

HYDROGEOLOGICAL MAPS OF THE NETHERLANDS

SCALE 1 : 1,500,000

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ABSTRACT

Two hydrogeological maps, in scale 1 : 1,500,000, have been compiled, based on the principles laid down for the International Hydrogeological Map of Europe. Map I is representative for shallow conditions; map II is representative for the sequence of sediments ranging from Pliocene to Holocene.

The International Hydrogeological Map of Europe, scale 1 : 1,500,000, is being composed under the auspices of the Commission for the Geological Map of the World by a sub-commission set up for this purpose. Sheet C5 was compiled first by way of experiment (Visser and Van der Heide, 1969). The Netherlands are situated on the western part of sheet C4. This sheet is in the course of preparation; publication however, is not to be expected before 1973. We are glad to have been offered the opportunity to publish in this special issue of "Geologie en Mijnbouw" two hydrogeological maps of the Netherlands. Map I represents relatively shallow conditions (the first 40 m) and map II represents the entire sedimentary sequence of interest to water supply. The authors are aware of some of the difficulties involved in presenting all relevant hydrogeological information on one or even two maps of scale 1 : 1,500,000. Because of the preliminary nature of these maps, awaiting final interpretation and publication as part of the Inter-

national Map, comment is invited.

The geology shown in these maps is not derived from the International Geological Map, 1 : 1,500,000. The latter mainly represents the soil map, the legend of which pertains to the upper few metres only. For our purpose, where hydrological phenomena are to be mapped, we have to look also at the subsurface sediments. Accordingly, the different geological boundaries as given here are derived from the Geological Map of the Netherlands 1 : 1,600,000 (1947), Pannekoeck et al. (1956) and published and unpublished data obtained by the new survey of the Geological Map 1 : 50,000.

The purpose and principle of hydrogeological maps are given in the International Legend for Hydrogeological Maps (Unesco, 1970). In such maps various areas are to be distinguished according to their hydrological character in relation to the geology. Any information leading to a better understanding of occurrence, movement, quantity and quality of ground water should be shown, according to the scale adopted. Only sufficient geology should be added to achieve this purpose. Geology should be subdued; hydrological features should be prominent.

In the International Hydrogeological Map of Europe, as is the case in the International Legend of Unesco, the character of an aquifer, is given in three colours, each in two shades, with a generalized lithology in grey symbols and structural features and stratigraphic letter indications in black. Distinction is made between ground water in porous (blue) and fissured (green) formations, the darker shades of each

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colour indicating extensive and highly productive aquifers with generally a high permeability, the lighter shades local or incoherent aquifers with mediocre or variable permeability. Brown is used for regions without aquifers or with local aquifers with low to very low permeability. The dark shade indicates areas without aquifers; the light brown indicates that at greater depth aquifers may be present. Isohypses of groundwater (violet), hydro-chemical information (orange), artificial works (red) and the net of irrigation canals and water ways (red) are to be added.

In the major part of the Netherlands Quaternary sediments were deposited to a great thickness due to the tectonic subsidence of the North Sea basin. Accordingly, various aquifers of different depth are present.

In map I only the upper 40 metres of sediment have been taken into account and the colours of the legend for the International Hydrogeological Map sheets are used. The large tectonical phenomena like the Brabant massive, the Central Graben, Peelhorst and Venlo Graben are clearly visible. Also the ice-pushed hills consisting of coarse-grained fluvial sands and the tongue basins filled with clay and fine sands can easily be distinguished. The major part of the Holocene sea and river clay area is coloured light brown; in this Holocene clay and peat region no ground water can be derived except from gullies filled up with sand.

The isohypses of ground water (violet) in map I are taken from several sources and unpublished maps, including those prepared by Zuiderzee- and Delta Works. They form a combination of phreatic water levels and piezometric surfaces form the shallow aquifers.

In map II all waterbearing formations in the Netherlands, mainly consisting of Pleistocene sands and gravels with intercalated fine-grained sandy and clayey beds and formations, are considered. Locally the aquifer extends downward into the Pliocene (f.i. in the SW) and upward into the Holocene (in the coastal dunes). To give an impression of the thickness of the Quaternary deposits, which consist in the middle and northwestern part of the Netherlands mainly of coarse sand, depth contours on the top of the Icenian are given.

The main portion of the country in map II is coloured dark blue, indicating the presence of ex-

tensive and highly productive aquifers, which, however, is not to say that the aquifer is uniform in performance. In some places it may be rather deep, as is the case in the central part where it underlies a few tens of metres of Eemian clays or in the SW where the Pleistocene has mediocre waterbearing qualities and the water is supplied mainly from the highly permeable Pliocene. A few rather small areas are coloured light blue: e.g. several coastal stretches where the dunes are poorly developed and the fresh water body is shallow; the thin cover of Quaternary on top of the Tertiary in the Peelhorst in the S and an area of Pliocene aquifers in the far southern part. A wide stretch in the central eastern part of the country has a light blue colouring also. Here shallow Tertiary of very low permeability is present; to the E the area grades into a narrow zone along the State boundary, coloured dark brown, where the Tertiary is overlain by morainic deposits. In this area a narrow Pleistocene gully filled with coarse material cuts into the Tertiary deposits. The clayey, fluvio-glacial gully fills in the N cutting into the main aquifer, are denoted by light brown.

Cretaceous aquifers occur in small areas in E and far S. Although the former consists of fine-grained Lower Cretaceous sandstones of low permeability, this area is shown by a light green colour because the small productivity is related to fissures due to faulting. The aquifer in the S consists of fissured limestones and chinks of Upper Senonian age (dark green).

The symbols in grey show the generalized lithology of the aquifers. They indicate also the areas where the aquifers are covered by more or less impervious sediments.

A complication, which may not have been foreseen in the legend to sheet C5, occurs in the coastal regions. Here the aquifer is filled to a large extent with brackish waters (over 150 to 200 mg Cl⁻/l, while in the southwestern, central and northern parts of the coastal areas both, surface and ground waters, are brackish. Since it was felt worthwhile to distinguish these regions from the remainder of the country, shades of orange are used to designate them. It should be stressed, however, that this is not in accordance with the principle of the legend. Capacity of the aquifers only should be shown in full colour and not, as has been done here, the quality of the ground water.

From the coastal regions the base of the fresh groundwater body dips inland, and the 50 metres depth contour is taken as their edge. In the areas of brackish waters, that roughly coincide with those flooded during the Holocene transgressions, the quality of the aquifer is not impaired, and only in the case that desalination of ground water is undertaken the ground waters in these areas will become usable.

The fresh/brackish water depth contours (orange) have been generalized from the results of geo-electric surveys and bore-hole information. It will be noted that in several places brackish water tongues overlie fresh ground water; in other places the slope of the fresh water base is too steep for the 50 and 100 metres contours to be shown separately.

As to the artificial works (red), the infiltration works in the dunes and the feeding pipe lines from the Rhine are added by the State Institute of Drinking Water Supply (maps I and II), as is a selection of those groundwater pumping stations (map II), that during 1970 produced more than half a

million cubic metres of ground water for household and industrial use. The enclosing dams of the IJssel Lake and of the river arms in the delta region in the SW, being the cause of the development of fresh water lakes and of profound future changes in hydrological conditions, are added as special features of the Netherlands.

REFERENCES

- Geologische Stichting, 1947 – Kleine geologische overzichtskaart van Nederland, schaal 1 : 600,000, Topografische Dienst, Delft.
- Pannekoek, A.J., editor, 1956 – Geological History of the Netherlands, Government Printing and Publishing Office, the Hague.
- Unesco, 1970 – International Legend for Hydrogeological Maps (in 4 languages), Paris.
- Visser, W.A. and Heide, S. van der, 1969 – The International Hydrogeological Map of Europe, Geol. en Mijnb. 48, p. 257-259.