Groundwater in the Czech part of Neisse River basin

Delineation method (3,1 – Czech strategy for water body delineation)

The basis for the determination of groundwater bodies in the Czech Republic was the hydrogeological zoning created about 40 year ago. In accordance with the Water Act No. 254/2001 Coll. and related implementing regulations (the Decrees of the Ministry of Agriculture No. 431/2001 and No. 432/2001 Coll.), hydrogeological zones are the basic units for groundwater balance and for storage of related records and they are a part of the public administration information systems. However, apart from the quantitative view, also quality assessment, i.e. the assessment of chemical status, needs to be taken into account for the requirements of the Water Framework Directive. At present, there is a new delineation of groundwater bodies in progress, which reviews the current knowledge of the environment of groundwater circulation and other requirements of the Water Act including the requirements and definitions of the Water Framework Directive.

The delineation of groundwater bodies in the 2004 stage is based on the delineation of hydrogeological zones of 1986, with necessary adjustments. The proposal for the method of delineation of groundwater bodies and groups of bodies includes the following basic steps:

- The existing hydrogeological zones will be used as a basis for the initial characterisation.
- The first step of the initial characterisation is an analysis and adjustment of the current hydrogeological zones, so that they can be considered as groundwater bodies or groups of bodies as regards natural conditions.

The Water Framework Directive interprets the term “groundwater body” (WFD Section 2.12) as a distinct volume of groundwater in an aquifer or in more aquifers defined by Section 2.11. The aquifer, as a rock environment where a water body is found, is essential for the definition of groundwater bodies and, primarily, for the elaboration of obligatory natural conditions.

The principle applied in the analysis is based on the possibility to assign each groundwater body to an international river basin according to the Water Framework Directive. In the case of basin structures, this mostly included consideration whether a zone is only discharged significantly into one or more international river basins. If a body boundary exceeds an international river basin and it is discharged mainly into this river basin, the current zone boundaries were not changed and the zone became a groundwater body. In the case of a significant discharge of such a zone into two international river basins, the zone was divided, based on an expert opinion, either according to the hydrogeological basin boundary or on a hydraulic principle.

All of the proposed boundaries of hydrogeological zones were revised in regard to the possibility of their definition and closure of flow. The proposed system makes it possible, if necessary, to balance either individual aquifers or hydrogeological zones or, conversely, several zones combined (e.g. zones of deeper structures together with quaternary zones), if this is reasonable (in the case of connectivity) or necessary (due to a temporary lack of data). Based on the results of geological, hydrogeological, water balance and water management analyses, a

proposal for the boundaries of groundwater bodies has been drawn up. The bodies are divided to three separated layers lying on top of one another:

- Layer of cenomanian bodies (bottom layer)
- Layer of main bodies
- Layer of top bodies (quaternary bodies and one cretaceous body)

Quaternary bodies have been changed against quaternary zones minimally.

The layer of bodies in basal cretaceous collector (cenomanian bodies) is completely new and it has been created by combining cretaceous zones on the right bank of the Elbe and subsequently by dividing them according to flow lines to four regions:
4710 – Basal cretaceous collector on the Jizera;
4720 – Basal cretaceous collector from Hamr to the Elbe;
4730 – Basal cretaceous collector in the Benešov synclinal fold;
4740 – Basal cretaceous collector in the Jetřichovice anticlinal fold.

The other cenomanian layers have been assigned as aquifers to the other cretaceous bodies, i.e. they are not determined separately.

Delineation of groundwater bodies

Groundwater bodies are currently delineated according to natural conditions. In the Czech Republic, 137 groundwater bodies (or groups of bodies) have been delineated according to natural characteristics and they are comprised of 156 single aquifers. It means that some water cretaceous bodies comprise more aquifers (max. 3).

Natural characteristics of groundwater bodies

For characterisation of groundwater bodies and for evaluation of effects and impacts, it is necessary to know the basic general and natural characteristics of groundwater bodies. The subject of natural characteristics, bound directly to the layer of bodies, are the following data:

- General data (ID, name, etc.);
- Selected natural characteristics (e.g. body area);
- Hydrogeological characteristics (relating to a collector or rock environment
  – stratigraphy, lithology, transmissivity, etc.);
- Discharge place of a groundwater body or a group of bodies (it expresses the dependence of surface-water ecosystems).

Each body or a group of bodies has its 4-digit code taken and extended from hydrogeological zones, which also applies to its name. Codes and names are unique, which means that no two bodies have the same code and name. General data also include whether it is a body or a group of bodies. The aquifer code consist of a body code and a serial number of the aquifer which also specifies its vertical position: Aquifer No. 1 is located on top, while Aquifer No. 3, if any, is the lowest/deepest.

4.1 – Czech strategy for pressure and impact analysis

In Czech Republic initial characterization of groundwater bodies was completed for the whole territory. It included particular steps:

- Delineation of groundwater bodies,
- Nature characteristics of bodies
- Dewatering of groundwater bodies
- Vulnerability of soil and rock environment against pollutants
- Inventory and assessment of significant pressures (abstractions, point sources of pollution and diffuse sources of pollution)
- Balance characteristics of groundwater bodies
- Evaluation of present monitoring
- Identification of groundwater bodies at risk

Risk assessment of groundwater bodies was performed both in view of chemical status and in view of quantitative status.

Risk assessment in view of quantitative status was based on available dates:

- Quantity of groundwater abstraction in period 1997-2002 (accounting abstractions >6000 m^3/year)
- Location and total abstractions in particular groundwater bodies
- Base flow (long term and annual dates) for particular bodies – fractiles 50, 80 and 95%
- Rates between maximal abstractions and long term base flow dates
- Rates between maximal abstractions and lowest annual base flow dates

Criteria for risk assessment of groundwater body was set as follows:

- Ratio abstraction/base flow 50% >0,5
- Ratio abstraction/base flow 80% >0,75
- Ratio abstraction/base flow 95% >1
- Missing dates concerning base flow
- Hydraulic connection with other body
- Influence on quantity of surface waters
- Destabilization of base flow

Risk assessment in view of chemical status was based on point sources of pollution, diffuse sources of pollution (nitrogen, acidification, pesticides) data and on other significant pressures. For particular categories direct and indirect assessment method was used. Also evaluation of representativeness of present monitoring network was part of risk assessment. As result of synthesis of direct and indirect assessment and actual monitoring groundwater bodies in view of risk for each category (point sources of pollution, nitrogen, acidification, pesticides) were assessed. In conclusion of assessment the synthesis of categories was performed, which result in classification of each groundwater body into “at risk” or “not at risk” category. After including other significant pressures final synthesis was performed.

Groundwater monitoring in the Czech section of the Neisse River (6.1 – Czech strategy for monitoring)

According to its foundation deed, the Czech Hydrometeorological Institute (CHMI) is responsible for the operation of state water quality monitoring networks. It currently secures the operation of the groundwater quality monitoring network. It provides groundwater sampling and sample analysing in external accredited laboratories. CHMI performs data collection, their checking and storage in the national database, and presentations and basic routine evaluations of these data.

In the Neisse River basin, in present state monitoring network, 36 groundwater monitoring structures (29 wells and 7 springs) are operated. The determination of quality indicators is performed in two groundwater structures (wells) – VP 2015 Višňová, hydrogeological zone 143, and VP 1966 Chrastava (Andělská Hora), hydrogeological zone 641, within operational monitoring. Only 24 indicators of 119 monitored water quality indicators in both wells from 2002 to 2004 were above the determination limit in VP 2015, while 28 indicators in VP 1966. The quality of water in both wells meets the requirements for raw water intended for treatment to obtain drinking water according to the Czech legislation. At the other 34 structures (27 wells and 7 springs), level movement and temperature (in the wells), and yield and temperature (in the springs) are monitored.

At present, the groundwater state monitoring network is being reconstructed in such a way that monitoring results meet the EU requirements and the requirement for groundwater protection in a densely populated and industrialized country. The newly proposed monitoring network has to cover, while the bases are met, i.e.:

- Identification of long-time trends
- Incorporation of ground waters in the hydrological balance as discharge components,
- Monitoring of water use and other anthropogenic influence on groundwater regime
- Collection of data for water-management balance,
- Assessment of influence of groundwater regime on the ecosystem as a whole,

appropriately the entire area of the Czech Republic and to record, in more details, those hydrogeological structures where the largest amount of groundwater is created.