Coupling GIS with a Database for Hydrogeological mapping

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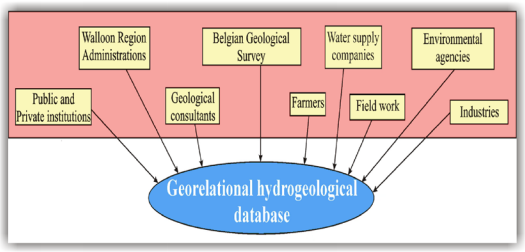
Introduction

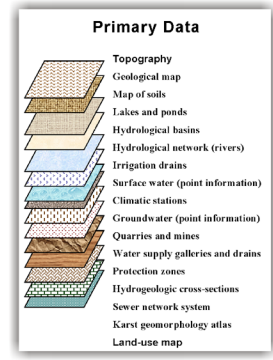
The Walloon Region of Belgium, *Direction Générale des Ressources Naturelles et de l'Environnement (DGRNE)*, has initiated in 1999 the first Belgian program of hydrogeological maps. These documents, strongly required by environmental research and management actors, are developped similtanuously with an extended hydrogeological database.

Primary data

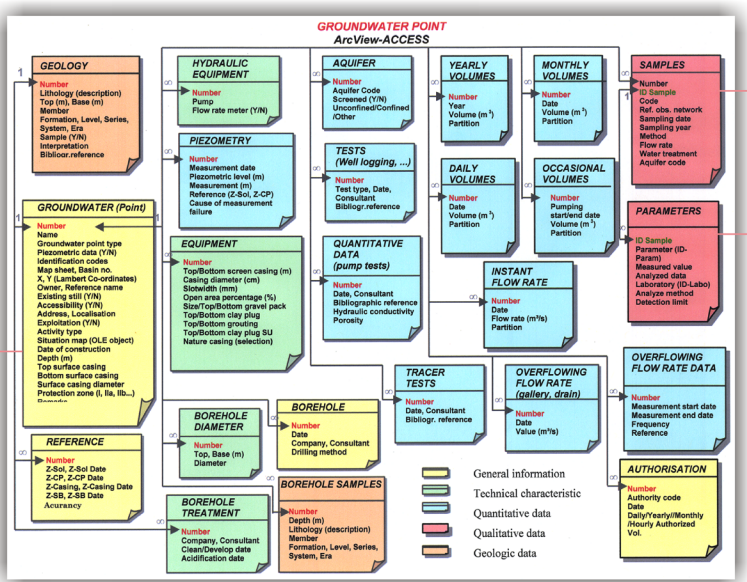
Methodology



The data which are necessary to realize the hydrogeological map come from numerous and various sources. These primary data concern general environmental informations (topography, geology, climate, land-use,…), hydrological and hydrogeological raw or pre-processed data,… Such abundant and complex informations need an organized scheme for capturing, storing, editing and displaying georeferenced data used by hydrogeologists.

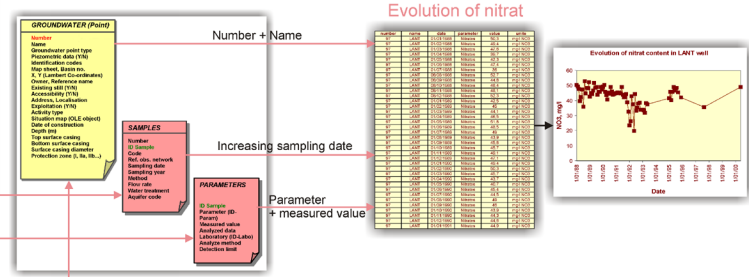


Hydrogeological database (BDHydro)



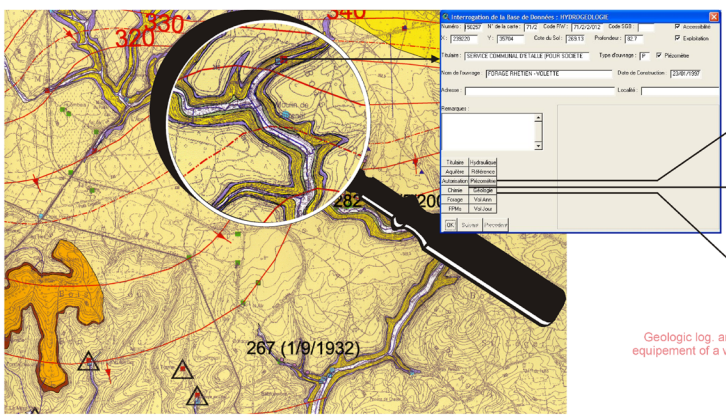
The georelational hydrogeological database has been developped using Access (Microsoft®). Data are stored in many tables linked by one-to-one or one-to-many relations. The main table, called Groundwater (point), contains general informations about all ponctual elements such as wells, springs, boreholes, drains, etc. The others tables contain more specific informations such as technical characteristics, quantitative data, qualitative data, geological data, etc.

The database structure allows an easy retrieval of specific informations as the piezometric evolution, the hydrochemical analysis, the record of exploited volumes, etc. using queries based on owners, topographical maps, investigated aquifer... and locations (geocentric query).

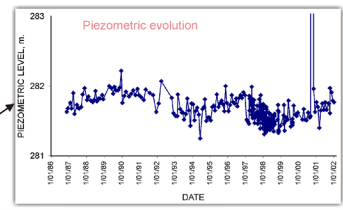


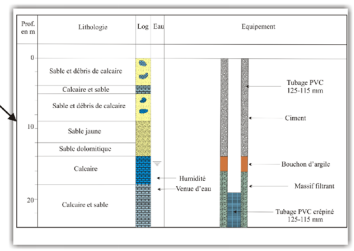
Coupling GIS-BDHydro

The georeferenced database is linked to the hydrogeological ArcView project, by an active ODBC/SQL connection which allows an automatic update of the hydrogeological map. Furthermore, a new Avenue program (BDHydro.avx) has been developed for ArcView 3.2a (ESRI®) in order to query directly and easily the data stored in the Access database from the ArcView project.



Fond topographique : Institut Géographique de Belgique





Geologic log. and equipement of a wells

Chemical characterization

descr	expr	valeur	normes
Conductivité	µs/cm à 25°C	390	2100
Température (in-situ)	° Celsius	23,1	25
pH	unités pH	7,48	6,5<pH<9,2
Dureté totale	° français	25,5	67,5
Alcalinité totale (TAC)	° français	17,65	
Calcium	mg/l Ca	75	270
Magnésium	mg/l Mg	3,6	50
Sodium	mg/l Na	2,08	150
Potassium	mg/l K	0,42	12
Fer (total) dissous	µg/l Fe	<0,001	200
Manganèse	µg/l Mn	<0,001	50
Sulfates	mg/l SO4	18	250
Bicarbonates	mg/l HCO3	215	
Chlore libre résiduel	mg/l	3,8	0,25
Ortho-Phosphates	mg/l PO4	<0,01	
Silice	mg/l SiO2	9	
Nitrates	mg/l NO3	3,3	50
Nitrites	mg/l NO2	<0,01	0,1
Ammonium	mg/l NH4	<0,01	0,5
Résidu sec	mg/l après séchage à 180 ° C	210	1500
(biodégradable)	mg/l C	0,23	
Aluminium	µg/l Al	<2	200
Antimoine	µg/l Sb	<2	10
Argent	µg/l Ag	<0,3	10
Arsenic	µg/l As	<2	50
Baryum	µg/l Ba	4	
Beryllium	µg/l Be	<0,1	
Bore	µg/l B	27	
Bromures	mg/l Br	26	
Cadmium	µg/l Cd	<0,05	5
Cobalt	µg/l Co	<2	
Cuivre	µg/l Cu	<1	100
Cyanures (totaux)	µg/l CN	<2	10
Chlorates	µg/l ClO3	<10	
Chrome (total)	µg/l Cr	<1	50
Etain	µg/l Sn	<1	
Fluorures	mg/l F	<50	1,5
Lithium	µg/l Li	3	
Mercure	µg/l Hg	<0,03	1
Molybdène	µg/l Mo	<1	
Nickel	µg/l Ni	<2	50
Plomb	µg/l Pb	<1	50
Selenium	µg/l Se	<2	10
Strontium	µg/l Sr	<100	
Titane	µg/l Ti	<1	
Vanadium	µg/l V	<2	
Zinc	µg/l Zn	<1	200

Conclusions

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. Coupling GIS with an hydrogeological database provides a powerful tool to meet efficiently the needs for a more considered and effective management of groundwater.