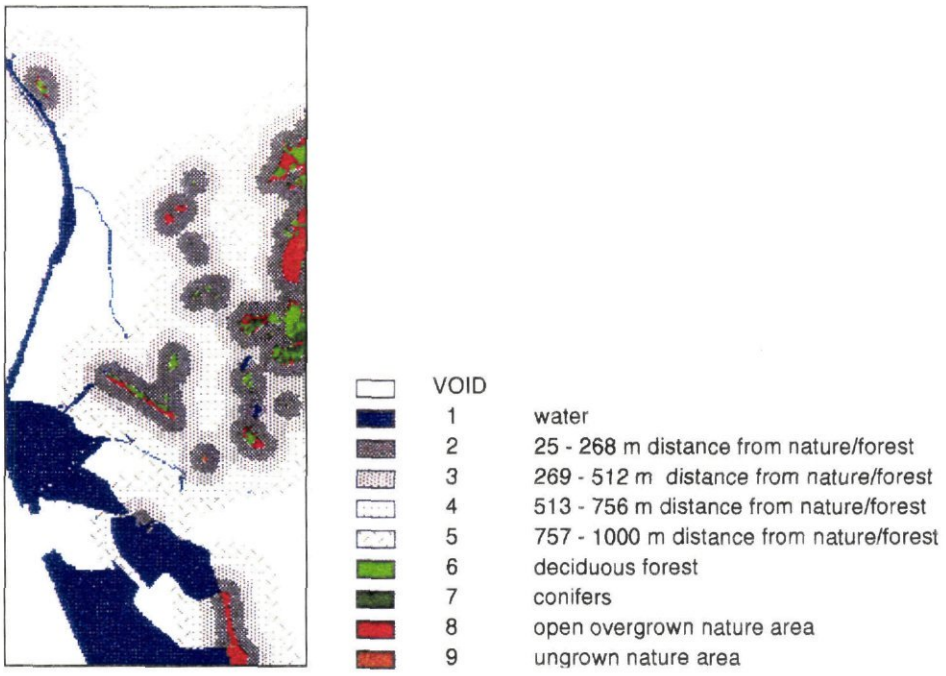
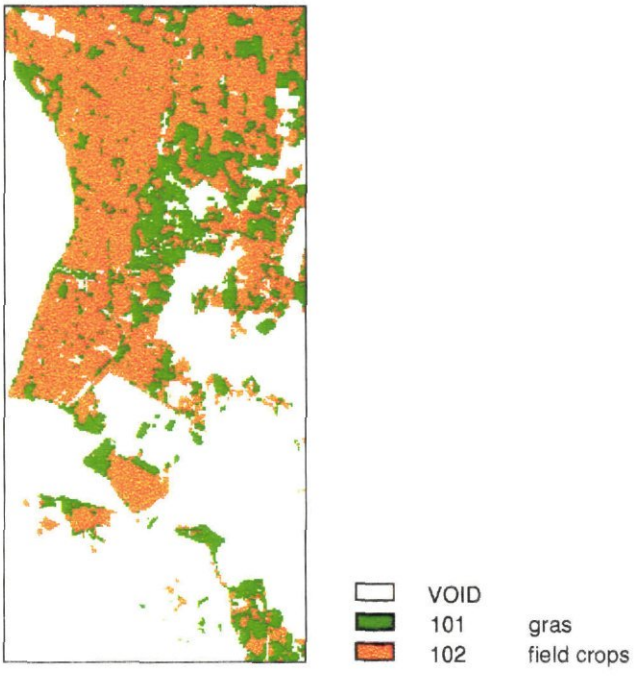


Figure A4. Field corps/grasses (FG) recode respace.



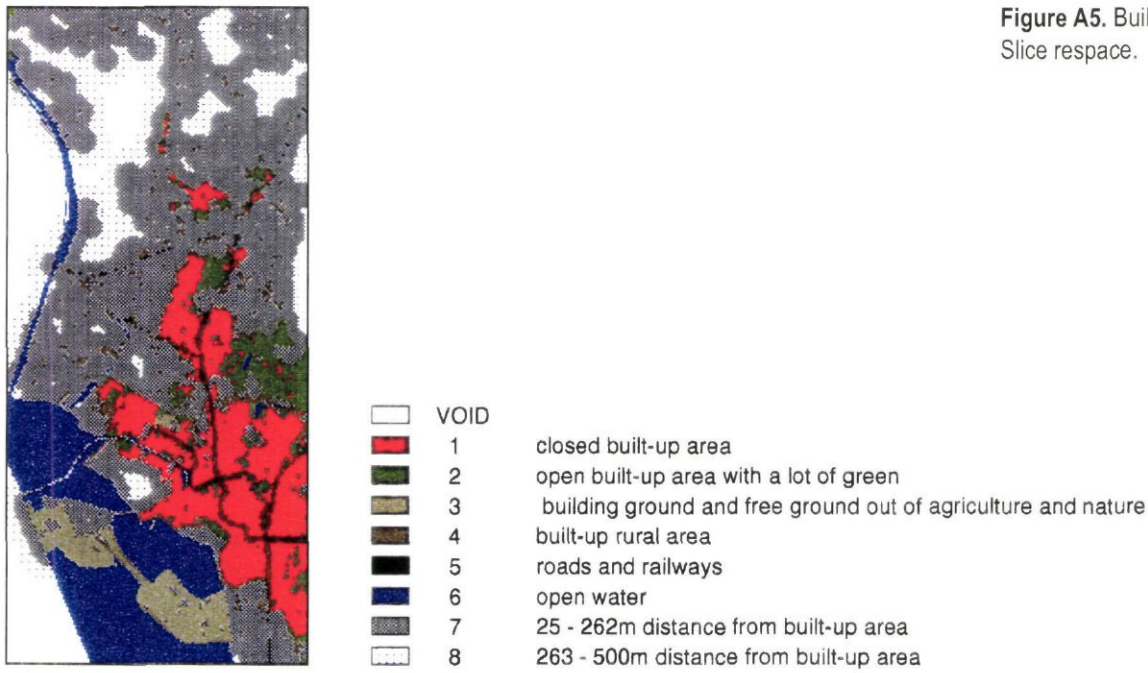


Figure A5. Built-up area (B) spread Slice respace.

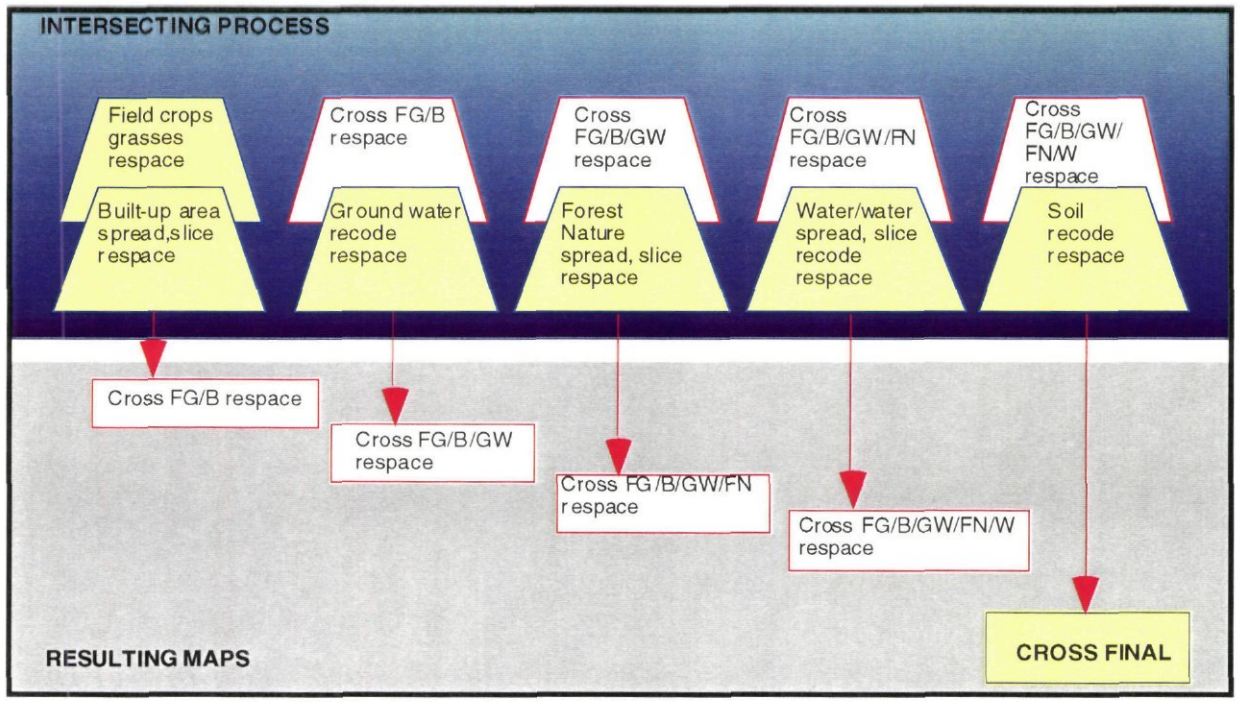


Figure A6. Intersections.

Figure A7. Cross FG/B respace.

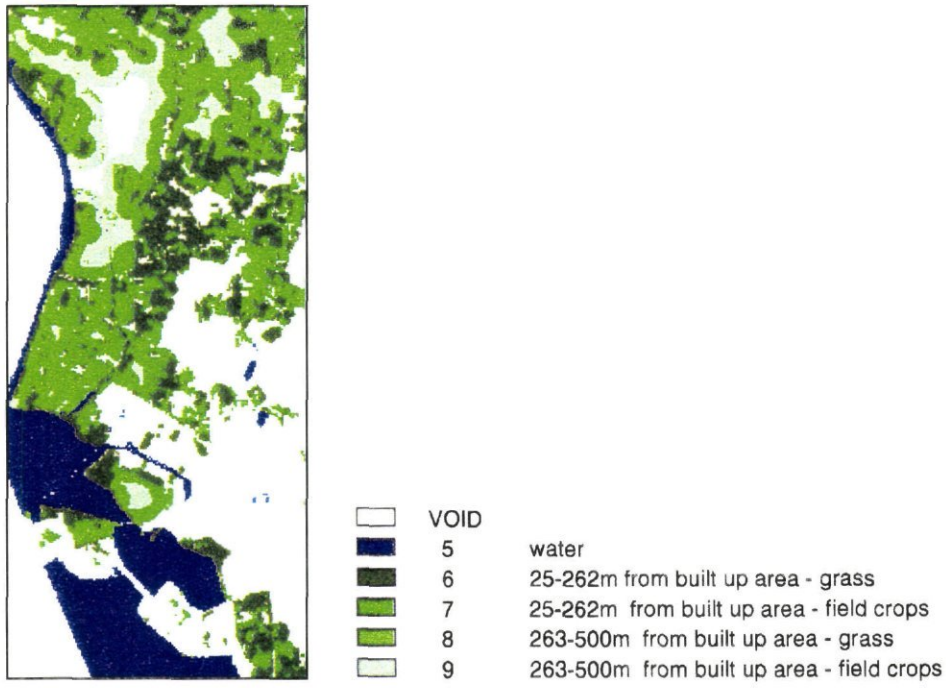


Figure A8. Cross FG/B/GW respace.

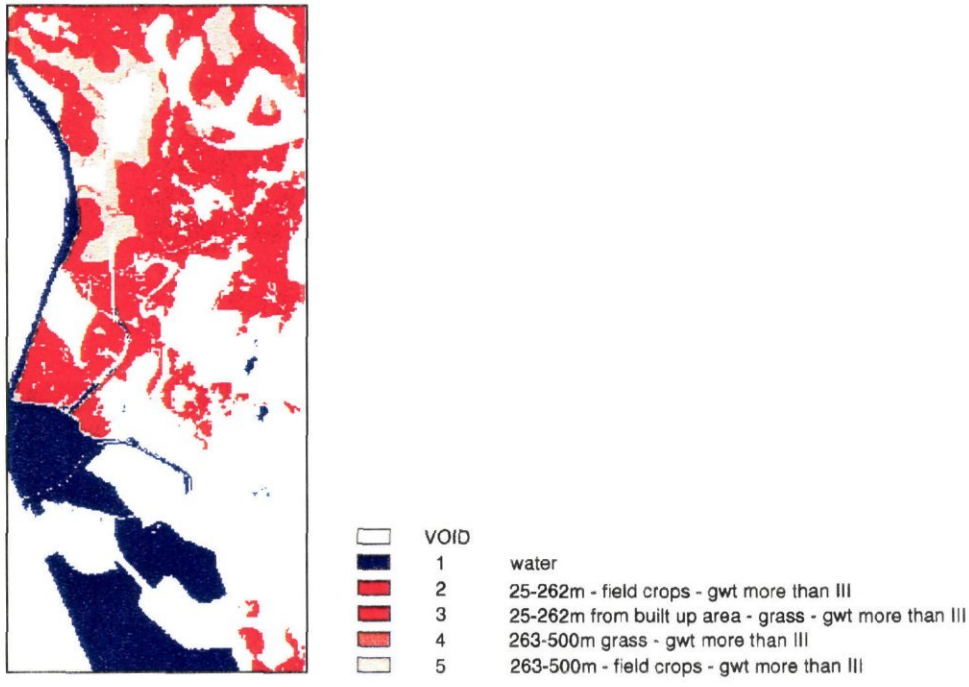
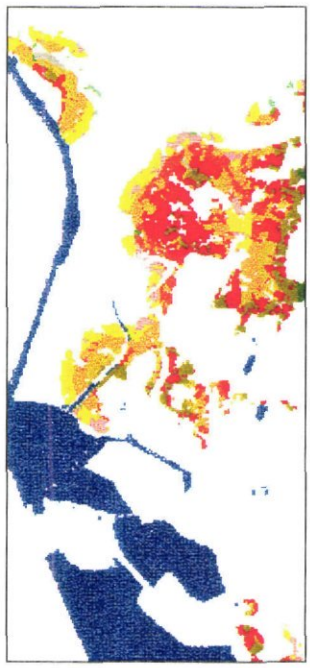


Figure A9. Cross FG/B/GW/FN respace.



	VOID	
	41	water
	42	25-262m from built up area - grass - gwt more than III - forests and nature areas on 25-268m
	43	25-262m from built up area - grass - gwt more than III - forests and nature areas on 269-512m
	44	25-262m from built up area - grass - gwt more than III - forests and nature areas on 513-756m
	45	25-262m from built up area - grass - gwt more than III - forests and nature areas on 757-1000m
	46	25-262m - akkerbouw - gwt more than III - forests and nature areas on 25-268m
	47	25-262m - akkerbouw - gwt more than III - forests and nature areas on 269-512m
	48	25-262m - akkerbouw - gwt more than III - forests and nature areas on 513-756m
	49	25-262m - akkerbouw - gwt more than III - forests and nature areas on 757-1000m
	50	263-500m - grass - gwt more than III - forests and nature areas on 25-268m
	51	263-500m - grass - gwt more than III - forests and nature areas on 269-512m
	52	263-500m - grass - gwt more than III - forests and nature areas on 513-756m
	53	263-500m - grass - gwt more than III - forests and nature areas on 757-1000m
	54	263-500m - akkerbouw - gwt more than III - forests and nature areas on 25-268
	55	263-500m - akkerbouw - gwt more than III - forests and nature areas on 269-512m
	56	263-500m - akkerbouw - gwt more than III - forests and nature areas on 513-756m
	57	263-500m - akkerbouw - gwt more than III - forests and nature areas on 757-1000m

Figure A10. Cross final 49W.

	VOID	TOTAL SURFACE = 6028,44 ha
	1	Water - TOTAL SURFACE = 1061,06 ha
	2	25-262m from built up area - grass - gwt more than III - forests and nature areas on 25-268m - surface water on distance less than 1000m - TOTAL SURFACE = 72,31 ha
	3	25-262m from built up area - grass - gwt more than III - forests and nature areas on 269-512m - surface water on distance less than 1000m - TOTAL SURFACE = 60,25 ha
	4	25-262m from built up area - grass - gwt more than III - forests and nature areas on 513-756m - surface water on distance less than 1000m - TOTAL SURFACE = 51,19 ha
	5	25-262m from built up area - grass - gwt more than III - forests and nature areas on 757-1000m - surface water on distance less than 1000m - TOTAL SURFACE = 40,19 ha
	6	25-262m from built up area - field crops - gwt more than III - forests and nature areas on 25-268m - surface water on distance less than 1000m - TOTAL SURFACE = 70,94 ha
	7	25-262m from built up area - field crops - gwt more than III - forests and nature areas on 269-512m - surface water on distance less than 1000m - TOTAL SURFACE = 76,62 ha
	8	25-262m from built up area - field crops - gwt more than III - forests and nature areas on 513-756m - surface water on distance less than 1000m - TOTAL SURFACE = 124,81 ha
	9	25-262m from built up area - field crops - gwt more than III - forests and nature areas on 757-1000m - surface water on distance less than 1000m - TOTAL SURFACE = 130,50 ha
	10	263-500m from built up area - grass - gwt more than III - forests and nature areas on 25-268m - surface water on distance less than 1000m - TOTAL SURFACE = 1,93 ha
	11	263-500m from built up area - grass - gwt more than III - forests and nature areas on 269-512m - surface water on distance less than 1000m - TOTAL SURFACE = 0,56 ha
	12	263-500m from built up area - grass - gwt more than III - forests and nature areas on 513-756m - surface water on distance less than 1000m - TOTAL SURFACE = 3,94 ha
	13	263-500m from built up area - grass - gwt more than III - forests and nature areas on 757-1000m - surface water on distance less than 1000m - TOTAL SURFACE = 8,19 ha
	14	263-500m from built up area - field crops - gwt more than III - forests and nature areas on 25-268 - surface water on distance less than 1000m - TOTAL SURFACE = 1,81 ha
	15	263-500m from built up area - field crops - gwt more than III - forests and nature areas on 269-512m - surface water on distance less than 1000m - TOTAL SURFACE = 8,38 ha
	16	263-500m from built up area - field crops - gwt more than III - forests and nature areas on 513-756m - surface water on distance less than 1000m - TOTAL SURFACE = 26,62 ha
	17	263-500m from built up area - field crops - gwt more than III - forests and nature areas on 757-1000m - surface water on distance less than 1000m - TOTAL SURFACE =32,25 ha

ANNEX B

Typology of Plant Communities

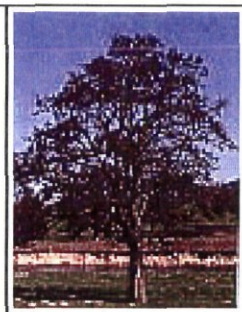
ALNION INCANAE

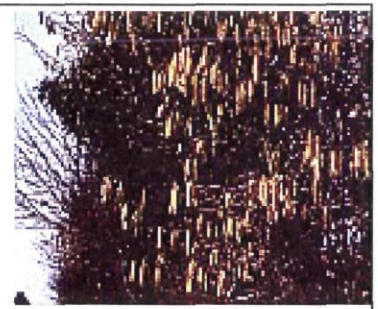
Marshy woodland in more or less mineral ground. Woods of Alnus and ash (sometimes oak and poplar) with dense undergrowth in ground with a high and often varying ground water level or with flowing water. The type of soil is either sand or clay, often with some peat. Brook valleys, wet valleys in zones with wind-borne sand deposits and dunes, soils composed of lowland river deposit and marine clay, occasionally flooded river banks outside the dykes, manured and partly irrigated higher and lower areas of peat ground.

Related man-made landscape:
Wet grasslands - meadows or pastures, possibly with (Rubion or Alnus) hedges, landscape with pollarded willows and poplar.

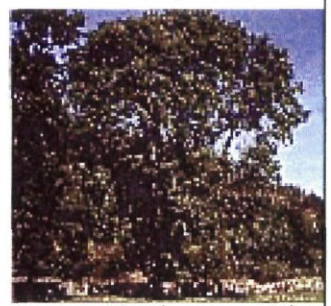
Main woody species:
Alnus glutinosa - alder: zwarte els
Corylus avellana - hazel: hazelaar
Fraxinus excelsior - ash: es
Populus nigra/americana - poplar: populier
Prunus padus - bird cherry: vogelkers
Quercus robur - oak; zomereik

Herbaceous plants:
Cardamine pratensis and flexuosa
Carex remota
Chrysosplenium alternifolium
Crepis paludosa
Deschampsia cespitosa


Alnus glutinosa


Corylus avelana


Quercus robur


Fraxinus excelsior

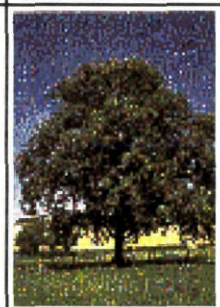
ULMION

Woodland in very rich, often more or less sandy soil, varying from very wet to very dry. Oak and ash (sometimes Acer pseudoplatanus) woods in wet ground with rich soil. Ground water level not too high, but near enough to the surface for roots to reach it. Rich, wet sand, no heavy clay soil: fluvial deposits of clay in higher areas; borders between dry sandy hills and wet valleys.

Related man-made landscape:
Settlements, horticulture (tree nurseries), fields (wheat, sugar beets, potatoes), pastures, country estates, elm-lined lanes. Forested dunes.

Main woody species:
Acer pseudoplatanus - maple tree: esdoorn
Corylus avellana - hazel; hazelaar
Fraxinus excelsior - ash; es
Prunus padus - bird cherry; vogelkers
Quercus robur - oak; zomereik
Sambucus nigra - elder; gewone vlier
Ulmus carpinifolia - elm; iep
Hedera helix - ivy; klimop

Herbaceous plants:
Alliaria petiolata
Corydalis solida
Dactylis glomerata
Ornithogalum umbellatum
Veroniva hederifolia


Ulmus carpinifolia


Acer pseudoplatanus


Sambucus nigra


Prunus padus

RUBION

The main species is Rubus fruticosus. Hedges and brushwood in rich, lime-deficient ground, mostly in river areas (alluvial soil), or in old soil (South Limburg).

Main woody species:
Cornus sanguinea
Crataegus monogyna - hawthorn; meidoorn
Euonymus europeaus - spindle tree; wilde kardinaalsmuts
Prunus spinosa - sloe; sleedoorn
Quercus robur - oak; zomereik
Rosa canina
Rubus fruticosus

Herbaceous plants:
Chaerophylum temulum
Galium cruciata
Stellaria media


Crategus monogyna


Prunus spinosa


Euonymus europeaus

CARPINION

Oak, ash (occasionally Acer psuedoplatanus and Fagus) woodland, (hedges, if any, of Carpinus betulus and Corylus avellana) in rich, loam ground which is not too wet. Querco-carpinetum is the only species in this association growing in the Netherlands.

Related man-made landscape:
Settlements, tree nurseries, fields (wheat in dry ground), grasslands (in very wet or very limy ground), possibly with Carpino rubion or Carpino Berberidion hedges.

Main woody species:
Carpinus betulus - hornbeam; haagbeuk
Corylus avellana - hazel; hazelaar
Fagus sylvatica - beech; beuk
Fraxinus excelsior - ash; es
Prunus avium - cherry; zoete kers
Quercus robur - oak; zomereik
Hedera helix - ivy; klimop


Carpinus betulus


Fagus sylvatica


Prunus avium


Fraxinus excelsior

QUERCION ROBORIS

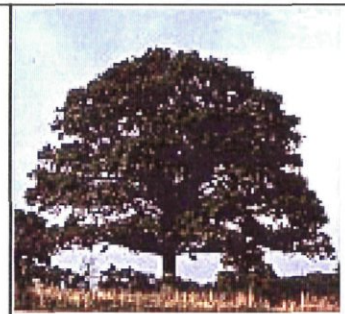
Woodland in ground poor in sand and loam.
Originally, large parts of the Netherlands were covered with these woods, which are still very important.
Quercion roboris has two sub-divisions.

Violeto-Quercion. Mostly found in richer soils. Oak (rarely birch or Fagus) woods or brushwood in sandy ground, not too poor in acid, and often loamy and moist.
In between the areas with Ulmion and Vaccinio-Quercion species, borders are found on high sandy areas, on the highest parts of old beach embankments, on loamy soil covered with a thin layer of sand, old crop fields with sandy soil which are now forested and lying idle. Besides the species mentioned above there are also:
Rubus fruticosus
Antoxanthum odoratum
Corydalis claviculata
Holcus molis
Teucrium scorodonia

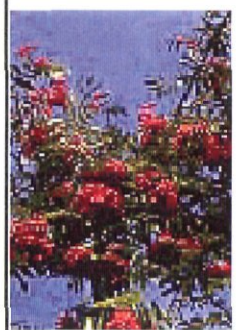
Related man-made landscape:
Fields (rye, potatoes).

Main woody species:
Betula verrucosa - birch; berk
Fagus sylvatica - beech; beuk
Frangula alnus
Quercus robur - oak; zomereik
Sorbus aucuparia - rowan tree; wilde lijsterbes
Lonicera periclymenum

Herbaceous plants:
Carex pilulifera
Galium hercynicum
Hieracium laevigatum umbellatum
Maianthemum bifolium
Melampyrum pratense


Quercus robur


Fagus sylvatica

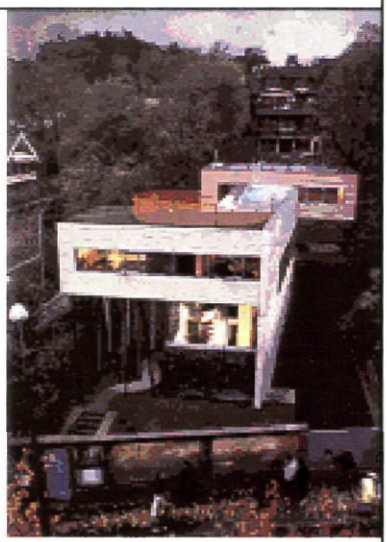
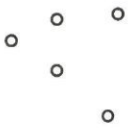
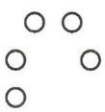
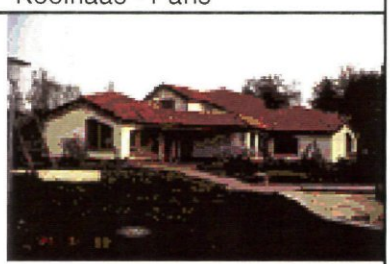
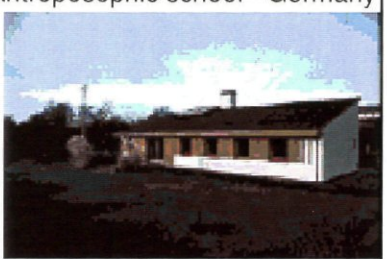
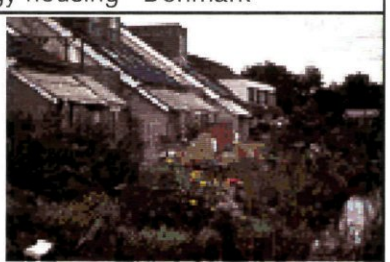
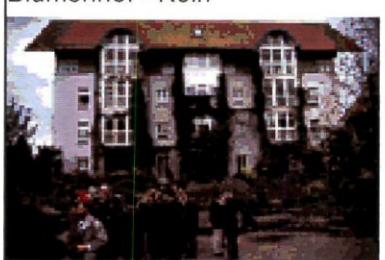

Sorbus aucuparia


Betula alba

Vaccinio-quercion. Oak (sometimes birch and beech) woods or brushwood in poor sandy, (occasionally clay) acid soils. Can be found on the largest parts of Pleistocene sandy areas and partly in old and young dunes. Other species are:
Calluna vulgaris
Vaccinium myrtillus
Aulacomnium androgynum
Dicranum scoparium
Leucobryum glaucum
Pleurozium schreberi

Related man-made landscape:
Prehistoric (Neolithic) settlements; heaths, most of which were later forested (with conifers), cultivated (the more or less dry areas - rye and potatoes), or turned into grasslands (wet areas). Forested areas with wind-borne sand deposits.

ANNEX C
Typology of housing

DENSITIES (inhabitants/ha)	CONCENTRATIONS	VARIANTS	
0 - 5		 Blumenhof - Koln	 Koolhaas - Paris
		 Shelter	
5 -20		 Lager Wiesen - Hanover	 Antroposophic school - Germany
			
		Second generation energy housing - Denmark	
20 - 40		 Blumenhof - Koln	 Roumoelenbeek - Haarlem
		 Eble - Frankfurt	 Hertzogenrath

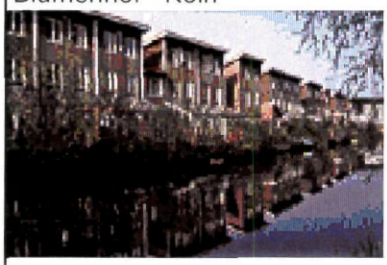
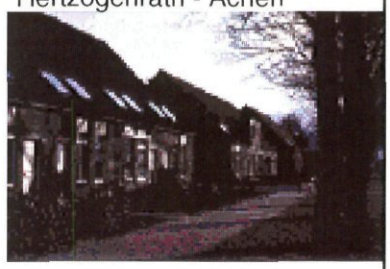
DENSITIES (inhabitants/ha)	CONCENTRATIONS	VARIANTS	
40 - 80	○○○○○	 Blumenhof - Koln	 Hertzogenrath - Achen
	○○○○○	 Tjerk Reijenga - Gouda	 PRW 83-62
80 - 160	◎	 Zwan - Voorburg	 Kristinsson - Schiedam
	○○○○○		 Baler - Berlin

Photo: Kees Duijvestein