COUPLING GIS WITH A DATABASE FOR HYDROGEOLOGICAL MAPPING

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The Walloon Region of Belgium, *Direction Générale des Ressources Naturelles et de l'Environnement (DGRNE)*, has initiated in 1999 the first Belgian hydrogeological mapping program. Four Walloon universities are involved : Faculty of Applied Sciences of Mons, Luxembourg University Foundation of Arlon, University of Liège and University of Namur. Twenty-height hydrogeological maps are already completed at a 1/25,000 scale but they are not yet officially published. Meanwhile, these documents are strongly required by environmental research and management actors. At the annual rate of three maps per team, the entire hydrogeological coverage of the Walloon region should be completed in 2010.

The hydrogeological data come from numerous and various sources as water regulators (Walloon Region administrations), water supply companies, Belgian geological survey, environmental agencies, industries, public and private institutions, farmers and many others. These primary data concern general environmental information (topography, geology, climate, land-use,…), hydrological and hydrogeological raw or pre-processed data,… (Figure 1). Such abundant and complex information need an organized scheme for capturing, storing, editing and displaying geographically referenced hydrogeological data that hydrogeologists use. A georelational hydrogeological database was thus created, whose development was constrained by a maximum storage of data with a minimum data redundancy, reduction of storage memory capacity and optimum retrievability of information for further analysis. This georelational database has been developed using Access (Microsoft) in order to ensure compatibility in future data-exchange operations. It could also be used to process and analyse spatially distributed data and to provide data sets in order to generate secondary information layer as maps of transmissivity, hydrochemical maps, vulnerability maps,…(Figure 1).

Data are stored in the many tables which constitutes the database. Each table concerns only either punctual (wells, springs,…) or linear (galleries,…) or polygonal elements (protection zones, watersheds,…). The main table, called *Groundwater (point)*, contains general information (unique number, geographic position, type, name, code, owner,..) about wells, springs, boreholes, drains,…(all punctual elements) (Figure 2). The others tables contain more specific information as technical characteristics, quantitative data (flow, volume, piezometric head, tests,…), qualitative data (hydrochemistry), geological data,... The relationships (one-to-one or one-to-many) between those tables are made in using a unique number. Furthermore, to ease data encoding, storage and queries construction, dictionaries (chemical parameters, topographic maps, consultant offices, laboratories,…) were added as reference tables replacing descriptions by ID-numbers. To improve the use of the database, several pre-defined queries are included in the project, like geocentric query, query based on the owner, on the topographic map, on the investigated aquifer,… A user-friendly interface (forms) is made to help the encoding and the reading in the database.

This georeferenced database is linked to an ArcView GIS project, by spatial queries and a Standard Query Language (SQL) connection (existing GIS function). The hydrogeological data stored in the database

can be easily updated and represented on the hydrogeological map. All points of the map are linked to the hydrogeological database by their unique number. For this project, a new Avenue extension (BDHydro.avx) has been developed for ArcView 3.2a (Environmental Systems Research Institute, ESRI). This allows to query directly and easily the data stored in the Access database from the ArcView project. All information about wells, piezometers …(all points) can be visualized by a simple click on one of the element of the map. It is thus possible for the user to show in the GIS project for example a hydraulic head evolution, exploited volumes, a chemical analysis table, a drill technical and geological log diagram,…

The use of Geographical Information Systems (GIS) has grown quickly in groundwater management and research. GIS is now widely used to create digital geographic databases, to manipulate and prepare data as input for various model parameters, and to display model output. This hydrogeological mapping program will allow in the near future to meet efficiently the needs for a more considered and effective management of Walloon groundwater thanks to the coupling of a Geographical Information System with a complex hydrogeological database.

References

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Figure 1. Hydrogeological data scheme

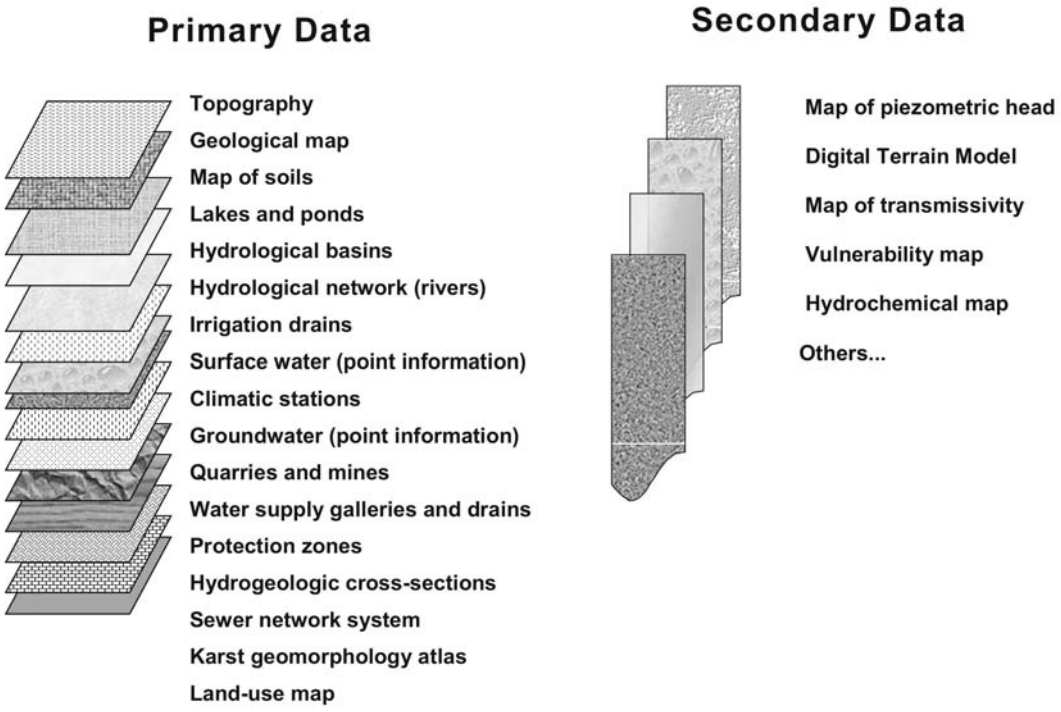

Figure 2. Simplified version of the attribute data scheme for "groundwater points"