8 MAP STUDY

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8.1	Mapping the earth's surface	71
8.2	Remote sensing images	71
8.3	Identification of shapes	72
8.4	The legend	72
8.5	Scale of a map	73
8.6	Different types of maps	74
8.7	Study aided by maps	74
8.8	Concluding remarks	78

A study concerning the making of maps and a study of how to use a map are two different subjects. Study addressing the making of maps comprises not only collecting data and recording them in a map, but also studying the production of maps (reproduction techniques, usage of colour, legend, readability). A study facilitated by maps often generates additional, new maps.

Recording study data by means of symbols in a map may be compared to descriptive study. Actually, a shape is recorded by means of a token. The meaning of all tokens used is described in a list linking each separate token with a description: the legend. Determining the content of the legend, particularly the variety of data to be recorded and the size, is a problem in conceptual terms as well as in terms of technical production. Studying maps by analysis, comparison and deduction exceeds the recording of shapes by means of well-known tokens or those agreed upon. A study like that comprises a historical study (development) as well as a categorising study (recognition). A design study by means of maps is also a possibility.

In this Chapter, making maps as such is not taken into account. How study data may be recorded in a map and how knowledge from a comparison and deduction of maps may contribute to urban designing are central issues.

8.1 MAPPING THE EARTH'S SURFACE

A territory may be documented spatially (without words) by way of a map, aerial photograph, satellite image[a], or a model. We restrict ourselves to images on a flat surface. A map or a remote sensing image is a distortion of reality, since a projection of a spherical surface, in this case a three-dimensional space is recorded. In addition, a map is an abstracted representation of reality. The content of the map is determined by the object of study, like topography, infrastructure, morphology, etc. The data result from measurements in the territory.

The conjunction of study and maps has been extended since the start of the twentieth century with the study associated with remote sensing images. A remote sensing image is a mapping of an environment obtained from a distance, without touching the object physically. A technique often employed is the vertical aerial photography of a territory. These images offer a detailed registration of all shapes present on earth in realistic proportion. A correction of distortions resulting from the projection – from sphere to flat surface – and from the lens technique employed belong to the scientific field of geodesy.

Shapes of the earth's surface may be recognised by the shape itself – like a building or a road – or by a combination of shapes. The images also document the date of the recording; it is automatically included on the image (a photograph) itself. The present generation of topographical maps has all been derived from remote sensing images.

8.2 REMOTE SENSING IMAGES

As a matter of fact, remote sensing images are unstructured material without legends, while maps feature legends, a descriptive list of tokens. The study of remote sensing images demonstrates two different options: production of a (topographical) map, and facilitating study of maps. In both cases recognition and interpretation of shapes is the objective, followed by recording in a document. Differences concern primarily the extent of depth, systematic approach and method of recording. The expertise of the researcher determines the recognition of the shapes. Other capabilities of the researcher, like the power to visualise a shape from above and an extraordinary patience, also play an important rôle. Because a trained researcher recognises and identifies more easily, he will get results more quickly. Knowledge of the territory covered by the satellite images is a great advantage.[b]

a The aerial photograph and the satellite image have been combined in the concept 'remote sensing image'. These images are being produced with the help of various recording techniques, such as photography, infra red recordings, radar, e.t.q.

b American Society for Photogrammetry and Ryerson R.A. (1999) *Manual of remote sensing*.

29 Oil port Pernis, Rotterdam. Author's interpretation based on an aerial photograph dating from 1970

1 BUILT-UP AREA		
	1.1 housing	
		1.1.1 detached house 1.1.2 semi-detached house 1.1.3 row of houses 1.1.4 urban villa 1.1.5 appartment buildings low 1.1.6 appartment buildings middle high 1.1.7 appartment buildings high rising 1.1.8 …
	1.2 commercial services	
		1.2.1 shop 1.2.2 shopping centre 1.2.3 shopping mall 1.2.4 hotels, restaurants, pubs 1.2.5 pleasure area 1.2.6 schools 1.2.7 medical provisions 1.2.7 cemeteria 1.2.8 …
	1.3 industry	
		1.3.1 … 1.3.2 …
	1.4 mixed housing and commerce	
		1.4.1 … 1.4.2 …
	1.5 mixed housing and industry	
		1.5.1 … 1.5.2 …
	1.6 mixed commerce and industry	
		1.6.1 … 1.6.2 …
	1.7 traffic and transport	
		1.7.1 … 1.7.2 …

30 Example of a simple determination table

By and large, a study of remote sensing images in order to produce a map is effected as follows. The researcher orders the material and tries, by looking and reading, to distinguish, recognise and identify shapes and structures. Shapes may be recognised and determined by certain characteristics as there are shading or colour, texture, pattern, shape, size, height, shadow, situation or environment. The result is a list of shapes, a preliminary legend. The method of representing the shapes by tokens, or possibly colours, is also recorded. A remote sensing image becomes more than a picture at random from the moment a (preliminary) legend has been drawn up. An ordering typology has been formulated. This typology is strongly determined by the field of expertise of the researcher. The preliminary legend is the basis for subsequent study, the interpretation. Combining shapes, the positioning of shapes with regard to one another and knowledge of a situation add to the content of the remote sensing image at the time of interpretation. The facility of the researcher to imagine a situation plays an important rôle. An example to illustrate: in a harbour area different types of buildings are located; like terminals, shipyards, docks, storage structures. On the waterfront cranes are installed and areas for containers. How would these activities look on an aerial photograph? Is it possible to recognise elements and activities as such?

The result of the operations is a map: a personal interpretation of a remote sensing image. In principle, this map is not objective. By recording the interpretation in a code, the legends, a higher level of objectivity is realised. The same interpretation may then be repeated for another area. In addition the legends heighten the uniformity and precision of the repetitions of the interpretation for other areas. When it becomes clear that no adequate tokens are available to render new shapes whilst interpreting a new area, the legends will be extended with new items. At least all tokens of the map should be present in the legend.

As a result inherent in production of a map – difference in scale with reality, thickness of lines, reproduction of a surface – and the impossibility to reproduce the smallest shapes and elements, they are conjugated, abstracted, omitted and, given their importance, depicted in an exaggerated way. An example of this method of making maps is the topographical map.[a] The topographical map is used as a basic map for the production of thematic maps.[b]

Utilising remote sensing images in the study of an area as a tool or an addition to the maps available is based on recognition and interpretation as well. In fact the same procedure as described is followed. With the help of these images the researcher may determine a further precision and content of the abstracted form, or, if necessary, update the maps with the most recently obtained remote sensing images.

8.3 IDENTIFICATION OF SHAPES

Keys of interpretation and determination tables are used particularly when interpreting remote sensing images. A table helps to identify the shape in an organised and consistent manner. This table may be a written one or pictures with or without description; it can be constructed in different ways. Most frequently employed are a selection table and a table based on elimination. In the case of a selection table the shape is determined by comparing the shape of the reproduction to a standard form from the table. In the case of elimination a selection from different possibilities is made step by step. Proceeding with what is chosen another choice from different possibilities is made by increasing precision. Ultimately, the result should be an unequivocal answer to the question: what shape is this? This method is very suitable for recognition of cultural products like buildings and results of civil engineering. It is also used for the determination of plants.

8.4 THE LEGEND

A distinction should be made between the content of a map and its reproduction or rendering. It is recommended to keep the content of a map as straightforward and unambiguous as possible. Do not combine two totally different studies in one map; make separate maps of the

a A map is a maximally faithful rendering of a part of the earth's surface.
b A thematic map indicates a specific theme, like infrastructure or soil.

different subjects of study. These maps may be compared to one another by sieve analysis.[a] Do restrict the number of categories in a legend for the sake of readability. Scientifically well-considered choices must be made where magnitude and importance of the different elements and shapes are concerned. How typical or characteristic these elements and shapes are is also of importance in the study? The choice determines scale and legend of the map. Put differently: the subject of the map determines the ‘content’ of the legend. The scale of the map chosen determines its level of detail and therefore the number of items in the legend. The content of the study determines the elements that must at least be represented. That is the reason that the content also determines the scale of the map.

Next to the conceptual aspect of the map, technical knowledge on the human capacity to discern is needed. This involves depiction of elements and shapes on a map, use of colouring, grey-tones, and so forth. Knowledge is required on the number of elements that may be distinguished on a map and on the smallest possible element still standing out at the scale chosen. To what extent may elements, for instance, be simplified in shape (straightened) or omitted? What is the importance of an element on a reproduction? What are the limits set to abstraction from reality of a map? Next to this knowledge on human perception there should be cognisance of reproduction techniques, both analogue and digital.

31 Topographical map of the city of Rhenen on scales 1:100.000, 50.000, 25.000 and 10.000, based on the same aerial photograph[b]

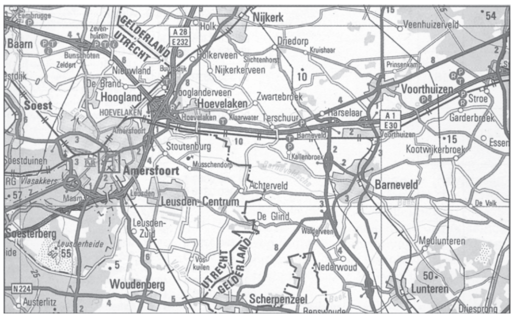
8.5 SCALE OF A MAP

As mentioned, the scale of a map is determined generally by the object of study. The precision of the map is inter-connected with its scale. On a map with a scale 1: 1.000 a road 10 m wide is proportionally represented by a line 1 cm thick. On a scale 1: 10.000 the same road is represented by a line 1 mm thick. At an even smaller scale (1: 100.000) the same road can not be rendered proportionally. However, if we deem this road to be very important, it may be indicated by a token. In that case the legends should mention the width of the road. A deliberately chosen falsification of scale then applies. Measurements on this last map mentioned in order to determine the width of the road, do not yield the correct width of it and are, therefore, not valid. In addition the correct positioning of this road is in jeopardy; within certain margins.

Obviously, maps with a small scale (1: 100.000) can contain less information than maps with a large scale (1: 1.000). On maps with a small scale the shapes have been abstracted and similar or associated shapes are placed in one category. Enlarging maps with a small scale does not yield more information and greater precision. Changing a map with a large scale into one with a smaller scale – the opposite procedure – gives a map with the same information and accuracy, as long as the new map may be reproduced technically. If the reproduction is not feasible the accuracy is at least equal to the one inherent in the new scale.

a Sieve analysis is a method super-imposing maps with the same scale in order to be able to inspect and analyse differences and similarities in mixing, spreading and accumulating spatial components. The method may be extended and refined in various ways by introducing the factor time or potential.

b Source: Topografische Dienst Nederland



32 Thematical map: the roadmap of The Netherlands[a]

8.6 DIFFERENT TYPES OF MAPS

Cartography distinguishes between basic maps – usually topographical maps – and thematic maps. A basic map is a two-dimensional representation of the shapes and elements occurring on the earth's surface. Generally, the basic map comprises the following elements: elevation, water, infrastructure, buildings, land utilisation: forests, meadows, farmland, and so forth. A researcher may use a basic map as a basis or reference for his study. A basic map usually serves as a background for thematic maps. They may be derived directly from the basic map, like a roadmap for motor vehicles, maps for tourists, maps of the distribution of dwelling clusters, maps of waterways, and so on.

One distinct category of thematic maps are maps where the distribution of characteristic non-topographical elements is depicted. Examples are geological maps and maps indicating soil compositions (figure 33 shows different kinds of clay, sand, peat and water), vegetation, population (figure 34 shows units of e.g. 100.000, 50.000, 20.000 people) and statistical deviations. The data for these maps have been obtained by study. They are based on data obtained in the field, or on study of sources in literature.

8.7 STUDY AIDED BY MAPS

Research with the use of maps comprises examination of inventories and source material as well as conventional research methods like describing, comparing, evaluating and recognising problems. Instead of maps, remote sensing images like aerial photos and satellite images can be used for research.

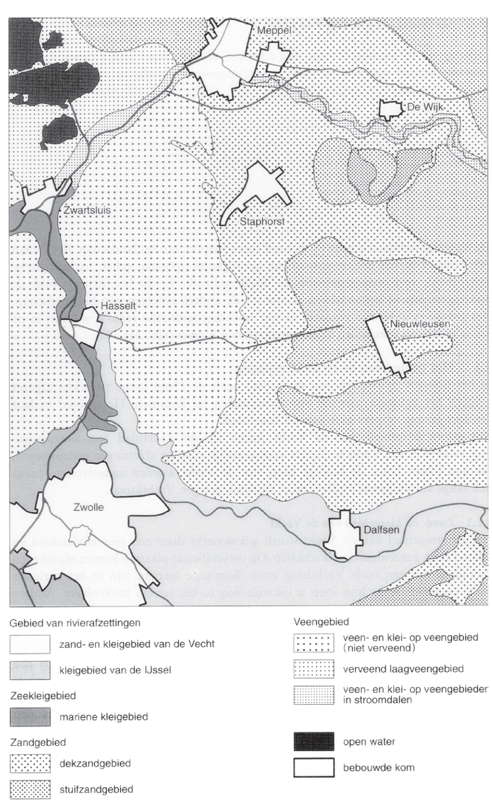
a. *Inventory*

This research comprises the following actions, depending on the choice of the subject to be inventoried:

- compilation of material in the form of maps and remote sensing images,
- scaling the maps by enlarging and reducing
- studying the maps and
- processing the research conclusions whether or not in map form.

33 Thematic map: soil composition based in data obtained 'in situ'.

34 Thematic map: dispersion of the population



a Source: Topografische Dienst Nederland

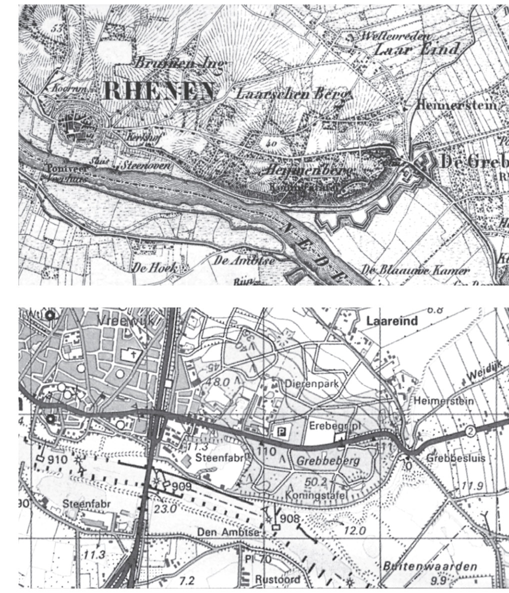
The subject of the inventory determines the contents and the legend of the newly generated map. The inventory is in fact a recording of forms in signs. A description of a form is recorded by means of signs. Normally a topographical map is used as a basic map, because this map is an objective representation of the reality. In fact, these maps could be denominated as second-generation maps.

b. Historical study

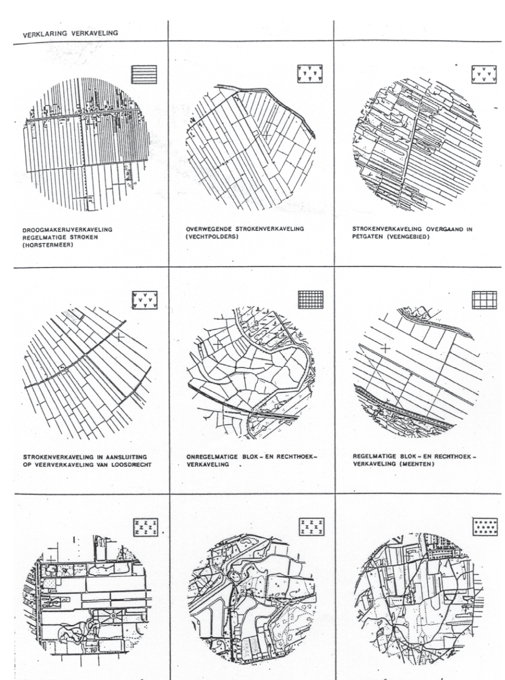
When carrying out a historical study of maps, besides an inventory, a comparative research is carried out. The transformation of a form in the course of time is subject of study. The research is normally carried out using topographical maps of varying ages. The map material can be supplemented using aerial photos if required. For clarification purposes maps other than topographical maps are studied, like watercourse maps, property maps etc, using the topographical map as background. Besides the comparison of various historical maps the maps also undergo other processes. Data from various maps are placed under one denominator where possible and recorded in one map. The maps are supplemented with details from written sources where required. For example in the case of research into soil contamination, details from chemical soil research and municipal permits of the companies established in that area are used.

c. Comparative study

Historical comparative study can be supplemented with an interpretation of the maps. Anomalies and similarly formed elements are recognised and established during this study. This way striking topographical elements like parcelling, watercourses, classification and forms of settlements are more closely examined. An attempt is made to find explanations for the characteristics found during the interpretation. These explanations can be based on the comparison of a thematic map like geological and soil maps, groundwater level maps and contour maps. Written sources like taxes, purchase reports of grounds, etc. can also clarify characteristics. The explanation of characteristic elements can result in research of the tolerated deviations within the form. In this manner the archetype of the form can be established. Using this archetype comparative study can subsequently be carried out regarding existence and distribution of this type using other maps. A good example of this is the landscape arrangement, which here in Holland was made using parcelling and settlement structure as a basis.[a]



35 Comparison of Rhenen between 1850-1865 and Rhenen around 1987[b]



36 Parcelling of The Netherlands according to Hofstee and Vlam (1952)

37 Legenda by image[c]

a Hofstee, E.W. and A.W. Vlam (1952) *Opmerkingen over de ontwikkeling van de perceelsvorming in Nederland;* Visscher, H.A. (1975) *Nederlandse landschappen;* Maas, Buro (1981) *Een beeld van het Zuidhollandse landschap, deel 1, 2 en 3*.

b Source: Topografische Dienst Nederland. See also: Topografische Dienst Emmen (2001) *Topografische dubbelatlas;* – (1996) *Grote provincie atlas 1:25.000*.

c Maas, Buro (1981) *Een beeld van het Zuidhollandse landschap, deel 1, 2 en 3*.

Sieve analyses can also be used for comparing maps of different types. The analysis can produce a suitability, which may or may not be coupled to a weighing. For example, the result of sieve analysis can be a potential map for agriculture. In Ian McHarg's *Design with nature* (1969) this method is described based upon the applications in the area of town and country planning.[a]

The latest development in the area of sieve analysis is analyses carried out using the GIS (geographical information systems) by computer. Maps are stored in the computer in layers of information. The information per layer is recorded in a grid. Combining or sieving various layers creates potential maps for a chosen function. Using this computer application the size of the grid plays an important rôle in the accuracy of the product. In this way the amount of information stored in the different layers is also crucial for the foundations of the result.

d. *Morphologic study*

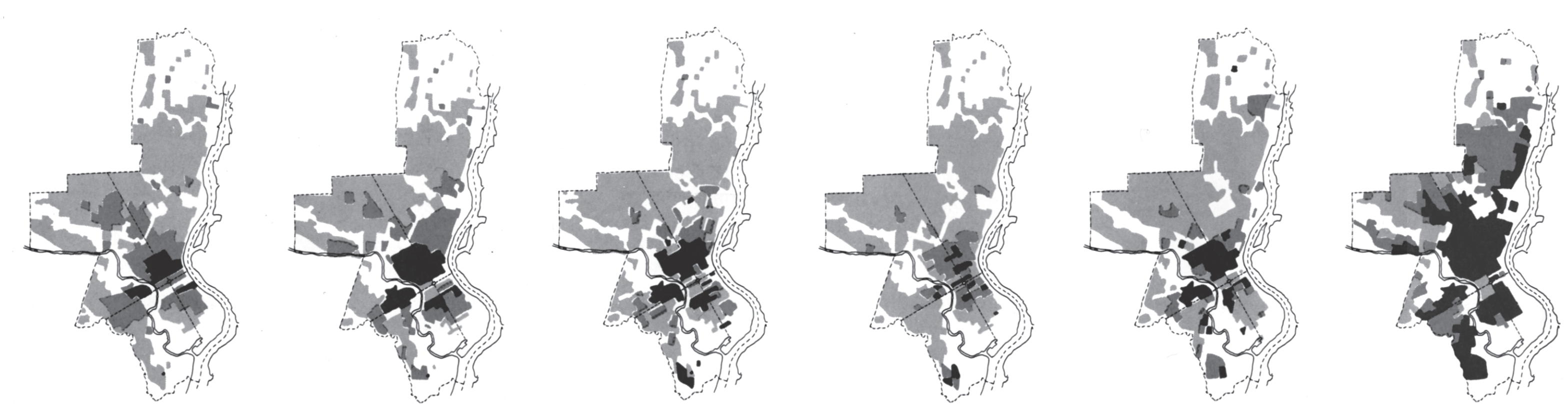
Carrying out a town planning survey, frequently use is made of images of the area in the form of topographical maps and remote sensing images. This way information about the position and structure of buildings, land utilisation, infrastructure, parcelling, water, etc. is collected. With morphological study the emphasis lies on space in every case. In fact it is not about space itself, but about the elements that form and determine space. The distribution, form and direction of space and space forming elements like walls play an important rôle during analysis. Morphologic research is often augmented with an explanation of the elements through the influence of the physical and socio-economic circumstances and history (origination history).

Key questions in morphologic research are:
- Is the form of space sheer co-incidence or are there circumstances which obviously have had an influence on the form and position of the space and the space forming elements?
- To what extent has history made its mark on the current form of town, village or landscape?

Besides studying and analysing historical maps, explanations are sought regarding form and distribution of the space and the elements which are part of this. A number of forms can be explained from geomorphology and sub-soil, however, the building technique and legislation also play a rôle. Palmboom's study into landscape and urbanisation between The Hague and Rotterdam is an example.[b] The intention of the analysis was not only to clarify in words the character of the area, but especially to illustrate the area using map images. Using a large number of map images it is made clear which form the area has, how it is made up and what it looks like. Aspects involved in the study are (small) height differences, parcelling forms, sub-soil, landscape forms (like dunes with shoreline complexes, rivers with riverbanks, tributaries). How insignificant these aspects may be, they had an effect on the area. The time el-

a McHarg, I (1969) *Design with nature*.
b Palmboom, F. (1990) *Landschap en verstedelijking tussen Den Haag en Rotterdam*.

38 Sieve analysis according to McHarg (1969)



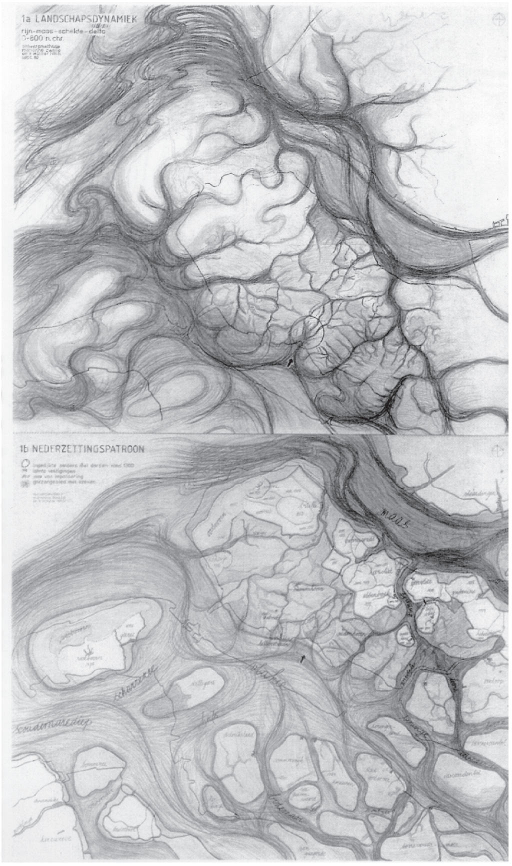
ement arises in an endless series of interventions in the Dutch landscape. Besides the comparison of historical images (time element) with the current situation, attention is also paid to the possible prospective changes. The aim of this analysis is not to freeze current structural images, but is actually for the benefit of the design. According to Palmboom the aim of the analysis is *"to find possible starting points for design proposals in the current situation, which can assist in directing a gradual, lengthy, and partially unpredictable process of change"*.

A similar study was carried out earlier by Buro Maas for parts of South-Holland Province: *An image of the Landscape of South-Holland*.[a] The emphasis in this study is on making the manner of origin and development of the landscape and the accompanying landscape forms, present in South Holland comprehensible. The study serves as a reference frame for municipal and provincial administrations to recognise and evaluate the consequences of intervention within the area - like town expansion or choice of area for a new industrial establishment. Designers can also make use of the landscape details assimilated in this study.

39 Parcelling analysis of Palmboom (1990)

40 Image of the South-Holland Landscape (Buro Maas, 1981)

a Maas, Buro (1981) *Een beeld van het Zuidhollandse landschap, deel 1, 2 en 3*.



41 Morphological study of the landscape (Reh, 1980)

e. morphologic research in aid of design

One special application of making a plan based upon morphological data is the book *How to do it differently* from South-Holland Province.[a] It illustrates how a study into the history of the development of the area surrounding Hellevoetsluis creates motives for designing a rich ecological and greenery structure and an interesting living environment. The planning preparation takes on the course of a creative process, whereby landscape forms are dramatised and transformed. Knowledge of various fields of specialisms comes together in the implementation of the plan. The study shows how a broad development plan takes shape in successive plan phases. A new process is systemising the 'image formation" and making the creative steps of the design process visible. Each step of the design process is explained using an image (map or sketch) and a description.

8.8 CONCLUDING REMARKS

The future of the map lies in digitalisation. The increase of knowledge associated with rendering representations in digital form will contribute to the study of maps and by maps. Due to the increased accuracy of digital representations of the maps expected, a generation of more information by special*ised* techniques will become easier. Aided by geographical information systems (GIS) sieve techniques can be employed more quickly and thoroughly. Digitising the existing body of maps is an awesome task. What should be digitised, and how, involves important decisions.

a Reh, W. (1980) *Hoe het ook anders kan*.