Hydrographic Information Systems and Cartography in Poland

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Introduction

- The significance of the information concerning hydrological and hydrographic conditions for Polish economy is special, as the country belongs to the poorest in Europe when it comes to water resources counted per one inhabitant (1,5 thousand cubic meters, with the European mean value of 4,5 thousand cubic meters per person). Central Poland is also liable to a process called "stepping". Adding to this the not–very–good state of cleanliness of surface water – flowing and stagnant, as well as sea– coastal water – the quantitative and qualitative water resources of the country require a particularly precise monitoring as well as taking adequate preventive measures for the improvement of country's water balance and management.
- This paper presents an outline of the existing Polish spatial information systems and cartographic studies related to the water conditions issues, with special regard to hydrographic aspects.

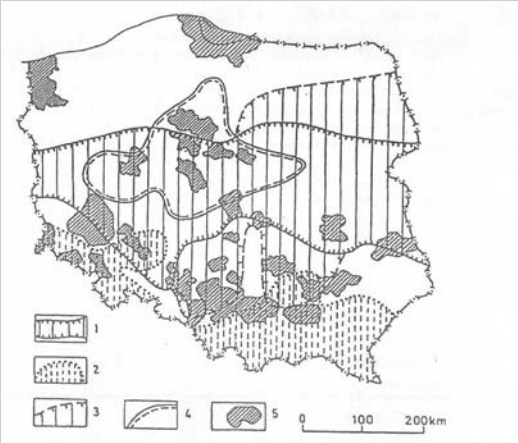


Fig. 1. Areas of surface water deficit and ecological threat in Poland

1.Areas of surface water deficit (monthly outflow equal or below 2 l / sek. km^2)

2.Areas of underground water deficit (below 0,11 l / sek. km^2)

3.General range of surface water deficit

4.Main area threatened by stepping

5. Areas of ecological threat

Information concerning water in the Spatial Information Systems in Poland:

- information system of environmental monitoring (soils, water, air)
- information system for the needs of the ***Geological Map of Poland***
- information system for meteorology and water management
- information system for the needs of hydrographic division of the country
- information system concerning swamps and grasslands.

- The national environment monitoring system is connected with the European Environment Information and Observation Network (EIONET) which is a branch of the European Environmental Agency (EEA). The Polish EIONET structures comprise, among others, the Chief Inspectorate of Environmental Protection, the Institute of Meteorology and Water Management, the Ministry of the Environment. The EU Census Bureau (Eurostat) collects through questionnaires comprehensive information about water (water management, water protection).

Evolution of Polish hydrographic cartography

- 1850: The Hydrographic Chart of the Polish Kingdom (1: 1,000 000).
- 1882: The Hydrographic Map of Old Slav Lands – the North – Western Part (1: 2, 000 000).
- 1925: The Review Hydrographic Map of the Republic of Poland (1: 750,000).
- 1957: The Polish Land Use Review Map (1: 1,000 000) based on the mid – war topographic maps in the same scale.
- 1951: The hydrographic mapping combined with the geomorphological mapping was initiated.

History of the Hydrographic Map of Poland (1: 50,000):

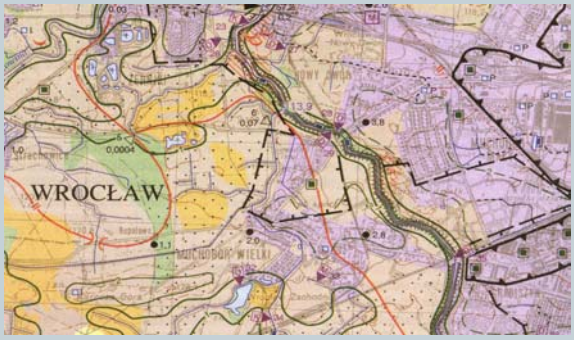
- 1951 – 1968: mapping comprised 19% of country's area
- 1984: the new map began to appear on the foundation of a topographic map of the 1965 coordinate system
- 1994: the 1992 coordinate system came into use
- 2004: the vector map (VMap L 2) was introduced, basing on a new technical directives GIS – 3.
- 2006: The Hydrographic Map covers 51% of the area of Poland.

Other chosen cartographic studies concerning hydrography:

- 1975 – 1980: The Review Hydrographic Division of Poland (1: 500,000).
- 1980: The Hydrographic Division of Poland (1: 200,000).
- Since 1983: The Geological – Economical Map of Poland (1: 50,000), since 1997 fulfills requirements of spatial information system – GIS.
- 1987: The Hydrological Atlas of Poland (1: 500,000).
- The Atlas of the Swamps of Poland (accomplished in the nineties) at the scale of 1: 300,000.
- 1996 – 2004: The Hydrogeological Map of Poland (1: 50,000)
- 2005: The Atlas of the Hydrographic Division of Poland (1: 50,000).

Review of chosen maps concerning water conditions

- ***The Hydrographic Map of Poland*** (1: 50,000) – in analogue and digital versions – is a thematic map offering a synthetic presentation of the conditions of water circulation against the background of geographic environment. The content of the map includes detailed information concerning:
  - topographic watersheds, surface water, underground water outflow, ground permeability, water management objects and phenomena, discharge gauging stations.
- The numerical map has been worked up in GIS, which meets, among others, the following requirements:
  - has a layer structure (each of the layers contains vector objects from the specified thematic range) as well as a descriptive database
  - offers a possibility of exchanging information with other GIS systems
  - enables the adjustment of the projection and the system of coordinates of a numerical map to the national system of spatial reference currently in force in Poland
  - allows to print the map in the CMYK system
  - offers a possibility of combining the neighbouring sheets into bigger vector areas.
- The raster foundations of combined situation and relief have a minimal resolution of 508 dpi.



- The Hydrographic Map of Poland (1: 50,000)

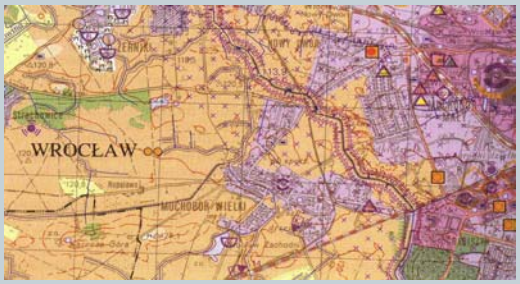
  – surroundings of Breslau (fragment of the sheet M – 33 – 34 – D Wrocław – Zach.); Chief Geodesist of the Country

- ***The Map of the Hydrographic Division of Poland*** (1: 50,000) presents:
  - the uniform, continuous hydrographic database for the whole area of Poland in the 1992 coordinate system
  - the set of vector informatics layers GIS (ArcInfo) with a reference database (full geometric and descriptive characteristics of the water network and river catchments)
  - the basis for the creation and periodical updating of thematic layers in the range of water management, hydrography, geology, protection of nature, etc.
  - the visualization and cartographic presentation of hydrographic data of varied thematic range, in the catchment system.

- The **informatics layers** (ArcInfo coverage) comprise:
  - marked streams, i.e. such for which catchments have been pointed out (rivers, streams, canals, ditches, etc.)
  - marked lakes (lakes, reservoirs, ponds)
  - catchments (in the hierarchic system)
  - unmarked streams, i. e. such that can, if necessary, be moved to a marked layer, after their catchment has been pointed out
  - unmarked lakes.
- The **reference database** comprises mainly:
  - marked streams sections, with the description of their character, type, kind, width, length, etc.
  - watersheds with their category, length, course, type
  - catchments – their perimeter, area, type (e.g. bifurcating, with no surface outflow)
  - characteristic points on streams (e.g. water spring) and watersheds (e.g. water gates)
  - lakes – their area and perimeter
  - hydrographic identifiers of streams and catchments
  - vocabulary index – names of catchments, streams, lakes.

- ***The Sozological Map of Poland*** (1: 50,000) presents human influence on natural environment. Works on a serial ***Sozological Map of Poland*** began in 1990.
- The content concerning **degradation of surface water** comprises information about:
  - sewage discharge (place of outflow, character) exceeding surface water contamination indices (physical, chemical, bacteriological)
  - quality of surface water in gauging stations (cleanliness classes, exceeding cleanliness norms)
  - contamination of coastal water (river water, industrial, municipal and agricultural sewage discharge, etc.).
- The content referring to the **change in water conditions** concerns mainly the anthropogenic influence on the rivers and water reservoirs regime – comprising such information as:
  - swollen surface water, industrial water reservoirs, fish-breeding ponds, other artificial water reservoirs, the loss of hydraulic links (long–lasting lowering of underground water surface causing, the loss of contact with river water, tightly built–up river beds), anthropogenic distortions of the hydrological regime of the stream, stream beds artificially transformed.

The content concerning the **degradation of underground water** comprises such information as:



The Sozological Map of Poland (1: 50,000) – surroundings of Breslau (fragment of the sheet M – 33 – 34 – D Wrocław – Zach.); Chief Geodesist of the Country

- grounds particularly susceptible to infiltration
- contaminated underground water (mainly on anthropogenic lands in non–seweraged settlements)
- direction of contamination transport in underground water (the direction stated or suspected)
- underground water surface artificially lowered
- depression sink (at present) – on the areas of water intake, mining exploitation, etc.
- renewability of underground water resources and their admissible management.

- ***The Hydrogeological Map of Poland*** (1: 50,000) is a serial map, accomplished in sheets in the INTERGRAPH computer system.
- The map contains the following **information**:
  - hydrogeological regionalization
  - water – bearing characteristics
  - hydrodynamics
  - quality of underground water (main usable water – bearing level, water quality indices, contamination sources, river water purity classes)
  - degree of threat to underground water
  - representative water springs, bore – holes, dug wells
  - explanatory text for each sheet.

- ***The Geological – Economical Map of Poland*** (1: 50,000) deals also with such problems as:
  - chosen hydrogeological elements intrinsic for the protection of surface and underground water against irrational management
  - cleanliness class for river water
  - borders of underground water reservoir
  - areas of degraded quality of underground water
  - borders of depression sinks
  - protection zones for spas and water intakes.

- ***The Atlas of the Swamps of Poland*** – natural and transformed (1: 300,000) consists of:
  - protected areas
  - outlines of swamps, considering: the occurrence of plant communities, type of swamps and the degree of anthropogenization, the area of swamps (below 10 ha, 10–50 ha, more than 50 ha).
- ***The Atlas of the Hydrographic Division of Poland*** (1: 200,000) contains 112 map sheets and the descriptive characteristics of water network, watersheds, etc. comprising 770 thousand objects.

Conclusion

The range of fields in which hydrographic, hydrogeological and related to them **information may be used** is very wide and comprises, among others:

- spatial planning and management
- issuing decisions concerning localization of ventures troublesome for environment
- planning investments in the range of water management
- designing water intakes and protection zones
- drawing up the listing of underground and surface water constituting the source of water supply
- working up programmes for surface and underground water protection.

The contemporary spatial planning in Poland makes a wide use of the existing databases, information systems, cartographic documents, etc. concerning hydrography. This information is used in **regional and local planning** in the range of water management and protection, serving the realization of the principles of **sustainable development.**