Status assessment for groundwater: characterisation and methodology

Annex 9 of the DRBM Plan

1. Deep groundwater body – thermal water	
Member State code (MS_Code)	**DEGK11110, ATGK100158**
Description of important transboundary groundwater body (GWB)	The thermal groundwater of the Malmkarst (Upper Jurassic) in the Lower Bavarian and Upper Austrian Molasse Basin is of transboundary importance. It is used for spa purposes and to gain geothermal energy. All the used geothermal water is reinjected into the same aquifer. The transboundary GWB covers a total area of 5900 km²; the length is 155 km and the width is up to 55 km. The aquifer is Malm (karstic limestone); the top of the Malm reaches a depth of more than 1000 m below sea level in the Bavarian (Germany, DE) part and 2000 m below in the Upper Austrian (AT) part. The groundwater recharge is mainly composed of subterranean inflow from the adjacent Bohemian Massif and infiltration of precipitation in the northern part of the GWB area. The total groundwater recharge was determined to be 820 l/s. The GWB is included in the Danube Basin Analysis (DBA) because of its intensive use. An expert group is responsible for bilateral exchange of information and sustainable transboundary use.
Description of the status assessment methodology	Basic remarks: As already presented previously, the access to information regarding deep GWBs is extremely difficult. This is first and foremost due to the fact that the establishment of measuring sites is technically very complicated and very expensive. Consequently it has not been possible for the water management administrations of both countries to set up and maintain a separate comprehensive measuring and monitoring network for the deep GWB in the Lower Bavarian – Upper Austrian Molasse Basin. Instead, wells (from which thermal water is abstracted for geothermal and balneological utilization) are used as measuring and sampling sites. Measurements and sampling are carried out by the private plant operators according to requirements laid down by the authorising bodies from both countries. Attention should be paid to the fact that in spite of the above-mentioned GWB sampling and additional studies carried out to identify the thermal-hydraulic conditions, the level of knowledge about the deep GWB is insufficient to describe its quantitative and qualitative status in analogy to a near-surface GWB. Therefore it was necessary to develop a procedure adapted to the given conditions for the identification of the quantitative and the qualitative status of the deep GWB. In future this procedure will have to be examined and, if necessary, adapted according to the extent and quality of data available. The procedure will have to be discussed and adopted by the "Permanent Commission after the Regensburg Treaty". **AT / DE: *Chemical status*** The *qualitative status* of the deep GWB will be described on the basis of measurement and analysis data according to a procedure agreed between the two states. The decisive parameters for the evaluation of the *qualitative status* of near-surface GWBs (such as nitrate and pesticides) are not relevant for deep GWBs. As expected, the parameters measured in the GWB extending over 5900 km² differ (in some cases considerably) from site to site. This is due to regionally different geo-hydraulic conditions. Therefore the description of the qualitative status cannot be made in the same way as that for near-surface GWBs (on the basis of aggregated data), but made on the basis of measurement and analysis data available at every individual measuring site. Contrary to near-surface GWBs, it should be considered that, due to the utilization of the waters (balneological and thermal uses), *good status* is not only not achieved if the concentration of certain contents rises above a certain level, but also if it falls below it. The available data is presently not sufficient to identify precisely enough the scope

<table>
<tr><th colspan="2">1. Deep groundwater body – thermal water</th></tr>
<tr><td></td><td>of fluctuations relevant for individual parameters at the individual measuring sites.

Good qualitative status is considered to be reached if the threshold value (TV) of the decisive parameters neither exceed nor fall below the scope of fluctuations determined for every measuring site. It is planned to examine the current selected scope of fluctuations on the basis of many years of monitoring, (at least over a period of 10 years) and to adapt them, where required.

In any case, the GWB is considered to be in a good qualitative status if at least 75% of the measuring sites meet good status.

The following parameters are used as a basis for the determination of the qualitative status of the deep GWB: temperature, electrical conductivity, total hardness, sulphate and chloride.

The findings available at the individual measuring and sampling sites for the short period from 2005 to 2007 show comparable results. Thus the deep GWB in the Lower Bavarian - Upper Austrian Molasse Basin is of good quantitative status.

AT / DE: Quantitative status

There is no interaction between deep groundwater and surface waters and/or terrestrial ecosystems.

The quantitative status of the deep GWB can be described by means of:
- the identification of trends over a period of many years monitoring of the level of hydraulic pressure at groundwater measuring sites and wells;
- a balancing calculation: a comparison between the thermal water supply and thermal water abstractions.

Apart from Bad Füssing (records since 1948), no long-term monitoring of pressure potentials that would be significant for a trend analysis is available.

As early as in 1998, detailed thermal water balancing was carried out for the deep GWB. In the course of this balancing an exploitation of the available thermal water resources by thermal water abstractions of about 25% was recorded, which corresponds to a good quantitative status (at least 30% of the quantity available).

In the meantime, the extent of utilisation has been considerably reduced due to successfully implemented management measures (among other things the obligation to reinject the used thermal water exclusively). Good quantitative status could be even further improved on the basis of the level of hydraulic pressure in the thermal waters of Bad Füssing which has risen again since then.

With a view to the regionally uneven distribution of the available quantity, water abstraction points and abstracted water quantities, a sub-division of the balance area into sub-areas can be made. For these areas the decisive balance parameters can be determined separately.</td></tr>
<tr><td colspan="2">In the case of poor chemical status:</td></tr>
<tr><td>Parameter(s) responsible for poor status</td><td>AT:

DE:</td></tr>
<tr><td>Further information on TVs</td><td>Procedure: Brief summary of the way the procedure set out in Annex II Part A of the Directive 2006/118/EC has been followed in order to derive TVs. [< 5000 characters]

AT:

DE:

Relationship: Brief summary of the relationship between TVs and background levels for naturally occurring substances. [< 2000 characters]</td></tr>
</table>

1. Deep groundwater body – thermal water				
	AT: DE:			
TVs per GWB	GWB	Pollutant / indicator	TV (or range) [1] (mg/l or µg/l)	Level at which the TV is established (national, RBD[2], GWB)

[1] Insert the range of TVs if different TVs are applied within the national aggregated ICPDR GWB

[2] River Basin District

2: Upper Jurassic – Lower Cretaceous groundwater body	
Member State Code MS_Code	**BG_DGW02 / RO_DL06**
Description of important transboundary GWB	Criteria for delineation: the development of Upper Jurassic- Lower Cretaceous permeable deposits and water content in these deposits. Geological overview: stratigraphic age is Upper Jurassic- Lower Cretaceous. Lithological composition: limestones, dolomitic limestones and dolomites. Overlying strata consists of marls, clays, sands, limestones, pebbles and loess. The age of the above mentioned deposits is Hauterivian, Sarmatian, Pliocene and Quaternary. Excluding small cropped out areas, the GWB is very well protected. Main GWB use: drinking water supply, agriculture and industry supply. There is no significant impact on the GWB in either Bulgaria (BG) or Romania (RO). In Romania the GWB has an interaction with Lake Sintghiol situated near the Black Sea. The criterion for selection as 'important' is size, which exceeds 4000 km².
Description of status assessment methodology	**BG: *Chemical status* and *quantitative status*** 1. Comparison was made between total water abstraction according to permits and exploitation resources. 2. Standards for groundwater quality were established using Annex 1 of the Regulation N-1/2007 for Research, Water Use and the Protection of Groundwater. 3. TVs were defined according to the "Common methodology for groundwater threshold values" developed by the EU WFD CIS Working Group C (WGC). According to Article 4 of the GWD, a GWB is of *good status* when Groundwater Quality Standards (GW-QSs) or TVs are not exceeded at any monitoring point. Where a GW-QS or TV has been exceeded at one or more monitoring points, appropriate investigation (with appropriate aggregation of the monitoring results), is needed to estimate the extent to which the GWB (in terms of volume or spatial area) has an annual arithmetic mean concentration of a pollutant higher than a GW-QS or TV. This concerns the assessment of: - significant environmental risk from pollutants across a GWB; - no significant impairment of human uses; - saline and other intrusion. To satisfactorily carry out the appropriate investigation(s), additional data may be used to refine the conceptual model and/or confirm the extent of exceedance. 4. The ratio between the extent of exceedance of the GWB compared with the total area of the water body was calculated (< 20%: good; >20%: poor, according to guidance on groundwater *chemical status*, status and trends - WGC). The extent of exceedance of the GWB is the spatial area – part of the GWB, obtained by adding up the area of circles surrounding the monitoring points having an annual arithmetic mean concentration of a pollutant higher than a GW-QS. 6. Trends in pollutant concentrations were calculated. The present groundwater status assessment was made for every GWB on the basis of conceptual models of aquifers, *chemical status* data from the national monitoring system for the periods 2004-2006 and 2007-2008. Monitoring data from drinking water supply sources for the period 2004-2007 have also been

2: Upper Jurassic – Lower Cretaceous groundwater body	
	used. Groundwater *quantitative status* was evaluated on the basis of a comparison between total water abstraction according to issued water use permits and exploitation resources established by "Orders of the Water Basin Directors". All transboundary GWBs were determined to be *not at risk*. For groundwater status assessment, TVs were determined**:** - For GWBs *at risk*: TVs for nitrates, ammonia, total iron. - Sea water intrusion: for chlorides and sulphate TVs, the background values were used in compliance with the EU WFD CIS Guidance on Groundwater Chemical status and Threshold Values. Only one GWB was determined *at risk* (for nitrates content). There is no available methodology for assessment of groundwater pollution from diffuse sources at this moment. A procedure is underway to attempt to address these problems. **RO: *Chemical status*** The methodology for *chemical status* assessment generally followed recommendations of the WGC in the document "Towards a Guidance on Groundwater Chemical Status and Threshold Values". The first step was to check for any exceedances of TVs. As no exceedance was present, the GWB was considered in *good status*. **RO: *Quantitative status*** Assessment was carried out after the *chemical status* assessment. As the *chemical status* was assessed as *good* and no sustained downward trend in water level was recorded across the water body (at any monitoring point), the water body was found to have *good quantitative status*.
In the case of poor *chemical status*:	
Parameter(s) respon-sible for *poor status*	**BG / RO:**
Further information on TVs	**Procedure:** Brief summary of the way the procedure set out in Annex II Part A of the GWD has been followed in order to derive the TVs. [<5000 characters] **BG / RO:** **Relationship:** Brief summary of the relationship between TVs and background levels for naturally occurring substances. [< 2000 characters] **BG / RO:**

Threshold values per GWB	GWB	Pollutant / indicator	TV (or range)[3] (mg/l or µg/l)	Level at which the TV is established (national, RBD, GWB)

[3] Insert the range of TVs if different TVs are applied within the national aggregated ICPDR GWB

<table>
<tr><td colspan="2">3: Middle Sarmatian – Pontian groundwater body</td></tr>
<tr><td>Member State Code MS_Code</td><td>RO_PR05/MD_PR01</td></tr>
<tr><td>Description of important transboundary GWB</td><td>The criterion for delineation of the Romanian (RO) - Moldovan (MD) GWB was the development of the Sarmatian aquiferous deposits in the territories of Neamt, Bacau and Vaslui districts, situated in the Siret and Prut River Basins. Lithologically, the water-bearing deposits are constituted of thin layers of sands and sandstones. The overlying stratum is represented by clay of about 50 m in thickness. The GWB is locally used for drinking water supply. The criterion for selection as “important” is its size, which exceeds 4000 km^2.</td></tr>
<tr><td>Description of status assessment methodology</td><td>RO: Chemical status

The methodology for the chemical status assessment followed the recommendations of WGC in the document “Towards a Guidance on Groundwater Chemical Status and Threshold Values”.

The first step was to check for any exceedances of TVs. As exceedance of the TV for NH_4 was recorded, the following relevant tests were carried out:
- General assessment of the chemical status: Data aggregation was carried out and it was checked whether the total area of exceedance was greater than 20% of the total area of the GWB. The test showed a good status for the water body;
- Saline or other intrusion: not relevant.
- Significant diminution of associated surface water chemistry and ecology due to transfer of pollutants from the GWB: The exceedance of the TV was not found in areas where pollutants might be transferred to surface waters. The pollutant load transferred from the GWB to the surface water body compared to the total surface water body load does not exceed 50%. The test showed a good status for the water body.
- Significant damage to groundwater dependent terrestrial ecosystems (GWDTE) due to transfer of pollutants from GWB: No GWDTE was found damaged. The test showed a good status for the water body.
- Meets the requirements of Water Framework Directive (WFD) Article 7(3) – Drinking Water Protected Areas: There is no evidence of increased treatment due to changes in water quality. The test showed a good status for the water body

MD: Chemical status: no data

RO: Quantitative assessment

This was carried out after the chemical status assessment. As the chemical status was assessed as good and no sustained downward trend in the water level was recorded across the water body (at any monitoring point), the water body was found to be in good quantitative status.

MD: Quantitative status: no data</td></tr>
<tr><td colspan="2">In the case of poor chemical status:</td></tr>
<tr><td>Parameter(s) responsible for poor status</td><td>RO:

MD:</td></tr>
</table>

3: Middle Sarmatian – Pontian groundwater body				
Further information on TVs	**Procedure:** Brief summary of the way the procedure set out in Annex II Part A of the GWD has been followed in order to derive the TVs. [<5000 characters] **RO:** **MD:** **Relationship:** Brief summary of the relationship between TVs and background levels for naturally occurring substances. [< 2000 characters] **RO:** **MD:**			
Threshold values per GWB	**GWB**	**Pollutant / indicator**	**TV (or range)** [4] (mg/l or µg/l)	**Level at which the TV is established** (national, RBD, GWB)

4: Sarmatian Groundwater Body	
Member State Code MS_Code	**RO_DL04 / BG_BSGW01**
Description of important transboundary GWB	Delineation criteria: development of Sarmatian permeable deposits and water resources in the deposits. The lithological composition of water-bearing deposits is as follows: Bulgaria: limestones, sands; Romania: oollitic limestones and organogenic limestones. The overlying strata consist of loess and clays. The GWB is well protected in clay-covered areas, but vulnerable to pollution in predom-inantly loess / sand-covered areas. This explains nitrate contamination in some areas. The main use of the GWB is for drinking water supply, and also in agricultural and industrial purposes. The main pressures are agriculture activities, waste landfills and small industrial plants. The GWB has an interaction with two small lakes in Bulgaria. The criterion for selection as "important" is size, which exceeds 4000 km^2.
Description of status assessment methodology	**BG: *Chemical status* and *quantitative status*** 1. A comparison was made between total water abstraction according to permits and exploitation resources. 2. Standards for groundwater quality were established using Annex 1 of the Regulation N-1/2007 for Research, Water Use and the Protection of Groundwater. 3. TVs were defined according to the "Common methodology for groundwater

[4] Insert the range of TVs if different TVs are applied within the national aggregated ICPDR GWB

4: Sarmatian Groundwater Body	
	threshold values" developed by the EU WFD CIS Working Group C (WGC).. According to Article 4 of the GWD, a GWB is of *good status* when GW-QSs or TVs are not exceeded at any monitoring point. Where a GW-QS or TV has been exceeded at one or more monitoring points, appropriate investigation (with appropriate aggregation of monitoring results) is needed to estimate extent to which the GWB (in terms of volume or spatial area) has an annual arithmetic mean con-centration of a pollutant higher than a GW-QS or TV. This concerns assessment of: - significant environmental risk from pollutants across a GWB; - no significant impairment of human uses; - saline and other intrusion. To satisfactorily carry out the appropriate investigation(s) additional data may also be used to refine the conceptual model and/or confirm the extent of exceedance. 5. The ratio between the extent of exceedance of the GWB compared with the total area of the water body was calculated (< 20%: good; >20%: poor, according to guidance on groundwater *chemical status*, status and trends - WGC). The extent of exceedance of the GWB is the spatial area – part of the GWB, obtained by adding up the area of circles surrounding the monitoring points having an annual arithmetic mean concentration of a pollutant higher than a GW-QS. 6. Trends in pollutant concentrations were calculated. The present groundwater status assessment was made for every GWB on the basis of conceptual models of aquifers, *chemical status* data from the national monitoring system for the periods 2004-2006 and 2007-2008. Monitoring data from drinking water supply sources for the period 2004-2007 have also been used. Groundwater *quantitative status* was evaluated on the basis of a comparison between total water abstraction according to issued water use permits and exploitation resources established by "Orders of the Water Basin Directors". All transboundary GWBs were determined to be *not at risk*. For groundwater status assessment, TVs were determined**:** - For GWBs *at risk*: TVs for nitrates, ammonia, total iron. - Sea water intrusion: for chlorides and sulphate TVs, the background values were used in compliance with the document "Towards a Guidance on Groundwater Chemical status and Threshold Values". Only one GWB was determined to be *at risk* (nitrates content). There is no available methodology for assessment of groundwater pollution from diffuse sources at this moment. A procedure is underway to attempt to address these problems. **RO: *Chemical status*** The methodology for *chemical status* assessment generally followed the recommendations of WGC in the document "Towards a Guidance on Groundwater Chemical Status and Threshold Values". The first step was to check for any exceedances of TVs. As no exceedance was present, the GWB was considered in *good status*. **RO: *Quantitative status*** Assessment was carried out after the *chemical status* assessment. As the *chemical status* was assessed as *good* and no sustained downward trend in water level was recorded across the water body (at any monitoring point), the water body was found to have *good quantitative status*.

4: Sarmatian Groundwater Body				
In the case of poor *chemical status*				
Parameter(s) responsible for *poor status*	**BG:** **RO:**			
Further information on TVs	**Procedure:** Brief summary of the way the procedure set out in Annex II Part A of the GWD has been followed in order to derive the TVs. [<5000 characters] **BG / RO:** **Relationship:** Brief summary of the relationship between TVs and background levels for naturally occurring substances. [< 2000 characters] **BG / RO:**			
Threshold values per GWB	**GWB**	**Pollutant / indicator**	**TV (or range)**[5] (mg/l or µg/l)	**Level at which the TV is established** (national, RBD, GWB)

[5] Insert the range of TVs if different TVs are applied within the national aggregated ICPDR GWB

5: Mures /Maros	
Member State Code MS_Code	**RO_MU20, RO_MU22 / HU_P.2.13.1, HU_P.2.13.2, HU_SP.2.13.1, HU_SP.2.13.2**
Description of important transboundary GWB	**Reasons for selection as an important transboundary GWB:** The alluvial deposit of the Maros/Mures River lies along both sides of the southern Hungarian – Romanian border, to the north of the actual river bed of the Maros/Mures. In particular, it is an important water resource for drinking water purposes for both countries and water abstraction in one country influences the water availability in the other. **General description:** The basin of the SE part of the Great Hungarian Plain is filled up with more than 2000 m thick deposits of different ages, which are progressively thinning in Romania. The alluvial fan of the Maros/Mures River forms the Pleistocene part of the strata. The aquifer is divided into several GWBs in both countries. Despite the differences in the delineation method of the two countries, it was possible to select the relevant water bodies from the transboundary point of view. Of the four water bodies containing cold water in Hungary (HU), two contain Quaternary strata from the surface to a depth of 30 m, namely the shallow GWBs (GWB HU_SP.2.13.1, GWB HU_SP.2.13.2). Underneath them are two porous GWBs (GWB HU_P.2.13.1, GWB HU_P.2.13.2), which, besides Quaternary strata, include some parts of the Upper-Pannonian deposits as well (to a depth of 400–500 m corresponding to the surface separating cold and thermal waters). Two Quaternary water bodies have been selected in Romania. On the Romanian side, two water bodies are included in the transboundary evaluation because in the Romanian method there is a separating horizon at the limit of the Upper (GWB RO_MU20) and Lower Pleistocene (GWB RO_MU22) age of the strata. Both water bodies can be lithologically characterised by pebbles, sands and clayey inter-layers, but the upper part is significantly coarser with better permeability. Virtually following the same separation line on the Hungarian side, the lower 100 m of the 250-300 m thick Pleistocene strata is silty-sand, sandy-silt, sand and clay, and the upper part is mainly sand with gravel, so that permeability improves towards the surface (the hydraulic conductivity of the aquifers ranges between 5–30 m/day). The covering layer is mainly sandy silt and clay of 3-13 m thickness. On the Romanian side, the upper water body is *unconfined* and the lower is *confined*. In Hungary both *confined* and *unconfined* conditions occur in the southern water bodies (GWB HU_SP.2.13.1, GWB HU_P.2.13.1) and mainly *confined* conditions are characteristic for the water bodies of the upward flow system (GWB HU_SP.2.13.2, GWB HU_P.2.13.2). The area covered by these water bodies is 4989 km^2. The groundwater table is 2-4 m below the surface in Hungary. Recharge in sandy areas has only local importance (15 Mm^3/year). At present, because of the considerable amount of water abstracted from the deep layers, there is a permanent recharge from shallow groundwater to the deep groundwater system (app. 15 Mm^3/year) and large areas with sandy-silty covered layers also contribute to the recharge of the abstracted amount in Hungary. Another important element of the global recharge of the Hungarian part is the lateral flow across the border, estimated at 15-20 Mm^3/d (uncertain value based on limited available knowledge). The direction of the groundwater flow is from the recharge area to the discharge areas (main river valleys and zones with groundwater level close to the surface) i.e. from SE to N and NW.

5: Mures /Maros	
Description of status assessment methodology	**RO: *Chemical status*** The methodology for the *chemical status* assessment followed the recommendations of WGC in the document "Towards a Guidance on Groundwater Chemical Status and Threshold Values". The first step was to check for any exceedances of TVs. As exceedance of the TVs for NO_3 and NH_4 was recorded, the following relevant tests were carried out: - General assessment of the *chemical status*: Data aggregation was carried out and it was checked whether the total area of exceedance was greater than 20% of the total area of the GWB. The test showed a *poor status* for the water body, so the GWB was considered to be in *poor status*. **HU: *Chemical status*** 1. Exceedance of TVs at monitoring points: This test is performed for all GWBs and for all chemical elements (for which standard or TV(s) have been determined) in the following steps: - Selection of WFD monitoring points where the average concentration for the period 2004-2007 **exceeds the determined standard or the TV**. - Exclusion of monitoring sites where the higher concentration is due to **natural conditions** (although the TV is determined considering natural background level, it is possible to detect an exceedance of natural origin). - Immediate classification as *poor status* for all those GWBs where a **drinking water production well or captured spring** shows exceedance of the drinking water standard to such an extent that changes in treatment technology are needed. GWB should be classified as *poor* in cases of danger of pollution to drinking water production wells. (see next point for potential impact on active abstractions). - Evaluation of data on groundwater quality **inside the drinking water source protection area** (corresponding to 50 years travel time, according to Hungarian legislation). The evaluation is carried out in the framework of the general status assessment of exploited drinking water resources, including all observation wells and information on sources of pollution. If the result of evaluation shows that pollution is able to cause exceedance of the drinking water standard at the abstraction point, involving change in treatment technology, the GWB is classified as having *poor status*. - Selection of monitoring wells **inside aquifers designated for future drinking water abstraction.** If the number of wells exceeding the drinking water standard is higher than a given value (determined as a function of the chemical element and the type of aquifer), the GWB is classified as having *poor status* since it is likely that the exploitation would be difficult: not possible or would need treatment. - Analysis of the real impact of exceedances on ecosystems (according to points 3 & 4. Where the NBL > DWS, the TV is taken into consideration. NBL: Natural Background Level DWS: Drinking Water Standard 2. Delineation of polluted areas: This test is carried out for **shallow and karstic GWBs regarding nitrate and ammonium**. The delineation of the polluted area (where the concentration exceeds the threshold of the given GWB) is based on all information (not only WFD monitoring!). The GWB is classified in *poor status* if **20–30% of the total surface of the GWB is**

5: Mures /Maros	
	polluted. For a given GWB, the criterion is selected according to its vulnerability: i.e. for karstic aquifers and GWBs with a recharge character 20%,: for other shallow GWBs: 30%. <u>3. Polluted surface water bodies:</u> The test is applied to those GWBs where for a **groundwater dependent surface water body, the physico-chemical or chemical test shows *poor status***, and its reason is not evidently sewage water discharges or diffuse pollution from surface runoff. Those cases shall also be analysed where a polluted monitoring well of a groundwater dependent surface water body of *poor chemical status*. can be found in the vicinity (closer than 5 km) The evaluation is special for each case, taking into account (i) all available data on groundwater and surface water quality, (ii) information on pollution sources - the point or diffuse character of the pollution, (iii) estimated load from pollution sources, (iv) attenuation and dilution effect. If it is proved that the *chemical status* of the GWB is the cause of the observed pollution in the surface water body, the GWB is classified as having *poor chemical status*. The real impact of **polluted springs** on the quality of the supplied water course is also evaluated, at least until the first water body (considering possible dilution). If the *physico-chemical or chemical status* of the surface water body is not *good* because of this pollution, the GWB is classified as having *poor status*. <u>4. Damaged groundwater dependent wetland and terrestrial ecosystems:</u> This test is applied for those GWBs where it is likely that the **documented damage of certain wetlands or GWDTEs** is due to polluted groundwater. The methodology for evaluation of the real impact on ecosystems is performed in a similar way to the case of aquatic ecosystems (see point 3.). Monitoring of the status of wetlands and GWDTEs is not part of the WFD, so only scattered information on status is available. **RO: *Quantitative status*** The quantitative status assessment was carried out after the *chemical status* assessment. As the *chemical status* was assessed as poor, the water balance test was performed (see below). The test showed a *good status* for the water body. **HU: *Quantitative status*** <u>1. Water balance test</u> The water balance test is carried out in two steps: - The GWB has *poor status* if **in 20% of its area, a continuous decreasing water level** can be observed due to groundwater abstraction. The test is based on data for the period 2001-2007. A declining trend of 5-15 cm/year (depending on aquifer type and depth) can be considered as significant. In mountainous regions, the rate of springs is also analysed; the significant trend depends on the average rate. Water abstractions causing the trend should be identified. (Trends caused by meteorological conditions or a short declining trend caused by new water abstractions are not considered.) If the designated area is in the vicinity of the country border, **transboundary conciliation is needed**. - The GWB is also considered to have *poor status* if **groundwater abstraction exceeds the available groundwater resource**. This test is applied for subsurface catchment areas, thus shallow and deeper GWBs (except porous thermal GWBs) and corresponding dominantly recharge and discharge GWBs are merged in GWB-groups. **The recharge** consists of three components: (i) recharge from precipitation, (ii) recharge from surface water, (iii) flow from adjacent GWB or GWB-group.

5: Mures /Maros	
	The recharge from precipitation is calculated by a spatially distributed (1x1 km grid) water balance model including precipitation (period 1991-2000), interception, surface runoff, evapotranspiration and storage in the unsaturated zone. Local recharge is ignored in dominantly discharge areas. **Recharge from surface water** (as a long-term average) is rare in Hungary, it is determined on a case by case basis. Although GWBs are grouped according to subsurface catchments, estimation of **flow from adjacent GWB-group** is still important (i) in the case of transboundary water bodies, (ii) between different types of GWBs, (iii) where the boundary in the deeper part does not represent the real no-flux boundary. The estimation is based on the results of regional groundwater flow models or simple calculations using maps of water levels and transmissibility. **The water demand of groundwater dependent ecosystems** also has three components: (i) baseflow and spring rates supplying aquatic ecosystems in water courses (ii) a surplus of evaporation in shallow lakes and wetlands (iii) a surplus of transpiration from groundwater (supplying GWDTE). **The water demand of aquatic ecosystem in rivers** is considered for small and medium water courses, where springs are frequent in the catchment or where the average groundwater level is above the bottom of the riverbed. Ecologically necessary low flow is estimated on the basis of required water depth, width and velocity. **The water demand of shallow lakes and wetlands** is estimated as the product of required water/wetland surface and a surplus of evaporation. The required water surface is estimated considering landscape-ecological aspects. **The water demand of vegetation in the discharge area** is estimated as the product of the area (where the groundwater should contribute significantly to the water supply of the vegetation) and the amount of capillary flow needed for surviving periods without precipitation. The potential area is delineated using GIS procedure (convenient combination of soil type and groundwater level). The required part is a percentage of the potential one (default is 30%). **The amount of abstracted water** is the sum of the amount abstracted by wells (average for the period 2004-2007) and the outflow related to other water uses (e.g. drainage canals, gravel pits, decreased surface water level). <u>2. Surface waters test</u> The test is applied to those GWBs where, for a groundwater dependent water body, the hydromorphological classification shows a critical flow situation and its reason is not evidently the use of surface waters. The GWB is classified as *poor status* if: - **the remaining spring rate** in low flow period (either due to abstraction by wells or due to the capture of spring) is smaller than the ecologically required flow; - **the decrease of baseflow** caused by groundwater abstraction (in whole catchment of the surface water body) exceeds half of the available surface water resource. <u>3. Groundwater dependent wetlands and terrestrial ecosystems test</u> The test (status evaluation) is applied to those GWBs where the available information shows significant damage in wetlands and GWDTE. - It is preferred that the real effect of groundwater status is determined by a case by case approach, including the analysis of the **role of groundwater levels and flow conditions in damaging biota** and the reason for it (e.g. groundwater abstraction or other water use, but climate change is not considered as a reason for bad status).

5: Mures /Maros	
	- In some cases, a detailed analysis is not possible because of limited available data. In these cases the GWB is classed as *poor status* if there are **direct and indirect groundwater abstractions whose recharge area overlaps with the recharge area of the ecosystem by more than 30%**.
In the case of *poor chemical status*	
Parameter(s) responsible for *poor status*	**RO:** **HU: nitrates (HU_SP.2.13.2)**
Further information on TVs	**RO:** The procedure for NBL and TV derivation was established in the framework of the MATRA PPA06/RM/7/5 Project. The first step of the procedure was NBL-derivation based on each Water Directorate water quality database. Data quality was controlled through four different criteria: - Ionic balance of the sample; - Sampling depth; - Sample typology; - NaCl content of the sample. Selection of unpolluted samples based on anthropic originated substances content (pesticides or other inorganic substances), using the Cl>200 mg/l content and NO_3>10 mg/l criteria. NBL was calculated as the 90 percentile of the remaining samples. When less than 20 samples remained after applying Cl and NO_3 content criteria, the NBL were calculated as the 50 percentile of all samples. Validation of the NBL was made through "expert judgment". TVs were derived by comparing NBL's with quality standard values. The quality standard values were established through Drinking Water Law no. 458/2002 completed with Law no. 311/2004 and through Surface Water Quality Standards approved through Environment and Sustainable Development Ministry Order No 161/2006. From these two standards, the most restrictive values were taken into account. If NBL was lower than the water quality standard, the TV was considered equal to the water quality standard. If NBL was greater than the water quality standard, the TV was considered to be the NBL value multiplied with a multiplying coefficient of 1.2. (according to the recommendations of WGC in the document "Towards a guidance on groundwater *chemical status* and threshold values" in order to avoid the problems of 90 percentile usage in the TV deriving methodology and also problems caused by the confidence level in the data quality (data sampled and analysed without using QA/QC (quality assurance and quality control) procedures and standards)). **HU:** TVs were established by following the guidelines given in Annex II Part A of the GWD. Substances considered for TVs are those listed in part B of GWD, as well as nitrates and pesticides. The TV of a given component was determined by taking into account: - the 90% percentile value (NBL) of the available chemical data of non-polluted objects of a given water body (NBL established for nitrate, ammonium, conductivity and sulphate (SO_4));

<table>
<tr><td colspan="5">5: Mures /Maros</td></tr>
<tr><td></td><td colspan="4">- the geology and hydrodynamics of the water body;
- Quality Standards (EQS surfacewater and DWS) of the given substance.
In the case of water bodies where both EQS surfacewater and DWS are applicable (e.g. for nitrates), TVs were established considering the more stringent criteria (i.e. EQSsurfacewater).
EQSsurfacewater is applicable only in case of karstic water bodies feeding surface waters for example by springs.
In the case of trichloroethylene and tetrachloroethylene, the DWS for pesticides took into account the GW-QS.
For those GWBs where the NBL was higher than the DWS due to natural hydro-geological reasons, the TVs for ammonium, SO_4 and EC were defined by taking into account these higher values, as described in EU WFD CIS Guidance Document No. 18.
To achieve EQ objectives in cold karstic GWBs with springs, TVs for nitrates were defined conforming to EQSsurfacewater (25 mg/l). For other GWBs, nitrate TV equals DWS. In the case of sulphate and EC, TVs can be higher than the quality standard, considering the geology or hydrogeological regime of the water bodies.</td></tr>
<tr><td rowspan="11">Threshold values per GWB</td><td>GWB</td><td>Pollutant / indicator</td><td>TV (or range)[6]
(mg/l or µg/l)</td><td>Level at which the TV is established
(national, RBD, GWB)</td></tr>
<tr><td>5-RO</td><td>Nitrate</td><td>50 mg/l</td><td>GWB</td></tr>
<tr><td>5-RO</td><td>NH_4</td><td>0.5-2.2 mg/l</td><td>GWB</td></tr>
<tr><td>5-RO</td><td>Cl</td><td>250 mg/l</td><td>GWB</td></tr>
<tr><td>5-RO</td><td>SO_4</td><td>250 mg/l</td><td>GWB</td></tr>
<tr><td>5-RO</td><td>As</td><td>0.04mg/l</td><td>GWB</td></tr>
<tr><td>5-RO</td><td>Cd</td><td>0.005 mg/l</td><td>GWB</td></tr>
<tr><td>5-RO</td><td>Pb</td><td>0.01 mg/l</td><td>GWB</td></tr>
<tr><td>5-RO</td><td>NO_2</td><td>0.5 mg/l</td><td>GWB</td></tr>
<tr><td>5-RO</td><td>PO_4</td><td>0.5-0.8 mg/l</td><td>GWB</td></tr>
<tr><td>HU_SP.2.13.2</td><td>Nitrate</td><td>50 mg/l</td><td>GWB</td></tr>
</table>

[6] Insert the range of TVs if different TVs are applied within the national aggregated ICPDR GWB

6: Somes / Szamos	
Member State Code MS_Code	**RO_SO01, RO_SO13 / HU_P.2.1.2, HU_SP.2.1.2, HU_P.2.3.2, HU_SP.2.3.2**
Description of important transboundary GWB	**Reasons for selection as an important transboundary GWB:** The alluvial deposit of the Somes/Szamos River extends on both sides of the northern part of the Hungarian-Romanian border. It is also connected to the aquifer system lying in Ukraine close to the borders. The aquifer system supplies drinking water to a population of approx. 170,000 inhabitants in Romania and 50,000 inhabitants in Hungary. On the Hungarian side, due to the lowland character and upward flow system, the terrestrial ecosystems require surplus transpiration from groundwater; 7% of the area of the water body is under nature conservation. The recharge zone is in Romania and Ukraine, thus the available groundwater resource and the status of the terrestrial ecosystems on the Hungarian side depend on the lateral flow from the neighbouring countries. The Romanian and Hungarian parts of the water body complex are described below. **General description:** The Somes/Szamos River has formed a 30–250 m thick alluvial deposit. The aquifer is divided into several GWBs in both countries. Despite the differences in the delineation method of the two countries, it was possible to select the relevant water bodies from the transboundary point of view. Four water bodies containing cold water occur in Hungary. Two of them contain Quaternary strata from the surface to a depth of 30 m, namely the shallow GWBs (GWB HU_SP.2.1.2, GWB HU_SP.2.3.2). Underneath are the porous GWBs (GWB HU_P.2.13.1, GWB HU_P.2.13.2), which beside Quaternary strata include some parts of the Upper-Pannonian deposits as well, to a depth of 400–500 m corresponding to the surface separating cold and thermal waters. Two Quaternary water bodies in Romania have been selected. The Holocene-Pleistocene formation is divided vertically in Romania by the horizon separating the Upper and Lower Pleistocene strata. In Romania two water bodies are considered, overlapping each other and covering a surface area of 1380 km^2. The Hungarian part can be characterised only by an upward flow system, thus no further horizontal separation is applied. The area covered by the water body is 1035 km^2. In Romania, the shallow (Holocene-Upper-Pleistocene) aquifer is *unconfined*, consisting of sands, argillaceous sands, gravels and even boulders in the eastern part, and has a depth of 25-35 m. The silty-clayey covering layer is 5–15 m thick. The deeper (Lower-Pleistocene) aquifer is *confined* (it is separated from the Upper-Pleistocene part by a clay layer); its bottom is declining from 30 m to 130 m below the surface from East to West. The gravel and sandy strata (characteristic westwards of the town of Satu-Mare) represent the main aquifer for water supply in the region. In Hungary (as part of the cold water body), the Quaternary (Pleistocene) and Holocene strata are 50 m thick at the Ukrainian border and its continuously declining bottom is around 200 m below the surface at the western boundary. Mainly *confined* conditions characterise the Hungarian part, with a silty clayey covering layer of 1–6 m (increasing from the NE to the SW). The Quaternary aquifer is sand or gravelly sand, and the hydraulic conductivity ranges between 10-30 m/d. It should be noted that the Hungarian water body includes the cold water bearing part of the Upper-Pannonian formation as well, to a depth of 400–500 m (under this level, thermal water of a temperature greater than 30 °C can be found). Depth of the groundwater level (mainly pressure in *confined* area) below the

<table>
<tr><td colspan="2">6: Somes / Szamos</td></tr>
<tr><td></td><td>surface ranges between 2 and 5 m in Hungary. The flow direction is from the ENE to the WSW in both countries, corresponding to the recharge and main discharge zones (rivers and area with groundwater level close to the surface).

The recharge area is in the Romanian part of the water body (and in Ukraine). In Hungary the infiltrated amount from local recharge zones supplies neighbouring discharge zones and cannot be considered as part of the available groundwater resources.</td></tr>
<tr><td>Description of status assessment methodology</td><td>RO: Chemical status

The methodology for the chemical status assessment followed the recommendations of WGC in the document “Towards a Guidance on Groundwater Chemical Status and Threshold Values”.

The first step was to check for any exceedances of TVs. As exceedance of the TVs for the following parameters: NH_4, NO_3, NO_2 and PO_4, Pb, and As, were recorded, the following tests were carried out:
- General assessment of the chemical status: Data aggregation was carried out and it was checked whether the total area of exceedance was greater than 20% of the total area of the GWB. The test showed a good status for the water body;
- Saline or other intrusion: was not relevant;
- Significant diminution of associated surface water chemistry and ecology due to transfer of pollutants from the GWB: The location of the exceedance of the relevant threshold values where not found in areas where pollutants might be transferred to the surface water. The load of the pollutant transferred from the GWB to the surface water body compared to the total load in the surface water body did not exceed 50%. The test showed a good status for the water body.
- Significant damage to GWDTEs due to transfer of pollutants from the GWB: No GWDTE was found damaged. The test showed demonstrated a good status;
- Meeting the requirements of WFD Article 7(3) – Drinking Water Protected Areas: there is no evidence of increased treatment due to changes in water quality. The test showed a good status for the water body.

HU: Chemical status

<u>1. Exceedance of TVs at monitoring points</u>:

This test is performed for all GWBs and for all chemical elements (for which standard or TV(s) have been determined) in the following steps:

- Selection of WFD monitoring points where the average concentration for the period 2004-2007 exceeds the determined standard or the TV.

- Exclusion of monitoring sites where the higher concentration is due to natural conditions (although the TV is determined considering natural background level, it is possible to detect an exceedance of natural origin).

- Immediate classification as poor status for all those GWBs where a drinking water production well or captured spring shows exceedance of the drinking water standard to such an extent that changes in treatment technology are needed. GWB should be classified as poor in cases of danger of pollution to drinking water production wells. (see next point for potential impact on active abstractions).

- Evaluation of data on groundwater quality inside the drinking water source protection area (corresponding to 50 years travel time, according to Hungarian legislation). The evaluation is carried out in the framework of the general status assessment of exploited drinking water resources, including all observation wells and information on sources of pollution. If the result of evaluation shows that pollution is able to cause exceedance of the drinking water standard at the</td></tr>
</table>

6: Somes / Szamos	
	abstraction point, involving change in treatment technology, the GWB is classified as having *poor status*. - Selection of monitoring wells **inside aquifers designated for future drinking water abstraction.** If the number of wells exceeding the drinking water standard is higher than a given value (determined as a function of the chemical element and the type of aquifer), the GWB is classified as having *poor status* since it is likely that the exploitation would be difficult: not possible or would need treatment. - Analysis of the real impact of exceedances on ecosystems (according to points 3 & 4. Where the NBL > DWS, the TV is taken into consideration. <u>2. Delineation of polluted areas:</u> This test is carried out for **shallow and karstic GWBs regarding nitrates and ammonium**. The delineation of the polluted area (where the concentration exceeds the threshold of the given GWB) is based on all information (not only WFD monitoring!). The GWB is classified in *poor status* if **20–30% of the total surface of the GWB is polluted.** For a given GWB, the criterion is selected according to its vulnerability: i.e. for karstic aquifers and GWBs with a recharge character 20%,: for other shallow GWBs: 30%. <u>3. Polluted surface water bodies:</u> The test is applied to those GWBs where for a **groundwater dependent surface water body, the physico-chemical or chemical test shows *poor status***, and its reason is not evidently sewage water discharges or diffuse pollution from surface runoff. Those cases shall also be analysed where a polluted monitoring well of a groundwater dependent surface water body of *poor chemical status*. can be found in the vicinity (closer than 5 km) The evaluation is special for each case, taking into account (i) all available data on groundwater and surface water quality, (ii) information on pollution sources - the point or diffuse character of the pollution, (iii) estimated load from pollution sources, (iv) attenuation and dilution effect. If it is proved that the *chemical status* of the GWB is the cause of the observed pollution in the surface water body, the GWB is classified as having *poor chemical status*. The real impact of **polluted springs** on the quality of the supplied water course is also evaluated, at least until the first water body (considering possible dilution). If the *physico-chemical or chemical status* of the surface water body is not *good* because of this pollution, the GWB is classified as having *poor status*. <u>4. Damaged groundwater dependent wetland and terrestrial ecosystems:</u> This test is applied for those GWBs where it is likely that the **documented damage of certain wetlands or GWDTEs** is due to polluted groundwater. The methodology for evaluation of the real impact on ecosystems is performed in a similar way to the case of aquatic ecosystems (see point 3.). Monitoring of the status of wetlands and GWDTEs is not part of the WFD, so only scattered information on status is available. **RO: *Quantitative status*** The quantitative status assessment was carried out after the *chemical status* assessment. The water balance test was performed as well. The test showed a *good status* for the water body. **HU: *Quantitative status*** <u>1. Water balance test</u>

6: Somes / Szamos	
	The water balance test is carried out in two steps: - The GWB has *poor status* if **in 20% of its area, a continuous decreasing water level** can be observed due to groundwater abstraction. The test is based on data for the period 2001-2007. A declining trend of 5-15 cm/year (depending on aquifer types and depth) can be considered as significant. In mountainous regions, the rate of springs are also analysed; the significant trend depends on the average rate. Water abstractions causing the trend should be identified. (Trends caused by meteorological conditions or a short declining trend caused by new water abstractions are not considered.) If the designated area is in the vicinity of the country border, **transboundary conciliation is needed**. - The GWB is also considered to have *poor status* if **groundwater abstraction exceeds the available groundwater resource**. This test is applied for subsurface catchment areas, thus shallow and deeper GWBs (except porous thermal GWBs) and corresponding dominantly recharge and discharge GWBs are merged in GWB-groups. **Recharge** consists of three components: (i) recharge from precipitation, (ii) recharge from surface water, (iii) flow from adjacent GWB or GWB-group. **Recharge from precipitation** is calculated by a spatially distributed (1x1 km grid) water balance model including precipitation (period 1991-2000), interception, surface runoff, evapotranspiration and storage in the unsaturated zone. Local recharge is ignored in dominantly discharge areas. **Recharge from surface water** (as a long-term average) is rare in Hungary, it is determined on a case-by-case basis. Although GWBs are grouped according to subsurface catchments, estimation of **flow from adjacent GWB-group** is still important (i) in the case of transboundary water bodies, (ii) between different types of GWBs, (iii) where the boundary in the deeper part does not represent the real no-flux boundary. The estimation is based on the results of regional groundwater flow models or simple calculations using maps of water levels and transmissibility. **The water demand of groundwater dependent ecosystems** also has three components: (i) baseflow and spring rates supplying aquatic ecosystems in water courses (ii) a surplus of evaporation in shallow lakes and wetlands (iii) a surplus of transpiration from groundwater (supplying GWDTE). **The water demand of aquatic ecosystem in rivers** is considered for small and medium water courses, where springs are frequent in the catchment or where the average groundwater level is above the bottom of the riverbed. Ecologically necessary low flow is estimated on the basis of required water depth, width and velocity. **The water demand of shallow lakes and wetlands** is estimated as the product of required water/wetland surface and a surplus of evaporation. The required water surface is estimated considering landscape-ecological aspects. **The water demand of vegetation in the discharge area** is estimated as the product of the area (where the groundwater should contribute significantly to the water supply of the vegetation) and the amount of capillary flow needed for surviving periods without precipitation. The potential area is delineated using GIS procedure (convenient combination of soil type and groundwater level). The required part is a percentage of the potential one (default is 30%). **The amount of abstracted water** is the sum of the amount abstracted by wells (average for the period 2004-2007) and the outflow related to other water uses (e.g. drainage canals, gravel pits, decreased surface water level). 2. Surface waters test

6: Somes / Szamos	
	The test is applied to those GWBs where, for a groundwater dependent water body, the hydromorphological classification shows a critical flow situation and its reason is not evidently the use of surface waters. The GWB is classified as *poor status* if: - **the remaining spring rate** in low flow period (either due to abstraction by wells or due to the capture of spring) is smaller than the ecologically required flow; - **the decrease of baseflow** caused by groundwater abstraction (in whole catchment of the surface water body) exceeds half of the available surface water resource. 3. Groundwater dependent wetlands and terrestrial ecosystems test The test (status evaluation) is applied to those GWBs where the available information shows significant damage in wetlands and GWDTE. - It is preferred that the real effect of groundwater status is determined by a case by case approach, including the analysis of the **role of groundwater levels and flow conditions in damaging biota** and the reason for it (e.g. groundwater abstraction or other water use, but climate change is not considered as a reason for bad status). - In some cases, a detailed analysis is not possible because of limited available data. In these cases the GWB is classed as *poor status* if there are **direct and indirect groundwater abstractions whose recharge area overlaps with the recharge area of the ecosystem by more than 30%**.
In the case of poor *chemical status*	
Parameter(s) responsible for *poor status*	**RO:** **HU:**
Further information on TVs	**Procedure:** Brief summary of the way the procedure set out in Annex II Part A of the GWD has been followed to derive TVs < 5000 characters **RO:** **HU:** TVs were established by following the guidelines given in Annex II Part A of the GWD. Substances considered for TVs were those listed in part B of the GWD, as well as nitrates and pesticides. The TV of a given component for a water body was determined by taking into account: - the 90% percentile value (NBL) of the available chemical data of non-polluted objects of a given water body (NBL was established for nitrates, ammonium, EC, sulphates); - the geology and the hydrodynamics of the water body; - Quality Standards (EQSsurfacewater and DWS) of the given substance. In the case of water bodies where both EQSsurfacewater and DWS are applicable (e.g. for nitrates), TVs were established considering the more stringent criteria (i.e. EQSsurfacewater). EQSsurfacewater is applicable only in the case of karstic water bodies feeding surface waters, for example by springs. In the case of trichloroethylene and tetrachloroethylene the DWS for pesticides took into account the GW-QS. For those GWBs where the NBL was higher than the DWS due to natural hydro-geological reasons, the TVs for ammonium, SO_4 and EC were defined by taking

<table>
<tr><td colspan="5">6: Somes / Szamos</td></tr>
<tr><td></td><td colspan="4">into account these higher values, as described in EU WFD CIS Guidance Document No. 18.

To achieve EQ objectives in cold karstic GWBs with springs, the TV for nitrates was defined to conform with EQSsurfacewater (25 mg/l). For other GWBs, the nitrate TV equals the DWS. In the case of sulphate and EC, TVs can be higher than the quality standard, considering the geology or hydrogeological regime of the water bodies.

Relationship: Brief summary of the relationship between TVs and background levels for naturally occurring substances< 2000 characters

RO:

HU: see the description above</td></tr>
<tr><td rowspan="4">Threshold values per GWB</td><td>GWB</td><td>Pollutant / indicator</td><td>TV (or range)[7]
(mg/l or µg/l)</td><td>Level at which the TV is established
(national, RBD, GWB)</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

[7] Insert the range of TVs if different TVs are applied within the national aggregated ICPDR GWB

<table>
<tr><th colspan="2">7: Upper Pannonian - Lower Pleistocene GWB from Backa and Banat / Vojvodina / Duna-Tisza köze déli rész</th></tr>
<tr><td>Member State Code MS_Code</td><td>RO_BA18 / RS_TIS_GW_I_1, RS_TIS_GW_SI_1, RS_TIS_GW_I_2, RS_TIS_GW_SI_2, RS_TIS_GW_I_3, RS_TIS_GW_SI_3, RS_TIS_GW_I_4, RS_TIS_GW_SI_4, RS_TIS_GW_I_7, RS_TIS_GW_SI_7, RS_D_GW_I_1, RS_D_GW_SI_1 / HU_SP.1.15.1, HU_P.1.15.2, HU_SP.1.15.2, HU_P.1.15.2, HU_SP.2.11.1, HU_P.2.11.1, HU_SP.2.11.2, HU_P.2.11.2, HU_SP.2.16.1, HU_P.2.16.1.</td></tr>
<tr><td>Description of important transboundary GWB</td><td>RO: Delineation

The criterion for delineation of this regional body was the development of fluvial-lacustrine Pannonian-Pleistocene aquiferous deposits, in the Bega and Timis River Basins. Lithologically, the water-bearing deposits are comprised of thin layers with a fine to medium grain-size (sands, rarely gravels), sometimes with a lens aspect, and are situated at a depth of 30-350 m. The overlaying strata are predominantly represented by detritic Quaternary deposits. The GWB is mainly used for drinking water, agricultural and industrial supplies. The criterion for selection as “important” is size: exceeding 4000 km^2.

RS: Delineation

The criteria for the identification of water bodies were the following:

Horizontal delineation was carried out by:
1. Separating the discharge and recharge areas of the water bodies;
2. Using existing hydrodynamic boundary conditions;
3. Identifying direction of flow and association to the immediate DRB and Tisza RB.

Vertical delineation (shallow/deep) was carried out by:
1. Separating the shallow GWBs by geological boundary- aquitard;
2. Identifying transmissivity and effective porosity of the aquifers (if no aquitard exists);
3. Looking at groundwater chemical characteristics.

HU: Delineation

The following procedure was carried our to re-delineate GWBs in Hungary in 2007:
1. Separation of the main geological features based on recent information: porous aquifers in the basins, karstic (Triassic) aquifers, mixed formations of the mountainous regions, other than karstic aquifers.
2. Vertical separation of shallow groundwater (generally to the first aquitard below the surface, or approx. the first 30 m below the water table where there is no aquitard) in the case of porous aquifers in the basins and in mountainous regions other than Triassic karsts and fractured rocks.
3. Thermal water bodies are separated according to a temperature of 30 ºC. In the case of porous aquifers, it is done vertically, while in karstic aquifers, horizontally. There are no thermal aquifers in the mountainous regions other than karstic ones.
4. Further division is related to the subsurface catchment areas and vertical flow system (in the case of porous aquifers) and to structural and hydrological units (in the case of karstic aquifers and mountainous regions).

Reasons for selection as an important transboundary GWB

The porous aquifer system between the Danube and Tisza Rivers is the biggest geological unit of the Pannonian Basin. It lies mainly in Hungary and Serbia, with a smaller part in Croatia and Romania. Serbia and Hungary have selected it as an important transboundary GWB complex because: (i) size, (ii) importance in supplying drinking water for the population and (iii) the need to satisfy the water demand of agriculture and industry, (iv) protected areas cover a large part of the GWB complex (protection zones for vulnerable drinking water resources, nature</td></tr>
</table>

7: Upper Pannonian - Lower Pleistocene GWB from Backa and Banat / Vojvodina / Duna-Tisza köze déli rész	
	conservation areas and nitrate-sensitive areas). **General description** The whole aquifer system of the Danube-Tisza region stretches from the foothills of the northern mountainous region of Hungary to the Danube in Serbia, where the river flows to the south-east. The western boundary is the Danube itself downstream of Budapest in Hungary but after crossing the Hungarian border it enlarges towards Slavonia (western part of Backa in Croatia). The eastern boundary is somewhat east from the Tisza River in Hungary and in Serbia it includes the Banat as well, whose eastern part is in Romania. The Danube, Tisza and Timis Rivers are important discharge-lines but cannot be considered as pure hydrodynamic boundaries, since there is some flow under the river in the deeper aquifer that is not discharged into the river. The aquifer system is divided into several GWBs. Despite the differences in the delineation method of the three countries, it was possible to select the relevant water bodies from the transboundary point of view: In Serbia, the area of the whole Dunav aquifer system is 17,435 km^2 (the areas of Backa and Banat). However, the transboundary importance is related only to the GWBs adjacent to the state borders with Hungary (a total of 6 GWBs: 3 shallow (RS_TIS_GW_SI_1; RS_TIS_GW_SI_2; RS_TIS_GW_SI_3) and 3 deep (RS_TIS_GW_I_1; RS_TIS_GW_I_2; RS_TIS_GW_I_3)) and with Romania (a total of 6 GWBs: 3 shallow (RS_TIS_GW_SI_4; RS_TIS_GW_SI_7; RS_D_GW_SI_1) and 3 deep (RS_TIS_GW_I_4; RS_TIS_GW_I_7; RS_D_GW_I_1)). The area of water bodies situated towards Hungary is 5647 km^2 and towards Romania 4859 km^2, with a total aggregated area of 10,506 km^2 for the Vojvodina GWB. In Hungary, the aquifer system is divided into several water bodies according to major subsurface catchment areas and downward-upward flow systems. For the transboundary conciliation, only the southern part of the aquifer system is considered, which includes 10 cold water bodies. Five of them contain Quaternary strata from the surface to a depth of 23-30 m, i.e. shallow GWBs (GWB HU_SP.1.15.1, GWB HU_SP.1.15.2, GWB HU_SP.2.16.1, GWB HU_SP.2.11.1, GWB HU_SP.2.11.2). Beneath these are five porous GWBs (GWB HU_P.1.15.1, GWB HU_P.1.15.2, GWB HU_P.2.16.1, GWB HU_P.2.11.1, GWB HU_P.2.11.2). Besides Quaternary strata, these include part of the Upper-Pannonian deposits as well, to a depth of 400–500 m corresponding to the surface and separating cold and thermal water bodies. The Hungarian part can be characterised by both upward and downward flow systems that are the basis for the horizontal separation of the GWBs. The area covered by these water bodies is 7098 km^2. The aquifer can be considered *unconfined* in the shallow GWBs, despite a considerable area where the water level is in the semi-permeable covering layer, and *confined* in the deeper ones. The depth of the groundwater level below the surface ranges between 3 and 5 m in Hungary, with a maximum depth of 7-12 m in the main recharge zones (GWB HU_SP.1.15.1, GWB HU_SP.2.16.1 and GWB HU_SP.2.11.1). In Romania, the aquifer system covers around 11,408 km^2 and is adjacent to the state border with Serbia. The GWB is generally *confined*, its covering strata being of Quaternary age. The depth of the groundwater level below surface ranges from 3-20 m. The protection degree of the GWB is very good. The main aquifer is the Quaternary alluvial deposit of the Danube lying on the Pannonian strata. Its thickness is a few tens of meters at the northern, western and southern boundary and increases up to 700 m in the middle of the basin (in the lower Tisza-valley). At the eastern boundary, the thick Quaternary deposit is a mixture of the alluvial deposits of the Danube and the Carpathian rivers. In respect to lithology, the aquifer consists of medium and coarse sands and gravely sands

7: Upper Pannonian - Lower Pleistocene GWB from Backa and Banat / Vojvodina / Duna-Tisza köze déli rész	
	with inter-layers and lenses of silty sands and silty clays. Average hydraulic conductivity ranges between 5–30 m/d. The topographically elevated ridge between the Danube and the Tisza is formed of eolian sand with relatively good recharge conditions and phreatic groundwater. In the river valleys and east of the Tisza, mainly *confined* conditions appear. The depth of the fluvial-swamp silty clays and swamp clays overlying strata varies from 10-20 m in the western and southern part, and up to 100-125 m in the north-eastern part of Backa and in Banat. Here, prior to intensive groundwater abstraction, an artesian type of groundwater occurred. The main recharge area is in Hungary, in the eolian sand ridge, and in Romania. In Hungary, the estimated value of the recharge is approx. 220 Mm^3/year. In Serbia, only local recharge areas exist (areas of the Deliblat Sands and the Subotica/Horgos Sands), thus the lateral flow crossing the border from the neighbouring country - as a component of the overall recharge - is very important. The groundwater is mainly discharged by the rivers (and drainage canals) and by the surplus of evapotranspiration from vegetation in the areas characterised by groundwater levels close to the surface. Small lakes and marshes in locally deeper areas (i.e. in topographic depressions) must be considered as local discharge areas – they are important from the nature conservation point of view. Besides natural discharge, there is also significant groundwater tapping for various uses (drinking water, agriculture, industry, irrigation etc.). In Vojvodina, the entire public water supply relies exclusively on groundwater from aquifers formed at different depths, from 20 m to more than 200 m. The direction of the groundwater flow in the upper part of the aquifer-system follows the topography and recharge-discharge conditions. At the Hungarian-Serbian border, the flow direction is almost parallel to the border (flowing slightly from Hungary towards Serbia). In the deeper part, the general flow direction is NW to SE i.e. from the Danube to the Tisza in Hungary and in Backa, while in northern Banat, the piezometric surface subsides from the frontier zone towards the Tisza and the Timis, and in southern Banat, from the Deliblat Sands, it dips to the south and towards the Danube.
Description of status assessment methodology	**RO: *Chemical status*** The methodology for the *chemical status* assessment generally followed the recommendations of the WGC in the document "Towards a guidance on groundwater *chemical status* and threshold values". The first step was to check any exceedances of TVs. As exceedances of TVs were recorded for the following parameters: NH_4, NO_3, NO_2, PO_4, Pb, and As, the following relevant tests where carried out: - **General assessment of the *chemical status*:** Data aggregation was performed and it was checked whether the total area of exceedance was greater than 20% of the total area of the GWB. The test showed a *good status* for the water body. - **Saline or other intrusion:** not relevant. - **Significant diminution of associated surface water chemistry and ecology due to transfer of pollutants from the GWB:** The location of the exceedance of the relevant TVs was not found in areas where pollutants might be transferred to surface waters. A comparison of the pollutant load transferred from the GWB to the surface water body with the total load in the surface water body did not exceed 50%. The test showed a *good status* for the water body. - **Significant damage to GWDTEs due to transfer of pollutants from the GWB:** No GWDTE was found to be damaged. The test showed a *good status* for the water body; - **Meets the requirements of WFD Article 7(3) –** Drinking Water Protected Areas: there is no evidence of increased treatment due to changes in water quality. The test showed a *good status* for the water body

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	RS: *Chemical status*: *Description of methodology for assessing chemical status. [< 5000 characters]* **no data** **HU: *Chemical status*** 1. Exceedance of threshold values at monitoring points This test is performed for all GWBs and all chemical elements, for which standard or TV(s) have been determined, according to the following steps: - Selection of WFD monitoring points where the average concentration of the period 2004-2007 **exceeds the determined standard or the TV**. - Exclusion of monitoring sites where the higher concentration is due to **natural conditions** (although the TV is determined considering natural background levels, it is possible to detect an exceedance of natural origin). - Immediate classification of *poor status* for all those GWBs where a **drinking water production well or captured spring** shows exceedance of the drinking water standard to such an extent that changes in treatment technology are needed. The GWB should be classified as *poor* in the case of the danger of pollution to drinking water production wells. (See next point for potential impact on active abstractions.) - Evaluation of data on groundwater quality **inside the drinking water source protection area** (corresponding to a 50-year travel time according to Hungarian legislation). The evaluation is carried out in the framework of a general status assessment of the exploited drinking water resources, including all observation wells, and information on the sources of pollution. If the result of the evaluation shows pollution is able to cause exceedance of the drinking water standard at the abstraction point (involving a change in treatment technology), the GWB is classified as being of *poor status*. - Selection of monitoring wells **inside aquifers designated for future drinking water abstraction.** If the number of wells exceeding the drinking water standard is higher than a given value (determined as a function of the chemical element and the type of aquifer), the GWB is classified as being of *poor status* since it is likely that the exploitation would be difficult: not possible or would require treatment. The real impact of exceedances on ecosystems is analysed according to points 3.& 4. Where the NBL > DWS, the TV is taken into consideration. 2. Delineation of polluted areas This test is carried out for **shallow and karstic GWBs regarding nitrates and ammonium**. The delineation of the polluted area (where the concentration exceeds the threshold of the given GWB) is based on all information (not only WFD monitoring!). The GWB is classified as being of *poor status* if **20–30% of the total surface of the GWB is polluted.** For a given GWB, the criterion is selected according to its vulnerability i.e. for karstic aquifers and GWBs with a recharge character: 20 % and for other shallow GWBs: 30%. 3. Polluted surface water bodies This test is applied to those GWBs where **the physico-chemical or chemical test for a groundwater dependent surface water body shows *poor status*** and its cause is not evidently sewage water discharge or diffuse pollution from surface runoff. Cases where a polluted monitoring well can be found in the vicinity (closer than 5 km) of a groundwater dependent surface water body of *poor chemical status*

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	will also be analysed. The evaluation is special to each case, taking into account (i) all available data on groundwater and surface water quality, (ii) information on pollution sources - the point or diffuse character of the pollution, (iii) estimated load from pollution sources, (iv) attenuation and dilution effects. If it is proved that the *chemical status* of the GWB is the cause of the observed pollution in the surface water body, the GWB is classified as being of *poor chemical status*. The real impact of **polluted springs** on the quality of the supplied water course is also evaluated, at least up until the first water body (considering possible dilution). If the *physico-chemical or chemical status* of the surface water body is not good because of this pollution, the GWB is classified as being of *poor status*. 4. Damaged groundwater dependent wetland and terrestrial ecosystems This test is applied for those GWBs where it is likely that the **documented damage of certain wetlands or GWDTEs** is due to polluted groundwater. The methodology for the evaluation of the real impact on the ecosystems is performed in a similar way as in the case of aquatic ecosystems (see point 3.). Monitoring of the status of wetlands and GWDTEs is not part of the WFD, so only scattered information on status is available. **RO: *Quantitative status*** The quantitative status assessment was carried out after the *chemical status* assessment. As the *chemical status* was assessed as *good* and no sustained downward trend in water levels was recorded across the water body (at any monitoring point), the water body was found to be in *good quantitative status* **RS: *Quantitative status*** *Description of methodology for assessing quantitative status. [< 5000 characters]* no data **HU: *Quantitative status*** 1. Water balance test The water balance test was carried out in two steps: - The GWB is in *poor status* if **continuous decreasing water levels can be observed in 20% of its area** due to groundwater abstraction. The test is based on data for the period 2001-2007. A declining trend of 5-15 cm/year (depending on aquifer type and depth) can be considered as significant. In mountainous regions, the rate of springs is also analysed: the significant trend depends on the average rate. Water abstractions causing the trend should be identified. (Trends caused by meteorological conditions or short declining trends caused by new water abstractions are not considered.) If the designated area is near the country border, **transboundary conciliation is needed**. - The GWB is also in *poor status* if **groundwater abstraction exceeds the available groundwater resource**. This test is applied for subsurface catchment areas, thus shallow and deeper GWBs (except porous thermal GWBs) and corresponding dominantly recharge and discharge GWBs are merged into GWB-groups. **Recharge** consists of three components: (i) recharge from precipitation, (ii) recharge from surface water, (iii) flow from adjacent GWB or GWB-group. **Recharge from precipitation** is calculated by a spatially distributed (1x1 km grid) water balance model including precipitation (period 1991-2000), interception, surface runoff, evapotranspiration and storage in the unsaturated zone. Local recharge is ignored in dominantly discharge areas.

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	Recharge from surface water (as a long-term average) is rare in Hungary; it is determined on a case-by-case basis. Although GWBs are grouped according to subsurface catchments, estimation of the **flow from adjacent GWB-groups** is still important (i) in the case of transboundary water bodies, (ii) between different types of GWBs, (iii) where the boundary in the deeper section does not represent a real no-flux boundary. The estimation is based on the results of regional groundwater flow models or simple calculations using maps of water levels and transmissibility. **The water demand of groundwater dependent ecosystems** also has three components: (i) baseflow and spring rates supplying aquatic ecosystems in water courses, (ii) surplus of evaporation from shallow lakes and wetlands, (iii) surplus of transpiration from groundwater (supplying GWDTEs). **The water demand of aquatic ecosystem in rivers** is considered for small and medium water courses, where springs are frequent in the catchment or where the average groundwater level is above the bottom of the riverbed. Ecologically necessary low flow is estimated on the basis of required water depth, width and velocity. **The water demand of shallow lakes and wetlands** is estimated as the product of required water/wetland surface and surplus of evaporation. The required water surface is estimated considering landscape-ecology aspects. **The water demand of vegetation in the discharge area** is estimated as the product of the area (where the groundwater should contribute significantly to the water supply of the vegetation) and the amount of capillary flow needed for surviving periods without precipitation. The potential area is delineated using a GIS procedure (convenient combination of soil type and groundwater level). The required part is a percentage of the potential one (default is 30%). **The amount of abstracted water** is the sum of the amount abstracted by wells (average for the period 2004-2007) and the outflow related to other water uses (e.g. drainage canals, gravel pits, decreased surface water level). <u>2. Surface waters test</u> This test is applied on those GWBs where, for a groundwater dependent water body, the hydromorphological classification shows a critical flow situation and its cause is not evidently the use of surface waters. The GWB is classified as *poor status* if: - **the remaining spring rate** in a low flow period (either due to abstraction by wells or the capture of springs) is smaller than the ecologically required flow; - **the decrease of the baseflow** caused by groundwater abstraction (in the whole surface water body catchment) exceeds half of the available surface water resource. <u>3. Groundwater dependent wetlands and terrestrial ecosystems test</u> This test (status evaluation) is applied to those GWBs where the available information shows significant damage to wetlands and GWDTEs. - It is preferable if the real effect of groundwater status is determined on a case-by-case basis, including analysis of the **role of groundwater levels and flow conditions in damage to biota** and its causes (e.g. groundwater abstraction or other water use; climate change is not considered as a reason for *poor status*). - A detailed analysis may not be possible due to limited available data. In this case the GWB is of *poor status* if there are **direct and indirect groundwater abstractions whose recharge area overlaps by > 30% with the recharge area**

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	of the ecosystem.			
In the case of poor *chemical status*				
Parameter(s) responsible for *poor status*	**RO / RS:** **HU: nitrates (HU_SP.2.16.1; HU_SP.1.15.1);**			
Further information on TVs	**Procedure:** **HU:** TVs were established by following the guidelines given in Annex II Part A of the GWD. Substances considered for TVs are those listed in part B of GWD, as well as nitrates and pesticides. The TV of a given component for a water body was determined by taking into account: - the 90% percentile value (NBL) of available chemical data of non-polluted objects for a given water body (NBL was established for nitrates, ammonium, EC and sulphate); - the geology and hydrodynamics of the water body; - Quality Standards (EQSsurfacewater and DWS) of the given substance. In the case of water bodies where both EQSsurfacewater and DWS are applicable (e.g. for nitrates), TVs were established considering the more stringent criteria (i.e. EQSsurfacewater). EQSsurfacewater is applicable only in the case of karstic water bodies feeding surface waters, for example by springs. In the case of trichloroethylene and tetrachloroethylene, the DWS for pesticides took into account the GW-QS. For those GWBs where the NBL was higher than the DWS due to natural hydro-geological reasons, the TVs for ammonium, SO_4 and EC were defined by taking into account these higher values, as described in EU WFD CIS Guidance Document No. 18. To achieve EQ objectives in cold karstic GWBs with springs, TVs for nitrates were defined in conformity with EQSsurfacewater (25 mg/l). For other GWBs, nitrate TV equals DWS. In the case of sulphate and EC, TVs can be higher than the quality standard, considering the geology or hydrogeological regime of the water bodies. **Relationship:** (*Brief summary of the relationship between TVs and background levels for naturally occurring substances < 2000 characters)* **HU:** see the description above			
Threshold values per GWB	**GWB**	**Pollutant / indicator**	**TV (or range)** [8]	**Level at which the TV is established**

[8] Insert the range of TVs if different TVs are applied within the national aggregated ICPDR GWB

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			(mg/l or µg/l)	(national, RBD, GWB)
	HU_SP.1.15.1 **HU_SP.2.16.1**	**Nitrate**	**50 mg/l**	**GWB**

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Member State Code MS_Code	**SK1000300P, SK1000200P / HU_P.1.1.1, HU_P.1.1.2, HU_SP.1.1.1, HU_SP.1.1.2**
Description of important transboundary GWB	**SK: Delineation** Delineation of water bodies in Slovakia (SK) consists of the following steps: 1. Aquifers are vertically divided into three levels: Quaternary sediments, Pre-quaternary strata containing cold waters and thermal aquifers (with temperature >25°C or considered thermal by classification). 2. The pre-quaternary strata are further divided horizontally by the geological type of the aquifer: volcanic rocks, other fissured rocks, karstic rocks or porous sediments. 3. Further separation is the result of surface catchment area borders (river basin management units). **HU: Delineation** Re-delineation of GWBs in Hungary in 2007 was carried out as follows: 1. Separation of the main geological features (based on recent information): porous aquifers in the basins, karstic (Triassic) aquifers, mixed formations of the mountainous regions, aquifers other than karstic. 2. Vertical separation of shallow ground water (generally to the first aquitard below the surface or approx. the first 30 m below the water table where an aquitard is not present) in the case of porous aquifers in the basins and mountainous regions, other than Triassic karsts and fractured rocks. 3. Separation of thermal water bodies according to a 30 °C temperature. In the case of porous aquifers it is done vertically, while in karstic aquifers horizontally. There are no thermal aquifers in the mountainous regions other than karstic ones. 4. Further division is related to the subsurface catchment areas and vertical flow systems (in the case of porous aquifers) and to structural and hydrological units (in the case of karstic aquifers and mountainous regions). For transboundary water bodies, more detailed further characterisation was carried out. (N.B. Due to the numerous transboundary water bodies and the expected 20–30% at risk of failing *good status*, Hungary decided to apply this methodology of further characterisation to all water bodies). **Reasons for selection as an important transboundary GWB** The large alluvial deposit of the River Danube downstream of Bratislava lies in three countries: Slovakia (Podunajská lowland and the Žitný ostrov area), Hungary (Northern part of Kisalföld including Szigetköz) and Austria. The aquifer system was considered by Slovakia and Hungary as an important transboundary aquifer because of (i) its size, (ii) the unique amount of available groundwater resource and its important actual use for drinking water and other purposes, (iii) the GDTE of the floodplain, (iv) the majority of the area is protected (protection zones for drinking water abstraction sites, nitrate sensitive areas and nature conservation areas), (v) the existence of the Gabcikovo Hydropower System. The sections situated in Slovakia and Hungary will be described in the following. **General description** The Danube has played the decisive role in the formation of the aquifer system. The main aquifer is made up of 15-500 m thick Quaternary alluvia: a hydraulically connected mixture of sands and gravels, intercalated with numerous clay and silt lenses. The average hydraulic conductivity is in the range of 100–500 m/day providing extremely high transmissivity, especially in the centre of the basin. Here, the bottom of the underlying Pannonian deposits is at a depth of 3500 m. The aquifer is divided into several GWBs in both countries. Despite the differences in

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	the delineation method of the two countries, it was possible to select the relevant water bodies from the transboundary point of view. Of the four water bodies containing cold water in Hungary, two of them contain Quaternary strata from the surface to a depth of 30 m, i.e. shallow GWBs (GWB HU_SP.1.1.1, GWB HU_SP.1.1.2). Beneath these are two porous GWBs (GWB HU_P.1.1.1, GWB HU_P.1.1.2), which beside the Quaternary strata include a part of the Upper-Pannonian deposits as well, to a depth of 400–500 m corresponding to the surface separating cold and thermal waters (1152 km²). Two Quaternary water bodies in Slovakia (2193 km²) have been selected, making a total of 3345 km² in both countries (see the summary table above). The aquifer can be considered as *unconfined*, despite a considerable area where the water level is in a semi-permeable covering layer. Due to the high transmissivity of the aquifer, the groundwater regime and quality mainly depend on surface water. The flow system and type of covering layer provide surplus recharge conditions in the majority of the area, but the main source of groundwater recharge is the Danube. Before the construction of the hydropower system (1992), the riverbed was the infiltration surface, and the Danube had been the hydraulic boundary between the countries as well. (In the upper parts of the Danube stream between Devín and Hrušov, since around the1970's, the river bed started to drain groundwater.) In the actual situation, the artificial recharge system is the main source for the vicinity of the Danube, but a remaining part of the aquifers in Hungarian territory is recharged by the Čunovo reservoir. Where the reservoir is near the main channel (between Rajka and Dunakiliti), considerable transboundary groundwater flow appears under the Danube. The Danube's river bed downstream of the reservoir – due to the derived flow and the consequently decreased average water level - drains the neighbouring groundwater, causing a considerable drop of groundwater level in the immediate vicinity of the river bed. Both the quantity and the quality of the recharge from the reservoir is highly dependent on the continuously increasing deposits in the reservoir and the developing physico-chemical processes. Deposits in the reservoir are extracted. Signs of long-term changes in quantity and quality of recharge caused by continuously increasing deposits in the reservoir have not yet been observed in the Slovak part of the aquifer. The depth of the groundwater table varies from between 2 and 5 m. The wetting conditions of the covering layer have substantially changed along the Danube and in lower Szigetköz, where prior to the derivation of the Danube, the groundwater fluctuated in the covering layer and the existing artificial recharge system did not sufficiently compensate the former influence of the Danube. In the Slovak territory, annual artificial flooding of the river branch system in the high water periods seems to be able to efficiently supply groundwater as well as soil moisture resources.
Description of status assessment methodology	**SK: *Chemical status*** To assess *chemical status*, the proposed methodology stems from the feasibility of the input information, conceptual model and the hydrogeochemical and hydrogeological interpretation of conditions in the Slovak Republic. Article 3.2 of the Groundwater Directive offers the possibility to establish TVs at: the national level; the river basin district level; the level of the area of the international river basin district falling within the territory of a Member State; or at the level of a GWB or group of GWBs. In the Slovak Republic, the NBL and TVs were established at the level of the GWB. <u>Determination of natural background levels</u>: The input data consists of the database from the Geochemical Atlas of the Slovak Republic (spatial factor, 16 359 samples) and the results of national monitoring of groundwater quality (time factor, 16 475 samples) in Slovakia. The next step was to eliminate each sample with anthropogenic impacts (pre-selection method with half the DWS for each compound). Sample elimination was also done in cases where just one

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	compound failed to satisfy this principle. For determination of the NBL, a statistical method was used (NBL=median+2*median absolute deviation). For the treatment of *less than LOQ* (limit of quantification), measurements were applied according to the following system: simple substitution (LOQ*0.5, when <40% values are below LOQ), 40-60% - Kaplan-Meier´s analysis was used and over 60% NBL=LOQ). NBL were estimated for: NO_3, As, Cd, Pb, Hg, NH_4, Cl, SO_4, Na, K, Ca, Mg, Sr, PO_4, HCO_3, Fe, Mn, Cr, Cu, Se and Al. For synthetic organic compounds (not originating in a natural way) the NBL was "zero concentration" and this is practically the value of the LOQ of a single organic compound. <u>Threshold values:</u> The TV is a half the interval between the determined NBL and the reference (drinking water standard). As the TV can be below the geogenic concentration in groundwater, for example in the case of heavy metals, the TV will be assessed on the basis of the natural background level (TV = NBL). <u>*Chemical status*</u>: For *chemical status* assessment, general assessment of the *chemical status* of the GWB as a whole was applied. Input data results from the quality monitoring network from 2007 were used. Criteria for assessing the groundwater *chemical status* for this test were drinking water standards and TVs. The annual arithmetic mean concentration of the relevant pollutant at each monitoring point was the basis for aggregation on the level of a GWB. In the case of non exceedances, the GWB is recommended to be of good *chemical status* for the relevant parameters. The next step was to calculate the extent of exceedance of mean values by using the Kriging method - in the case of quaternary GWB (porous permeability and over five monitoring points). An acceptable extent of exceedance would not exceed 20% of the total GWB. In the case of pre-quaternary GWBs with fissure, karst, karst-fissure permeability, annual average concentrations with 20% confidence intervals were used. The final assessment of the *chemical status* of the GWB and its verification was performed using a GIS technique via comparison with maps of land use, hydrogeological and hydrogeochemical conditions in the GWB. **HU: *Chemical status*** <u>1. Exceedance of TVs at monitoring points</u> This test is performed for all GWBs and all chemical elements for which standards or TV(s) have been determined, in the following steps: - Selection of WFD monitoring points where the average concentration for the period 2004-2007 **exceeds the determined standard or the TV**. - Exclusion of monitoring sites where the higher concentration is due to **natural conditions** (although the TV is determined considering the natural background level, it is possible to detect an exceedance of natural origin). - Classification of *poor status* for all those GWBs where a **drinking water production well or captured spring** shows exceedance of the drinking water standard to such an extent that changes in treatment technology are needed. The GWB should be classified as *poor* in the case of danger of pollution to drinking water production wells. (See next point for potential impact on active abstractions.) - Evaluation of data on groundwater quality **inside the drinking water source protection area** (corresponding to a 50-year travel time according to Hungarian legislation). The evaluation is carried out in the framework of a general status assessment of exploited drinking water resources, including all observation wells and information on sources of pollution. If the result of evaluation shows that pollution is able to cause exceedance of the drinking water standard at the abstraction point involving a change in treatment technology, the GWB is classified as being in *poor status*.

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	- Selection of monitoring wells **inside aquifers designated for future drinking water abstraction.** If the number of wells exceeding the drinking water standard is higher than a given value (determined as a function of the chemical element and type of aquifer), the GWB is classified as *poor status* since it is likely that the exploitation would be difficult: not possible or would need treatment. - The real impact of exceedances on ecosystems is analysed according to points 3. & 4. Where the NBL > DWS the TV is taken into consideration. <u>2. Delineation of polluted areas</u> This test is carried out for **shallow and karstic GWBs regarding nitrates and ammonium**. The delineation of the polluted area (where the concentration exceeds the threshold of the given GWB) is based on all information (not only WFD monitoring!). The GWB is classified as having *poor status* if **20–30% of the total surface of the GWB is polluted.** For a given GWB, the criterion is selected according to its vulnerability i.e. for karstic aquifers and for GWBs of recharge character: 20 %; for other shallow GWBs: 30%. <u>3. Polluted surface water bodies</u> This test is applied in those GWBs where **the physico-chemical or the chemical test shows *poor status* for a groundwater dependent surface water body** and its reason is not evidently sewage water discharges or diffuse pollution from surface runoff. Cases where a polluted monitoring well can be found in the vicinity (closer than 5 km) of a groundwater dependent surface water body of *poor chemical status* will also be analysed The evaluation is special to each case, taking into account (i) all available data on groundwater and surface water quality, (ii) information on pollution sources - the point or diffuse character of the pollution, (iii) estimated load from pollution sources, (iv) attenuation and dilution effects. If it is proved that the *chemical status* of the GWB is the cause of the observed pollution in the surface water body, the GWB is classified as having *poor chemical status*. The real impact of **polluted springs** on the quality of the relevant water course is also evaluated, at least up until the first water body (considering possible dilution). If the *physico-chemical or chemical status* of the surface water body is *not good* because of this pollution, the GWB is classified as having *poor status*. <u>4. Damaged groundwater dependent wetland and terrestrial ecosystems</u> This test is applied to those GWBs where it is likely that the **documented damage to certain wetlands or GWDTE** is due to polluted groundwater. The methodology of the evaluation for the real impact on ecosystems is performed in a similar way to the case of aquatic ecosystems (see point 3.). Monitoring of the status of wetlands and GWDTEs is not part of the WFD, so only scattered information on status is available. **SK: *Quantitative status*** To determine the overall quantitative status for GWBs, four tests were applied: 1. Water balance test: Long-term annual abstraction from the GWB must not exceed 80% of available groundwater resources. Quantification of available groundwater resources was based on national quantification and categorization of exploitable groundwater amounts in individual GWBs: 8 categories with different accuracies for determined amounts varying from 100% (water balance evaluation) to 30% (less then 1 year of groundwater monitoring data); available groundwater resources for

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	GWB is the sum of groundwater amount in the individual category multiplied by the different significance from 1 to 0.3). 2. Groundwater level and discharge test: Identifying the presence of sustained long-term declines in groundwater levels or groundwater discharge caused by long-term groundwater abstraction using long-term groundwater monitoring data from the national groundwater monitoring network and the Mann-Kendall test (95% and 99% probability, z varying from absolute min to -3.0). 3. Surface water flow test: Evaluation of surface water discharge in surface water balance profiles (inside of surface water bodies failing their WFD environmental flow objectives). The sum of the long-term average groundwater abstraction in the balance area above the surface water balance profile must not exceed 50% from $Q_{180\ (2007)}$ or 100% from Q_{355} (whole monitoring period). 4. Groundwater dependent terrestrial ecosystems test: Expert judgment on GWDTEs and the influence of groundwater abstraction - groundwater pressures (and subsequently indication of flow or groundwater level changes due to groundwater abstraction) on GWDTEs. The assessments were made on the basis of selected ecological criteria established according to the common depended terrestrial ecosystems. **HU: *Quantitative status*** 1. Water balance test The water balance test is carried out in two steps: - The GWB is in *poor status* if **in 20% of its area, continuous decreasing water levels** can be observed due to groundwater abstraction. The test is based on data for the period 2001-2007. A declining trend of 5-15 cm/year (depending on aquifer type and depth) can be considered as significant. In mountainous regions, the rate of springs is also analysed; the significant trend depends on the average rate. Water abstractions causing the trend should be identified. (Trends caused by meteorological conditions or short declining trends caused by new water abstractions are not considered.). If the designated area is near the country border, **transboundary conciliation is needed**. - The GWB is also in *poor status* if the **groundwater abstraction exceeds the available groundwater resource**. This test is applied to subsurface catchment areas, thus shallow and deeper GWBs (except porous thermal GWBs) and corresponding dominantly recharge and discharge GWBs are merged in GWB-groups. **Recharge** consists of three components: (i) recharge from precipitation, (ii) recharge from surface water, (iii) flow from adjacent GWB or GWB-group. **Recharge from precipitation** is calculated by a spatially distributed (1x1 km grid) water balance model including precipitation (period 1991-2000), interception, surface runoff, evapotranspiration and storage in the unsaturated zone. Local recharge is ignored in dominantly discharge areas. **Recharge from surface water** (as a long-term average) is rare in Hungary, it is determined on a case-by-case basis. Although GWBs are grouped according to subsurface catchments, estimation of **flow from adjacent GWB-group** is still important (i) in the case of transboundary water bodies, (ii) between different types of GWBs, (iii) where the boundary in the deeper part does not represent a real no-flux boundary. The estimation is based on the results of regional groundwater flow models or simple calculations using maps of water levels and transmissibility. **The water demand of groundwater dependent ecosystems** also has three components: (i) baseflow and spring rates supplying aquatic ecosystems in water

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	courses, (ii) a surplus of evaporation in shallow lakes and wetlands, (iii) a surplus of transpiration from groundwater (supplying GWDTE). **The water demand of aquatic ecosystem in rivers** is considered for small and medium water courses, where springs are frequent in the catchment or where the average groundwater level is above the bottom of the riverbed. Ecologically necessary low flow is estimated on the basis of required water depth, width and velocity. **The water demand of shallow lakes and wetlands** is estimated as the product of required water/wetland surface and the surplus of evaporation. The required water surface is estimated considering landscape-ecology aspects. **The water demand of vegetation in the discharge area** is estimated as the product of the area (where the groundwater should contribute significantly to the water supply of the vegetation) and the amount of capillary flow needed for surviving periods without precipitation. The potential area is delineated using a GIS procedure (convenient combination of soil type and groundwater level). The required part is a percentage of the potential one (default is 30%). **The amount of abstracted water** is the sum of the amount abstracted by wells (average for the period 2004-2007) and the outflow related to other water uses (e.g. drainage canals, gravel pits, decreased surface water level). <u>2. Surface waters test</u> This test is applied for those GWBs where the hydromorphological classification shows a critical flow situation for a groundwater dependent water body and its reason is not evidently the use of surface waters. The GWB is classified as *poor status* if: - **the remaining spring rate** in low flow period (either due to abstraction by wells or the capture of springs) is smaller than the ecologically required flow; - **the decrease in baseflow** caused by groundwater abstraction (in the whole catchment of the surface water body) exceeds half of the available surface water resource. <u>3. Groundwater dependent wetlands and terrestrial ecosystems test</u> This test (status evaluation) is applied to those GWBs where the available information shows significant damage to wetlands and GWDTEs. - It is preferred, that the real effect on groundwater status is determined on a case-by-case approach, including the analysis of the **role of groundwater levels and flow conditions in damage to biota** and the reason for it (e.g. groundwater abstraction or other water use; climate change is not considered as a reason for *poor status*). - A detailed analysis may not be possible because of limited available data. In this case, the GWB is of *poor status* if there are **direct and indirect groundwater abstractions whose recharge area overlaps by more than 30% with the recharge area of the ecosystem**.
In the case of *poor chemical status*	
Parameter(s) responsible for *poor status*	**SK:** **HU: nitrates (HU_SP.1.1.2)**

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Further information on TVs	**SK: Procedure and relationship to background levels** To establish TVs as criteria, usage criteria were considered (drinking water standards). TVs were set by comparing natural background levels to the criteria value (CV). When NBLs and CVs are compared, two situations may arise: - NBL is below the CV. In this case the TV was established above the NBL. - NBL is higher than the CV. In this case, the TV should be equal to the NBL. The TV is half of the interval between the determined NBL and the reference (drinking water standards). As the TV can be below geogenic concentrations in groundwater, for example in the case of heavy metals, the TV will be assessed on the basis of the natural background level (TV = NBL). **HU: Procedure and relationship to background levels** TVs were established by following the guidelines given in Annex II Part A of the GWD. Substances considered for TVs were those listed in part B of the GWD, as well as nitrates and pesticides. The TV of a given component for a water body was determined by taking into account: - the 90% percentile value (NBL) of available chemical data on non-polluted objects for a given water body (NBL was established for nitrates, ammonium, EC and sulphate); - the geology and hydrodynamics of the water body; - Quality Standards (EQSsurfacewater and DWS) of the given substance. In the case of water bodies, where both EQSsurfacewater and DWS are applicable (e.g. for nitrates), TVs were established considering the more stringent criteria (i.e. EQSsurfacewater). EQSsurfacewater is applicable only in the case of karstic water bodies feeding surface waters, for example by springs. In the case of trichloroethylene and tetrachloroethylene, the DWS for pesticides took into account the GW-QS. For those GWBs where the NBL was higher than the DWS due to natural hydro-geological reasons, the TVs for ammonium, SO_4 and EC were defined by taking into account these higher values, as described in EU WFD CIS Guidance Document No. 18. To achieve EQ objectives in cold karstic GWBs with springs, TVs for nitrates were defined to conform with EQSsurfacewater (25 mg/l). For other GWBs, nitrate TV equals DWS. In the case of sulphate and EC, TVs can be higher than the quality standard, considering the geology or hydrogeological regime of the water bodies.			
TVs per GWB	**GWB**	**Pollutant / indicator**	**TV (or range)** [9] (mg/l or µg/l)	**Level at which the TV is established** (national, RBD, GWB)
	-	**NO_3**	**50**	**national**

[9] Insert the range of TVs if different TVs are applied within the national aggregated ICPDR GWB

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	SK 1000300P	Na	104.45	GWB
	SK 1000300P	F	0.85	GWB
	SK 1000300P	Cl	62.30	GWB
	SK 1000300P	SO_4	157.60	GWB
	SK 1000300P	NH_4	0.26	GWB
	SK 1000300P	Cr	0.026	GWB
	SK 1000300P	Cu	0.502	GWB
	SK 1000300P	As	0.006	GWB
	SK 1000300P	Cd	0.002	GWB
	SK 1000300P	Se	0.006	GWB
	SK 1000300P	Pb	0.007	GWB
	SK 1000300P	Hg	0.00075	GWB
	-	atrazine	0.05 µg/l	national
	-	simazine	0.05 µg/l	national
	-	tetrachloroethylene	5 µg/l	national
	-	trichloroethylene	5 µg/l	national
	SK1000200P	Na	105.75	GWB
	SK1000200P	F	0.755	GWB
	SK1000200P	Cl	60.75	GWB
	SK1000200P	SO_4	148.90	GWB
	SK1000200P	NH_4	0.255	GWB
	SK1000200P	Cr	0.0255	GWB
	SK1000200P	Cu	0.501	GWB
	SK1000200P	As	0.006	GWB
	SK1000200P	Cd	0.002	GWB
	SK1000200P	Se	0.0055	GWB
	SK1000200P	Pb	0.0065	GWB
	SK1000200P	Hg	0.0007	GWB
	HU_SP.1.1.1	Nitrate	50 mg/l	GWB

9: Bodrog	
Member State Code MS_Code	**SK1001500P / HU_P.2.5.2, HU_SP.2.5.2**
Description of important transboundary GWB	**SK / HU: Delineation** See GWB no. 8. for details. **SK / HU: Reasons for selection as an important transboundary GWB** At the common eastern border of Slovakia and Hungary, the alluvial aquifer system corresponding to the Bodrog River catchment area in Slovakia and the Tisza-valley between Záhony and Tokaj (confluence with the Bodrog River) has been selected as important due to: (i) its significance in meeting the water demand of the region, (ii) the contamination threat of groundwater in the vicinity of state border between Slovakia and Hungary. A part of the water aquifer system is located in Ukraine. **SK / HU: General description** The aquifer is the alluvial deposit of the Bodrog River and its tributaries. The Tisza divides the lowland area in Hungary into Bodrogköz (northern part) and Rétköz (southern part). Holocene silty-clayey layers cover the surface, along with peaty areas. The Quaternary aquifer is around 60 m thick on the Slovakian side and its thickness gradually increases in Hungary towards the south (50-200 m). The fluvial sediments (from sandy gravels in the north to sands in the south with intercalated silt and clay lenses) can be characterised by 5–30 m/d hydraulic conductivity. In the Slovakian part, only the Quaternary aquifer system is part of the transboundary water body-complex, while in Hungary the upper part of the Pannonian formation is also attached (depth is approx. 500 m, corresponding to a water temperature of < 30°C). The horizontal extension of the water body on the Slovak side is 1466 km^2, while in Hungary the two water bodies cover an area of 1300 km^2. The main recharge area is in Slovakian territory. The rain waters infiltrate at the marginal mountains and penetrate into permeable deep aquifers. In the upstream part of the catchment area, surface waters also contribute to the recharge. On the Slovakian side, the water bodies are mainly *unconfined* or in some places partly *confined*. In Hungary both water bodies are in a discharge position and the main aquifers can be considered as *confined*. Here the groundwater level lies close to the surface (between 2 and 4 m below). Where it is around 2 m below the surface, the groundwater can considerably contribute to the transpiration needs vegetation, which are adapted to these conditions, and consequently are very sensitive to the status of the groundwater. The surplus of evapotranspiration and the artificial drainage system (canals) collect the upward groundwater flow. From the south, the sandy hills of Nyírség contribute to the discharged groundwater as well, but the boundary of the waters of different origin is not known exactly (that is why both discharge areas in Hungary have been attached to the transboundary aquifer). The general direction of the groundwater flow is N-S (NE-SW) to the north of the Tisza River, SE-NW in the Rétköz and uncertain below the Tisza. The regional hydrogeochemical picture follows the flow system. Close to the river bed sections, recharging groundwater quality is almost the same as in surface streams. Generally low total dissolved solids, Ca-Mg-HCO_3 type waters occur in the recharge areas, Na-HCO_3 waters dominate in the middle and western part of Rétköz, and a mixture of these two types in the western part of the Bodrogköz region. At the centre of Bodrogköz, elevated Cl content indicates strong upward migration from the deeper zones. The major water quality problem of natural origin in the Bodrogköz Quaternary aquifer complex is the high iron and manganese content (reducing conditions). In the Rétköz elevated arsenic levels occur (10-30 µ/l).

9: Bodrog	
	The estimated amount of available groundwater resources is almost 50 Mm³/year in the Slovakian part. From that 10–15 Mm³/year should be maintained as lateral flow towards the Hungarian part. It should be mentioned that the southern part of the Hungarian discharge area receives water from the southern recharge areas as well, but no local recharge can be considered available for abstraction in Bodrogköz and Rétköz. **SK / HU: Major pressures and impacts** Groundwater is mainly used for drinking water supply, but partially for industrial and agricultural purposes (including irrigation) as well. The use ratio is quite low in Slovakia: only 10%. The development is limited by the occurrence of technologically inappropriate substances in the water (Mn and Fe) and sometimes also by groundwater pollution from surface waters, industry, agriculture and transport infrastructure (Strážske, Hencovce, Michalovce, Čierna nad Tisou). In Hungary, the available groundwater resources of the two water bodies are quite different. In the northern part, which is closely related to the Slovakian part, the water demand of groundwater dependent aquatic and terrestrial ecosystems can be estimated at 5–8 Mm³/d, thus the available groundwater resource is in the range of 5–7 Mm³/year. The abstracted amount of groundwater is 3 Mm³/year, so the use ratio is around 50 %, but the majority is concentrated in the Ronyva/Roňava river valley. In the southern part the lateral flow from the recharge zone of the Nyírség (approx. 30 Mm³/year) provides sufficient water for the minimum water demand of ecosystems (8–12 Mm³/year) and for the 8 Mm³/year required for abstraction. Groundwater quality in the Slovakian part (mainly alluvial sediments along the Laborec) is strongly influenced by potential risks from diffuse (mainly agricultural activities) and point sources (chemical industry Chemko Strážske etc.). In Hungary, 10 significant point sources of pollution have been registered. The shallow groundwater usually has high nitrate levels under the settlements, because of inappropriate handling of manure and the total or partial absence of sewerage systems. Agriculture contributes to the pollution as well, through the use of chemicals. The estimated amount of surplus nitrogen is 15 kgN/ha/year originated from the use of 88 kgN/ha/year fertilizer and 13 kgN/year manure. The groundwater quality in Slovakia is monitored at 21 sampling sites; groundwater samples are taken from the first aquifer once a year (in the autumn). In agricultural areas, nitrogen substances and micropollutants have been found exceeding limit values. Hungarian water quality monitoring concentrates on the surrounding waterworks. The quality of the Ronyva/Roňava aquifer close to the Sátoraljaújhely waterworks shows increasing tendency for nitrate pollution: the average concentration is around 30 mg/l, and in one production well the nitrate-concentration exceeded the limit value of 50 mg/l. Information on pollution in arable lands is practically missing in this region. The high vulnerability of groundwater and the expected future development in water demand requires a high level of protection in the Slovakian part of the region, mainly oriented on measures focused on industrial pollution sources. In Hungary the protection zones around waterworks (5%) need special attention.
Description of status assessment methodology	***SK: Chemical status*** To assess *chemical status*, the proposed methodology stems from the feasibility of the input information, conceptual model and the hydrogeochemical and hydrogeological interpretation of conditions in the Slovak Republic. Article 3.2 of the Groundwater Directive offers the possibility of establishing TVs at the national level, at the river basin district level, the level of the area of the international river basin district falling within the territory of a Member State; or at the level of a GWB or group of GWBs. In the Slovak Republic, the NBL and TVs were established at the level of the GWB.

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	Determination of natural background levels The input data consists of the database from the Geochemical Atlas of the Slovak Republic (spatial factor, 16 359 samples) and the results of national monitoring of groundwater quality (time factor, 16 475 samples) in Slovakia. The next step was the elimination of each sample with anthropogenic impacts (pre-selection method: half of the DWS for each compound). The sample elimination was also done in the case where only one compound didn't satisfy this principle. For determination of the NBL, statistical methods were used (NBL=median+2*median absolute deviation). For the treatment of *less than LOQ,* measurements were applied according to the following system: simple substitution (LOQ*0.5, when <40% values are below LOQ), 40-60% - Kaplan-Meier´s analysis was used and over 60% NBL=LOQ). NBL were estimated for: NO_3, As, Cd, Pb, Hg, NH_4, Cl, SO_4, Na, K, Ca, Mg, Sr, PO_4, HCO_3, Fe, Mn, Cr, Cu, Se and Al. For synthetic organic compounds (not originating in a natural way) the NBL is *zero concentration* and this is practically the value of the LOQ of a single organic compound. TVs The TV is half the interval between the determined NBL and the reference (drinking water standards). As the TV can be below the geogenic concentrations in groundwater, for example in the case of heavy metals, the TV will be assessed on the basis of the natural background level (TV = NBL). *Chemical status* For *chemical status* assessment, a general assessment of the *chemical status* of the GWB as a whole was applied. The input data results from the quality monitoring network from 2007 were used. The criteria for assessing groundwater *chemical status* for this test were drinking water standards and TVs. The annual arithmetic mean concentration of the relevant pollutant at each monitoring points was the basis for aggregation at the level of a GWB. In the case of non exceedances, the GWB is recommended to be of *good chemical status* for the relevant parameters. The next step was to calculate the extent of exceedance of mean values by using the kriging method in the case of quaternary GWB (porous permeability and over 5 monitoring points). An acceptable extent of exceedance would not exceed 20% of the total GWB. In the case of pre-quaternary GWBs with fissure, karst or karst-fissure permeability, annual average concentrations with 20% confidence intervals were used. The final assessment of the *chemical status* of the GWB and its verification was performed using a GIS technique via comparison with maps of land use, hydrogeological and hydrogeochemical conditions in the GWB. ***HU: Chemical status*** 1. Exceedance of TVs at monitoring points This test is performed for all GWBs and all chemical elements, for which standards or TV(s) have been determined, using the following steps. - Selection of WFD monitoring points, where the average concentration for the period 2004-2007 **exceeds the determined standard or the TV**. - Exclusion of monitoring sites where the higher concentration is due to **natural conditions** (although the TV is determined considering natural background level, it is possible to detect an exceedance of natural origin). - Classification of *poor status* for all those GWBs where a **drinking water production well or captured spring** shows exceedance of the drinking water standard to such an extent that changes in treatment technology are needed. The GWB should be classified as *poor* in the case of danger of pollution to drinking water production wells. (See next point for potential impact on active abstractions.) - Evaluation of data on groundwater quality **inside the drinking water source**

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	protection area (corresponding to a 50-year travel time, according to Hungarian legislation). The evaluation is carried out in the framework of the general status assessment for exploited drinking water resources, including all observation wells and information on sources of pollution. If the result of the evaluation shows that pollution is able to cause exceedance of the drinking water standards at the abstraction point, involving a change in treatment technology, the GWB is classified as having *poor status*. - Selection of monitoring wells **inside aquifers designated for future drinking water abstraction**. If the number of wells exceeding the drinking water standard is higher than a given value (determined as a function of the chemical element and type of aquifer), the GWB is classified as being of *poor status* since it is likely that the exploitation would be difficult: not possible or would need treatment. - The real impact of exceedances on ecosystems is analysed according to points 3. & 4. Where the NBL > DWS the TV is taken into consideration. <u>2. Delineation of polluted areas</u> This test is carried out for **shallow and karstic GWBs regarding nitrates and ammonium**. The delineation of the polluted area (where the concentration exceeds the threshold of the given GWB) is based on all information (not only WFD monitoring!). The GWB is classified as having *poor status* if **20–30% of the total surface of the GWB is polluted.** For a given GWB, the criterion is selected according to its vulnerability i.e. for karstic aquifers and GWB of recharge character: 20%: for other shallow GWBs: 30%. <u>3. Polluted surface water bodies</u> This test is applied in those GWBs where **the physico-chemical or the chemical test shows *poor status* for a groundwater dependent surface water body** and its reason is not evidently sewage water discharges or diffuse pollution from surface runoff. Cases where a polluted monitoring well can be found in the vicinity (closer than 5 km) of a groundwater dependent surface water body of *poor chemical status* will also be analysed The evaluation is special to each case, taking into account (i) all available data on groundwater and surface water quality, (ii) information on pollution sources - the point or diffuse character of the pollution, (iii) estimated load from pollution sources, (iv) attenuation and dilution effects. If it is proved that the *chemical status* of the GWB is the cause of the observed pollution in the surface water body, the GWB is classified as having *poor chemical status*. The real impact of **polluted springs** on the quality of the relevant water course is also evaluated, at least up until the first water body (considering possible dilution). If the *physico-chemical or chemical status* of the surface water body is *not good* because of this pollution, the GWB is classified as having *poor status*. <u>4. Damaged groundwater dependent wetland and terrestrial ecosystems</u> This test is applied for those GWBs where it is likely that the **documented damage of certain wetlands or GWDTEs** is due to polluted groundwater. The methodology of the evaluation of the real impact on ecosystems is performed in a similar way to the case of aquatic ecosystems (see point 3.). Monitoring of the status of wetlands and GWDTEs is not part of the WFD, so only scattered information on status is available. **SK: *Quantitative status***

9: Bodrog	
	To determine the overall quantitative status for the GWB, four tests were applied: 1. Water balance test – Long-term annual abstraction from the GWB must not exceed 80% of the available groundwater resources. Quantification of available groundwater resources was based on the national quantification and categorization of exploitable groundwater amounts in individual GWBs (8 categories with different levels of accuracy for determined amounts varying from 100% (water balance evaluation) to 30% (less then 1 year groundwater monitoring data); available groundwater resources for GWBs is the sum of groundwater amount in the individual category multiplied by different significances from 1 to 0.3). 2. Groundwater level and discharge test: Identifying the presence of sustained long-term declines in groundwater levels or groundwater discharge caused by long-term groundwater abstraction using long-term groundwater monitoring data from national groundwater monitoring network and the Mann-Kendall test (95% and 99% probability, z varying from absolute min to -3.0). 3. Surface water flow test: Evaluation of surface water discharge in surface water balance profiles (inside of surface water bodies failing their WFD environmental flow objectives). Sum of the long-term average groundwater abstraction in the balance area above the surface water balance profile must not exceed 50% from $Q_{180\ (2007)}$ or 100% fromQ_{355} (whole monitoring period). 4. Groundwater dependent terrestrial ecosystems test: Expert judgment of GWDTEs and the influence of groundwater abstraction - groundwater pressures (and subsequently indication of flow or groundwater level changes due to groundwater abstraction) on GWDTEs. The assessments were made on the basis of selected ecological criteria established according to the common depended terrestrial ecosystems **HU: *Quantitative status*** 1. Water balance test The water balance test is carried out in two steps: - The GWB is in *poor status* if **in 20% of its area, continuous decreasing water levels** can be observed due to groundwater abstraction. The test is based on data for the period 2001-2007. A declining trend of 5-15 cm/year (depending on aquifer type and depth) can be considered as significant. In mountainous region, the rate of springs is also analysed, the significant trend depends on the average rate. Water abstractions causing the trend should be identified. (Trends caused by meteorological conditions or a short declining trend caused by new water abstractions are not considered.). If the designated area is near the country border, **transboundary conciliation is needed**. - The GWB is also in *poor status*, if **groundwater abstraction exceeds the available groundwater resource**. This test is applied for subsurface catchment areas, thus shallow and deeper GWBs (except porous thermal GWB) and corresponding dominantly recharge and discharge GWBs are merged in GWB-groups. **Recharge** consists of three components: (i) recharge from precipitation, (ii) recharge from surface water, (iii) flow from adjacent GWB or GWB-group. **Recharge from precipitation** is calculated by a spatially distributed (1x1 km grid) water balance model including precipitation (period 1991-2000), interception, surface runoff, evapotranspiration and storage in the unsaturated zone. Local recharge is ignored in dominantly discharging areas. **Recharge from surface water** (as a long-term average) is rare in Hungary, it is determined on a case-by-case basis. Although GWBs are grouped according to subsurface catchments, estimation of

9: Bodrog	
	flow from adjacent GWB-group is still important (i) in the case of transboundary water bodies, (ii) between different types of GWBs, (iii) where the boundary in the deeper part does not represent a real no-flux boundary. The estimation is based on the results of regional groundwater flow models or simple calculations using maps of water levels and transmissibility. **The water demand of the groundwater dependent ecosystems** also has three components: (i) baseflow and spring rates supplying aquatic ecosystems in water courses, (ii) surplus of evaporation in shallow lakes and wetlands, (iii) surplus of transpiration from groundwater (supplying GWDTEs). **The water demand of aquatic ecosystems in rivers** is considered for small and medium water courses, where springs are frequent in the catchment or where the average groundwater level is above the bottom of the riverbed. Ecologically necessary low flow is estimated on the basis of required water depth, width and velocity. **The water demand of shallow lakes and wetlands** is estimated as the product of required water/wetland surface and surplus of evaporation. The required water surface is estimated considering landscape-ecology aspects. **The water demand of vegetation in the discharge area** is estimated as the product of the area (where the groundwater should contribute significantly to the water supply of the vegetation) and the amount of capillary flow needed for surviving periods without precipitation. The potential area is delineated using a GIS procedure (convenient combination of soil type and groundwater level). The required part is a percentage of the potential one (default is 30%). **The amount of abstracted water** is the sum of the amount abstracted by wells (average for the period 2004-2007) and the outflow related to other water uses (e.g. drainage canals, gravel pits, decreased surface water level). <u>2 Surface waters test</u> This test is applied to those GWBs where the hydromorphological classification shows a critical flow situation for a groundwater dependent water body and its reason is not evidently the use of surface waters. The GWB is classified as being of *poor status* if: - **the remaining spring rate** in low flow period (either due to abstraction by wells or the capture of springs) is smaller than the ecologically required flow; - **the decrease of the baseflow** caused by groundwater abstraction (in the whole catchment of the surface water body) exceeds half of the available surface water resource. <u>3. Groundwater dependent wetlands and terrestrial ecosystems test</u> This test (status evaluation) is to be applied for those GWBs where the available information shows significant damage to wetlands and GWDTEs. - It is preferred, that the real effect on groundwater status is determined on a case-by-case basis, including analysis of the **role of groundwater levels and flow conditions in damage to biota** and the reason for it (e.g. groundwater abstraction or other water use; climate change is not considered as a reason for *poor status*). - Maybe a detailed analysis is not possible because of limited available data. In that case the GWB is in *poor status* if there are **direct and indirect groundwater abstractions whose recharge area overlaps in more than 30% with the recharge area of the ecosystem**.
In the case of poor *chemical status*	

<table>
<tr><td colspan="5">9: Bodrog</td></tr>
<tr><td>Parameter(s) responsible for poor status</td><td colspan="4">SK:
HU:</td></tr>
<tr><td>Further information on TVs</td><td colspan="4">SK: Procedure and relationship to background levels
For establishing TVs as criteria, usage criteria were considered (drinking water standards). TVs were set by comparing the natural background level to the criteria value (CV). When NBLs and CVs are compared, two situations may arise:
- NBL is below the CV. In this case, the TV were established above the NBL.
- NBL is higher than the CV. In this case, the TV should equal the NBL.
The TV is half of the interval between the determined NBL and the reference (drinking water standards). As the TV can be below the geogenic concentrations in groundwater, for example in the case of heavy metals, the TV will be assessed on the basis of the natural background level (TV = NBL).
HU: Procedure and relationship to background levels
TVs were established by following the guidelines given in Annex II Part A of the GWD. Substances considered for TVs are those listed in part B of GWD, as well as nitrates and pesticides. The TV of a given component for a water body was determined by taking into account:
- the 90% percentile value (NBL) of the available chemical data of non-polluted objects of a given water body (NBL was established for nitrates, ammonium, EC and sulphate);
- the geology and hydrodynamics of the water body;
- Quality Standards (EQSsurfacewater and DWS) for the given substance.
In the case of water bodies, where both EQSsurfacewater and DWS are applicable (e.g. for nitrates), TVs were established considering the more stringent criteria (i.e. EQSsurfacewater).
EQSsurfacewater is applicable only in the case of karstic water bodies feeding surface waters, for example by springs.
In the case of trichloroethylene and tetrachloroethylene, the DWS for pesticides took account of the GW-QS.
For those GWBs where the NBL was higher than the DWS due to natural hydro-geological reasons, the TVs for ammonium, SO_4 and EC were defined by taking into account these higher values, as described in EU WFD CIS Guidance Document No. 18.
To achieve EQ objectives in cold karstic GWBs with springs, TVs for nitrates were defined to conform with EQSsurfacewater (25 mg/l). For other GWBs, nitrate TVs equal DWS. In the case of sulphate and EC, TVs can be higher than the quality standard, considering the geology or hydrogeological regime of the water bodies.</td></tr>
<tr><td>TVs per GWB</td><td>GWB</td><td>Pollutant / indicator</td><td>TV (or range)[10]
(mg/l or µg/l)</td><td>Level at which the TV is established
(national, RBD, GWB)</td></tr>
</table>

[10] Insert the range of TVs if different TVs are applied within the national aggregated ICPDR GWB

9: Bodrog				
	SK1001500P-	NO_3	50	national
	SK1001500P	Na	111	GWB
	SK1001500P	F	0.85	GWB
	SK1001500P	Cl	72.35	GWB
	SK1001500P	SO_4	167.35	GWB
	SK1001500P	NH_4	0.295	GWB
	SK1001500P	Cr	0.027	GWB
	SK1001500P	Cu	0.504	GWB
	SK1001500P	As	0.006	GWB
	SK1001500P	Cd	0.002	GWB
	SK1001500P	Se	0.006	GWB
	SK1001500P	Pb	0.009	GWB
	SK1001500P	Hg	0.0007	GWB
	SK1001500P-	atrazine	0.05 µg/l	national
	SK1001500P-	simazine	0.05 µg/l	national
	SK1001500P-	tetrachloroethylene	5 µg/l	national
	SK1001500P	trichloroethylene	5 µg/l	national

<table>
<tr><td colspan="2">10: Slovensky kras / Aggtelek</td></tr>
<tr><td>Member State Code MS_Code</td><td>SK200480KF / HU_K.2.2</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Description of important transboundary GWB</td><td>SK / HU: Delineation

See GWB no. 8.

SK / HU: Reasons for selection as an important transboundary GWB

The Aggtelek Mountain and Slovensky kras form a large common karstic aquifer system in the eastern part of each country. It has been selected as an important transboundary water body for this Danube Basin report because: (i) the National Park covers the majority of its surface, where the role of groundwater is presented by springs and stalactite caves, (ii) it forms a significant drinking water resource in Slovakia and regionally important in Hungary (iii) it is a vulnerable area requiring protection.

SK / HU: General description

The GWB is in a Mesozoic complex with morphologically visible karstic plateau and canyon-like valleys of water courses, separating different units. Hydrogeological units are very different according to permeability, groundwater circulation, groundwater regime, and also in the resulting yield of groundwater springs. From the hydrogeological point of view, the most important tectonic unit in the area is the Silicicum unit, mainly its Middle Triassic and Upper Triassic parts. The most important aquifer here is the Middle and Upper Triassic limestone and dolomites with karst-fissure type permeability. Similarly important hydrogeological units on the Hungarian side are Alsóhegy, Nagyoldal, Hasagistya and Galyaság, which contain the Aggtelek-Domica cave system. Tertiary basins act as a regional impermeable barrier for the groundwater accumulated in Triassic limestone.

The transboundary karstic aquifer is divided into two water bodies by the state-border. The horizontal extensions are 598 km^2 and 471 km^2 in Slovakia and Hungary respectively, thus the total size is 1069 km^2.

Groundwater circulation in these rocks is controlled by extreme heterogeneity of carbonate rocks, following tectonic development. These tectonically pre-destined drainage structures show the major influence on the direction of groundwater flows. The majority of groundwater is drained towards big karstic springs. Areas between such tectonic faults are less karstified and also less permeable. If not drained by cave systems or permeable tectonic faults, groundwater usually feeds the Quaternary coverage. A specific hydraulic feature of the karstified carbonate complex with preferred drainage structures is that no continuous groundwater table can be defined within the rock mass. Groundwater in many cases only fills up karstic openings – conduits, sometimes enlarged into cave systems, while segments between the preferred groundwater routes are unsaturated. On the other hand, groundwater level changes in these zones are sharp and show quick response to the meteorological situation. The typical amplitude of groundwater level change is from 5 to 15 m. In such levels above the erosion base, perennial springs occur after intensive rainfall events or sudden snowmelts. Hidden outflow to the deeper structures within and outside the area of territory (generally of westward direction under the Tertiary sediments of the Rimavská kotlina Basin) is considered to be quite important from the water management point of view. Groundwater abstraction for various purposes is concentrated at the natural outflows of springs – a relatively small portion is abstracted by pumping from boreholes and wells.

SK / HU: Major pressures and impacts

The estimated amount of available resources in Slovenský kras is 40.4 Mm^3/year;</td></tr>
</table>

10: Slovensky kras / Aggtelek	
	actual use is estimated at 21% of available resources, mainly for drinking water purposes. On the Hungarian side, only the karstic water is utilized, which flows out naturally from karstic springs in Jósvafő, Szögliget, Komjáti, Égerszög and Aggtelek. There are enough data about karst spring discharge. Observed discharge data are available for a period of nearly 30 years. No important karstic water abstraction will be planned in the area because of the National Park. On the plateau, forestry is predominant, with some agriculture, settlements and related economic activities concentrated in the basins and river valleys. In both countries, only a few point sources of pollution occur and intensive agriculture is also insignificant. National Parks cover the majority of the area. In addition, in Hungary, the total area of the GWB is considered as Nitrate-sensitive. Groundwater quality on the Slovakian side has been monitored in 16 sampling sites: groundwater samples are taken from the first aquifer once a year (in the autumn). Quality monitoring shows no deterioration of the water quality compared to drinking water standards. 6 karst-springs are monitored four times per year for quality sampling in Hungary; they do not show signs of pollution.
Description of status assessment methodology	**SK: *Chemical status*** To assess *chemical status*, the proposed methodology stems from the feasibility of the input information, conceptual model and the hydrogeochemical and hydrogeological interpretation of conditions in the Slovak Republic. Article 3.2 of the Groundwater Directive offers the possibility of establishing TVs at the national level, at the river basin district level, the level of the area of the international river basin district falling within the territory of a Member State; or at the level of a GWB or group of GWBs. In the Slovak Republic, the NBL and TVs were established at the level of the GWB. <u>Determination of natural background levels</u> Input data consists of the database from the Geochemical Atlas of the Slovak Republic (spatial factor, 16 359 samples) and results from national monitoring of groundwater quality (time factor, 16 475 samples) in Slovakia. The next step was elimination of samples with anthropogenic impacts (pre-selection method: half of DWS for each compound). Sample elimination was also done in the case where only one compound didn't satisfy this principle. For determination of the NBL, the following statistical method was used: NBL=median+2*median absolute deviation. For the treatment of *less than LOQ* measurements, the following system was applied: simple substitution (LOQ*0.5, when <40% values are below LOQ), 40-60% - Kaplan-Meier´s analysis was used and over 60% NBL=LOQ). NBLs were estimated for: NO_3, As, Cd, Pb, Hg, NH_4, Cl, SO_4, Na, K, Ca, Mg, Sr, PO_4, HCO_3, Fe, Mn, Cr, Cu, Se and Al. For synthetic organic compounds (not originating in a natural way) the NBL is *zero concentration* and this is practically the value of the LOQ of a single organic compound. <u>TVs</u> The TV is half of the interval between the determined NBL and the reference (drinking water standards). As the TV can be below geogenic concentrations in groundwater, for example in the case of heavy metals, the TV will be assessed on the basis of the natural background level (TV = NBL). <u>*Chemical status*</u> For *chemical status* assessment a general assessment of the *chemical status* of the GWB as a whole was applied. Input data results for the quality monitoring network

10: Slovensky kras / Aggtelek	
	from 2007 were used. Criteria for assessing groundwater *chemical status* for this test were drinking water standards and TVs. The annual arithmetic mean concentration of the relevant pollutant at each monitoring point is the basis for aggregation on the level of a GWB. In the case of non exceedances, the GWB is recommended to be of *good chemical status* for the relevant parameters. The next step was to calculate the extent of exceedance of mean values by using the kriging method, in the case of quaternary GWBs (porous permeability and over five monitoring points). An acceptable extent of exceedance would not exceed 20% of the total GWB. In the case of pre-quaternary GWBs with fissure, karst or karst-fissure permeability, annual average concentrations with 20% confidence interval were used. The final assessment of the *chemical status* of GWB and its verification was performed using a GIS technique via comparison with maps of land use, hydrogeological and hydrogeochemical conditions in the GWB. **HU: *Chemical status*** <u>1. Exceedance of threshold values at monitoring points</u> This test is performed for all GWBs and all chemical elements, for which standard or TV(s) have been determined, according to the following steps: - Selection of WFD monitoring points where the average concentration of the period 2004-2007 **exceeds the determined standard or the TV**. - Exclusion of monitoring sites where the higher concentration is due to **natural conditions** (although the TV is determined considering natural background levels, it is possible to detect an exceedance of natural origin). - Classification of *poor status* for all those GWBs where a **drinking water production well or captured spring** shows exceedance of the drinking water standard to such an extent that changes in treatment technology are needed. The GWB should be classified as *poor* in the case of the danger of pollution to drinking water production wells. (See next point for potential impact on active abstractions.) - Evaluation of data on groundwater quality **inside the drinking water source protection area** (corresponding to a 50-year travel time according to Hungarian legislation). The evaluation is carried out in the framework of a general status assessment of the exploited drinking water resources, including all observation wells, and information on the sources of pollution. If the result of the evaluation shows pollution is able to cause exceedance of the drinking water standard at the abstraction point (involving a change in treatment technology), the GWB is classified as being of *poor status*. - Selection of monitoring wells **inside aquifers designated for future drinking water abstraction.** If the number of wells exceeding the drinking water standard is higher than a given value (determined as a function of the chemical element and the type of aquifer), the GWB is classified as being of *poor status* since it is likely that the exploitation would be difficult: not possible or would require treatment. The real impact of exceedances on ecosystems is analysed according to points 3.& 4. Where the NBL > DWS, the TV is taken into consideration. <u>2. Delineation of polluted areas</u> This test is carried out for **shallow and karstic GWBs regarding nitrates and ammonium**. The delineation of the polluted area (where the concentration exceeds the threshold of the given GWB) is based on all information (not only WFD monitoring!). The GWB is classified as being of *poor status* if **20–30% of the total surface of the GWB is polluted.** For a given GWB, the criterion is selected according to its vulnerability i.e. for karstic aquifers and GWBs with a recharge character: 20 % and for other shallow GWBs: 30%.

10: Slovensky kras / Aggtelek	
	3. Polluted surface water bodies This test is applied to those GWBs where **the physico-chemical or chemical test for a groundwater dependent surface water body shows *poor status*** and its cause is not evidently sewage water discharge or diffuse pollution from surface runoff. Cases where a polluted monitoring well can be found in the vicinity (closer than 5 km) of a groundwater dependent surface water body of *poor chemical status* will also be analysed. The evaluation is special to each case, taking into account (i) all available data on groundwater and surface water quality, (ii) information on pollution sources - the point or diffuse character of the pollution, (iii) estimated load from pollution sources, (iv) attenuation and dilution effects. If it is proved that the *chemical status* of the GWB is the cause of the observed pollution in the surface water body, the GWB is classified as being of *poor chemical status*. The real impact of **polluted springs** on the quality of the supplied water course is also evaluated, at least up until the first water body (considering possible dilution). If the *physico-chemical or chemical status* of the surface water body is not good because of this pollution, the GWB is classified as being of *poor status*. 4. Damaged groundwater dependent wetland and terrestrial ecosystems This test is applied for those GWBs where it is likely that the **documented damage of certain wetlands or GWDTEs** is due to polluted groundwater. The methodology for the evaluation of the real impact on the ecosystems is performed in a similar way as in the case of aquatic ecosystems (see point 3.). Monitoring of the status of wetlands and GWDTEs is not part of the WFD, so only scattered information on status is available. **SK: *Quantitative status*** To determine the overall quantitative status for GWBs, four tests were applied: 1. Water balance test: Long-term annual abstraction from the GWB must not exceed 80% of available groundwater resources. Quantification of available groundwater resources was based on national quantification and categorization of exploitable groundwater amounts in individual GWBs: 8 categories with different accuracies for determined amounts varying from 100% (water balance evaluation) to 30% (less then 1 year of groundwater monitoring data); available groundwater resources for GWB is the sum of groundwater amount in the individual category multiplied by the different significance from 1 to 0.3). 2. Groundwater level and discharge test: Identifying the presence of sustained long-term declines in groundwater levels or groundwater discharge caused by long-term groundwater abstraction using long-term groundwater monitoring data from the national groundwater monitoring network and the Mann-Kendall test (95% and 99% probability, z varying from absolute min to -3.0). 3. Surface water flow test: Evaluation of surface water discharge in surface water balance profiles (inside of surface water bodies failing their WFD environmental flow objectives). The sum of the long-term average groundwater abstraction in the balance area above the surface water balance profile must not exceed 50% from $Q_{180\ (2007)}$ or 100% from Q_{355} (whole monitoring period). 4. Groundwater dependent terrestrial ecosystems test: Expert judgment on GWDTEs and the influence of groundwater abstraction - groundwater pressures (and subsequently indication of flow or groundwater level changes due to groundwater abstraction) on GWDTEs. The assessments were made on the basis of selected ecological criteria established according to the common depended terrestrial ecosystems. **HU: *Quantitative status***

10: Slovensky kras / Aggtelek	
	1. Water balance test The water balance test is carried out in two steps: - The GWB is in *poor status* if **in 20% of its area, continuous decreasing water levels** can be observed due to groundwater abstraction. The test is based on data for the period 2001-2007. A declining trend of 5-15 cm/year (depending on aquifer type and depth) can be considered as significant. In mountainous regions, the rate of springs is also analysed; the significant trend depends on the average rate. Water abstractions causing the trend should be identified. (Trends caused by meteorological conditions or short declining trends caused by new water abstractions are not considered.). If the designated area is near the country border, **transboundary conciliation is needed**. - The GWB is also in *poor status* if the **groundwater abstraction exceeds the available groundwater resource**. This test is applied to subsurface catchment areas, thus shallow and deeper GWBs (except porous thermal GWBs) and corresponding dominantly recharge and discharge GWBs are merged in GWB-groups. **Recharge** consists of three components: (i) recharge from precipitation, (ii) recharge from surface water, (iii) flow from adjacent GWB or GWB-group. **Recharge from precipitation** is calculated by a spatially distributed (1x1 km grid) water balance model including precipitation (period 1991-2000), interception, surface runoff, evapotranspiration and storage in the unsaturated zone. Local recharge is ignored in dominantly discharge areas. **Recharge from surface water** (as a long-term average) is rare in Hungary, it is determined on a case-by-case basis. Although GWBs are grouped according to subsurface catchments, estimation of **flow from adjacent GWB-group** is still important (i) in the case of transboundary water bodies, (ii) between different types of GWBs, (iii) where the boundary in the deeper part does not represent a real no-flux boundary. The estimation is based on the results of regional groundwater flow models or simple calculations using maps of water levels and transmissibility. **The water demand of groundwater dependent ecosystems** also has three components: (i) baseflow and spring rates supplying aquatic ecosystems in water courses, (ii) a surplus of evaporation in shallow lakes and wetlands, (iii) a surplus of transpiration from groundwater (supplying GWDTE). **The water demand of aquatic ecosystem in rivers** is considered for small and medium water courses, where springs are frequent in the catchment or where the average groundwater level is above the bottom of the riverbed. Ecologically necessary low flow is estimated on the basis of required water depth, width and velocity. **The water demand of shallow lakes and wetlands** is estimated as the product of required water/wetland surface and the surplus of evaporation. The required water surface is estimated considering landscape-ecology aspects. **The water demand of vegetation in the discharge area** is estimated as the product of the area (where the groundwater should contribute significantly to the water supply of the vegetation) and the amount of capillary flow needed for surviving periods without precipitation. The potential area is delineated using a GIS procedure (convenient combination of soil type and groundwater level). The required part is a percentage of the potential one (default is 30%). **The amount of abstracted water** is the sum of the amount abstracted by wells (average for the period 2004-2007) and the outflow related to other water uses (e.g. drainage canals, gravel pits, decreased surface water level).

10: Slovensky kras / Aggtelek	
	2. Surface waters test This test is applied for those GWBs where the hydromorphological classification shows a critical flow situation for a groundwater dependent water body and its reason is not evidently the use of surface waters. The GWB is classified as *poor status* if: - **the remaining spring rate** in low flow period (either due to abstraction by wells or the capture of springs) is smaller than the ecologically required flow; - **the decrease in baseflow** caused by groundwater abstraction (in the whole catchment of the surface water body) exceeds half of the available surface water resource. 3. Groundwater dependent wetlands and terrestrial ecosystems test This test (status evaluation) is applied to those GWBs where the available information shows significant damage to wetlands and GWDTEs. - It is preferred, that the real effect on groundwater status is determined on a case-by-case approach, including the analysis of the **role of groundwater levels and flow conditions in damage to biota** and the reason for it (e.g. groundwater abstraction or other water use; climate change is not considered as a reason for *poor status*). - A detailed analysis may not be possible because of limited available data. In this case, the GWB is of *poor status* if there are **direct and indirect groundwater abstractions whose recharge area overlaps by more than 30% with the recharge area of the ecosystem**.
In the case of poor *chemical status*	
Parameter(s) responsible for *poor status*	**SK:** **HU:**
Further information on TVs	**SK: Procedure and relationship to background levels** For establishing TVs as criteria, usage criteria were considered (drinking water standards). TVs were set by comparing the natural background levels to the criteria value (CV). When NBLs and CVs are compared, two situations may arise: - NBL is below the CV. In this case, the TV was established above the NBL. - NBL is higher than the CV. In this case, the TV should be equal to the NBL. The TV is half of the interval between the determined NBL and the reference (drinking water standards). As the TV can be below the geogenic concentrations in groundwater, for example in the case of heavy metals, the TV will be assessed on the basis of the natural background level (TV = NBL). **HU: Procedure and relationship to background levels** TVs were established following the guidelines given in Annex II Part A of the GWD. Substances considered in the TV establishment are those listed in part B of GWD, as well as nitrates and pesticides. The TV of a given component for a water body was determined by taking into account: - the 90% percentile value (NBL) of the available chemical data of non-polluted objects for a given water body (NBL was established for nitrate, ammonium, EC and sulphate); - the geology and the hydrodynamics of the water body; - Quality Standards (EQSsurfacewater and DWS) for the given substance. In the case of water bodies where both EQSsurfacewater and DWS are applicable (e.g. for nitrates), TVs were established considering the more stringent criteria (i.e.

10: Slovensky kras / Aggtelek

EQSsurfacewater).

EQSsurfacewater is applicable only in the case of karstic water bodies feeding surface waters, for example by springs.

In the case of trichloroethylene and tetrachloroethylene, the DWS for pesticides took account of the GW-QS.

For those GWBs where the NBL was higher than the DWS due to natural hydro-geological reasons, the TVs for ammonium, SO_4 and EC were defined by taking into account these higher values, as described in EU WFD CIS Guidance Document No. 18.

To achieve EQ objectives in cold karstic GWBs with springs, TVs for nitrates were defined to conform to EQSsurfacewater (25 mg/l). For other GWBs, nitrate TV equals DWS. In the case of sulphate and EC, TVs can be higher than the quality standard, considering the geology or hydrogeological regime of the water bodies.

TVs per GWB

GWB	Pollutant / indicator	TV (or range) [11] (mg/l or µg/l)	Level at which the TV is established (national, RBD, GWB)
SK200480KF-	NO_3	50	national
SK200480KF	Na	52.30	GWB
SK200480KF	F	0.8	GWB
SK200480KF	Cl	56.75	GWB
SK200480KF	SO_4	167.55	GWB
SK200480KF	NH_4	0.265	GWB
SK200480KF	Cr	0.0252	GWB
SK200480KF	Cu	0.5	GWB
SK200480KF	As	0.0055	GWB
SK200480KF	Cd	0.0017	GWB
SK200480KF	Se	0.0055	GWB
SK200480KF	Pb	0.0055	GWB
SK200480KF	Hg	0.00055	GWB
SK200480KF-	atrazine	0.05 µg/l	national
SK200480KF-	simazine	0.05 µg/l	national
SK200480KF-	tetrachloroethylene	5 µg/l	national
SK200480KF-	trichloroethylene	5 µg/l	national

[11] Insert the range of TVs if different TVs are applied within the national aggregated ICPDR GWB

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Member State Code MS_Code	**SK300010FK, SK300020FK / HU_K.1.2, HU_K.1.4, HU_KT.1.2**
Description of important transboundary GWB	**SK / HU: Delineation** See GWB no. 8 **SK / HU: Reasons for selection as an important transboundary GWB** The Middle and Upper-Triassic karstic dolomite and limestone formation of the northern part of the Transdanubian Mountain (Hungary) and the Komarnanská Výsoká Kryha (Slovakia) belong to one of the largest karstic aquifer systems in Central Europe. It provides good quality drinking water for the population of the region in Hungary; it contributes to the characteristic landscape by supplying springs; and the deeper part of the aquifer system comprises a very important thermal water resource in both countries. **SK / HU: General description** The karstic formation of the northern part of the Transdanubian Mountains is composed mainly of Upper-Triassic dolomite and limestone. The considerable matrix porosity of the dolomite is due to its dense fissure-system, while in the limestone large fractures are characteristic along the faults. The elevated open karstic zones are separated by sunken basins, where the thickness of the covering layer is several hundred metres. Above the thermal part it exceeds 500 m in thickness (in some places it reaches up to 2500 m) consisting of different types of sediments: sand, clay, marl, sandstone and Eocene karstic formation with brown coal. The Slovakian part (the Komarno block) extends between Komarno and Sturovo. It is fringed by the Danube River in the south and by the east-west Hurbanovo fault in the north. The southern limit along the Danube is tectonic as well and therefore the Komarno block is a sunken tract of the northern slope of the Gerecse and Pilis Mountains. The Komarno block consists largely of Triassic dolomites and limestones up to 1000 m in thickness. The surface of the pre-Tertiary substratum plunges towards the north from a depth of approximately 100 m near the River Danube to as much as 3000 m near the Hurbanovo fault. The karstic aquifer is divided into six water bodies. In Hungary, where the recharge area appears, two water bodies bearing cold waters (HU_K.1.2 and HU_K1.4) have been delineated according to the flow system. The thermal water bodies are in close hydraulic connection with the cold ones. (in Hungary waters with a temperature > 30°C are considered as thermal, while in Slovakia the limit is 25°C HU_Kt.1.2, SK_300010FK and SK_300020FK.) To be noted is the fact that the missing continuation of the cold water bodies in the Slovakian part is mainly due to the differing considerations of the temperature limit. Taking into account, hydrogeothermal aspects, the deep Slovakian karstic aquifer is divided into the Komarno high block (SK300010FK) and the Komarno marginal block (SK300020FK). The total area of the transboundary water body-complex is 3811 km^2 (563 km^2 in Slovakia and 3248 km^2 in Hungary). The Danube River is the regional erosion base of the water bodies. The water level fluctuation is in strong relation to the water level changes in the river. The water bodies are hydraulically connected. The recharge area is on the Hungarian side and the total recharge is estimated at 60 Mm^3/y. Without abstraction this amount of water is discharged by springs and the upward flow towards the covering layer, and some part infiltrates to the deeper, thermal part.

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	The temperature of the water abstracted (captured) from the Hungarian thermal water body does not exceed 50 °C. Heat-flow densities suggest that the Komarno high block can be characterised by a fairly low thermal spring at Sturovo and Patince (39°C and 26°C) and the marginal block by medium geothermal activity (40–68 °C). Heat flow given in mW/m² is 50-60 in the Komárno high block and 60–70 mW/m² in the Komárno marginal block, both considered as low values. The coefficient of transmissivity in the high block varies from 13 to 100 m²/d, while in the marginal block between 4 to 20 m²/d. Prognostic recoverable amounts for thermal water in the high block is estimated at 12,000 m³/d water at 20 to 40 °C. In the marginal block the abstracted thermal water should be reinjected after use. **SK / HU: Major pressures and impacts** In Hungary, the actual abstractions are approx. 30 Mm³/y from the cold part and 2 Mm³/y from the thermal part. In Slovakia, the thermal water abstraction is 0.6 Mm³/y mainly in the Komárno-Patince-Štúrovo area. The cold karstic water is used for drinking water, while the thermal water for balneology (in Hungary and also in Slovakia) and for energetical purposes (in Slovakia). Disposal of used geothermal water is resolved in Slovakia by discharge into surface water (River Danube and Váh) after dilution with groundwater on acceptable qualitative parameters. Due to mining activities in the 20th century, the actual water levels - especially in the cold water bodies on the Hungarian side - are significantly lower than the long-term natural averages and as a consequence all cold and lukewarm karstic springs have dried out. On the Slovak side, the regime of geothermal water (decreasing discharges of wells) was also affected by extensive pumping of karstic water from coal mines in Tatabánya and Dorog (Hungary). After the mining was stopped (in 1993), water levels have been showing an increasing trend and the gradual reappearance of the springs is forecasted in the coming 5-15 years. The abandoned cuts and fields of mines submerged by the rising karstic waters represent a potential pollution source. Water quality monitoring has been installed, but data are not sufficient for estimating future impacts. In extremely vulnerable open karstic areas, a few settlements should be considered as potential sources of pollution. A relatively high number of significant pollutants exist in the area (40). The majority lie above the *not vulnerable* covered part. The average amount of nitrogen fertilizer is 86 kgN/ha/year, the use of manure is insignificant (3 kgN/ha/year). The surplus nitrogen from agriculture is 17 kgN/ha/year, but in the majority of the area the thick covering layers provide natural protection. (Localities in real danger should be assessed at a smaller scale, focusing on open karstic zones).
Description of status assessment methodology	**SK: *Chemical status*** To assess *chemical status*, the proposed methodology stems from the feasibility of the input information, conceptual model and the hydrogeochemical and hydrogeological interpretation of conditions in the Slovak Republic. Article 3.2 of the Groundwater Directive offers the possibility of establishing TVs at the national level, at the river basin district level, the level of the area of the international river basin district falling within the territory of a Member State; or at the level of a GWB or group of GWBs. In the Slovak Republic, the NBL and TVs were established at the level of the GWB. Determination of natural background levels Input data consists of the database from the Geochemical Atlas of the Slovak Republic (spatial factor, 16 359 samples) and results from national monitoring of groundwater quality (time factor, 16 475 samples) in Slovakia. The next step was elimination of samples with anthropogenic impacts (pre-selection method: half of DWS for each compound). Sample elimination was also done in the case where only

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	one compound didn't satisfy this principle. For determination of the NBL, the following statistical method was used: NBL=median+2*median absolute deviation. For the treatment of *less than LOQ* measurements, the following system was applied: simple substitution (LOQ*0.5, when <40% values are below LOQ), 40-60% - Kaplan-Meier´s analysis was used and over 60% NBL=LOQ). NBLs were estimated for: NO_3, As, Cd, Pb, Hg, NH_4, Cl, SO_4, Na, K, Ca, Mg, Sr, PO_4, HCO_3, Fe, Mn, Cr, Cu, Se and Al. For synthetic organic compounds (not originating in a natural way) the NBL is *zero concentration* and this is practically the value of the LOQ of a single organic compound. <u>TVs</u> The TV is half of the interval between the determined NBL and the reference (drinking water standards). As the TV can be below geogenic concentrations in groundwater, for example in the case of heavy metals, the TV will be assessed on the basis of the natural background level (TV = NBL). *<u>Chemical status</u>* For *chemical status* assessment a general assessment of the *chemical status* of the GWB as a whole was applied. Input data results for the quality monitoring network from 2007 were used. Criteria for assessing groundwater *chemical status* for this test were drinking water standards and TVs. The annual arithmetic mean concentration of the relevant pollutant at each monitoring point is the basis for aggregation on the level of a GWB. In the case of non exceedances, the GWB is recommended to be of *good chemical status* for the relevant parameters. The next step was to calculate the extent of exceedance of mean values by using the kriging method, in the case of quaternary GWBs (porous permeability and over five monitoring points). An acceptable extent of exceedance would not exceed 20% of the total GWB. In the case of pre-quaternary GWBs with fissure, karst or karst-fissure permeability, annual average concentrations with 20% confidence interval were used. The final assessment of the *chemical status* of GWB and its verification was performed using a GIS technique via comparison with maps of land use, hydrogeological and hydrogeochemical conditions in the GWB. **HU: *Chemical status*** <u>1. Exceedance of threshold values at monitoring points</u> This test is performed for all GWBs and all chemical elements, for which standard or TV(s) have been determined, according to the following steps: - Selection of WFD monitoring points where the average concentration of the period 2004-2007 **exceeds the determined standard or the TV**. - Exclusion of monitoring sites where the higher concentration is due to **natural conditions** (although the TV is determined considering natural background levels, it is possible to detect an exceedance of natural origin). - Classification of *poor status* for all those GWBs where a **drinking water production well or captured spring** shows exceedance of the drinking water standard to such an extent that changes in treatment technology are needed. The GWB should be classified as *poor* in the case of the danger of pollution to drinking water production wells. (See next point for potential impact on active abstractions.) - Evaluation of data on groundwater quality **inside the drinking water source protection area** (corresponding to a 50-year travel time according to Hungarian legislation). The evaluation is carried out in the framework of a general status assessment of the exploited drinking water resources, including all observation wells, and information on the sources of pollution. If the result of the evaluation shows pollution is able to cause exceedance of the drinking water standard at the abstraction point (involving a change in treatment technology), the GWB is classified as being of *poor status*.

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	- Selection of monitoring wells **inside aquifers designated for future drinking water abstraction.** If the number of wells exceeding the drinking water standard is higher than a given value (determined as a function of the chemical element and the type of aquifer), the GWB is classified as being of *poor status* since it is likely that the exploitation would be difficult: not possible or would require treatment. The real impact of exceedances on ecosystems is analysed according to points 3.& 4. Where the NBL > DWS, the TV is taken into consideration. 2. Delineation of polluted areas This test is carried out for **shallow and karstic GWBs regarding nitrates and ammonium**. The delineation of the polluted area (where the concentration exceeds the threshold of the given GWB) is based on all information (not only WFD monitoring!). The GWB is classified as being of *poor status* if **20–30% of the total surface of the GWB is polluted.** For a given GWB, the criterion is selected according to its vulnerability i.e. for karstic aquifers and GWBs with a recharge character: 20 % and for other shallow GWBs: 30%. 3. Polluted surface water bodies This test is applied to those GWBs where **the physico-chemical or chemical test for a groundwater dependent surface water body shows *poor status*** and its cause is not evidently sewage water discharge or diffuse pollution from surface runoff. Cases where a polluted monitoring well can be found in the vicinity (closer than 5 km) of a groundwater dependent surface water body of *poor chemical status* will also be analysed. The evaluation is special to each case, taking into account (i) all available data on groundwater and surface water quality, (ii) information on pollution sources - the point or diffuse character of the pollution, (iii) estimated load from pollution sources, (iv) attenuation and dilution effects. If it is proved that the *chemical status* of the GWB is the cause of the observed pollution in the surface water body, the GWB is classified as being of *poor chemical status*. The real impact of **polluted springs** on the quality of the supplied water course is also evaluated, at least up until the first water body (considering possible dilution). If the *physico-chemical or chemical status* of the surface water body is not good because of this pollution, the GWB is classified as being of *poor status*. 4. Damaged groundwater dependent wetland and terrestrial ecosystems This test is applied for those GWBs where it is likely that the **documented damage of certain wetlands or GWDTEs** is due to polluted groundwater. The methodology for the evaluation of the real impact on the ecosystems is performed in a similar way as in the case of aquatic ecosystems (see point 3.). Monitoring of the status of wetlands and GWDTEs is not part of the WFD, so only scattered information on status is available. **SK: *Quantitative status*** No data **HU: *Quantitative status*** 1. Water balance test The water balance test is carried out in two steps: - The GWB is in *poor status* if **in 20% of its area, continuous decreasing water levels** can be observed due to groundwater abstraction. The test is based on data for the period 2001-2007. A declining trend of 5-15 cm/year (depending on aquifer

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	type and depth) can be considered as significant. In mountainous regions, the rate of springs is also analysed; the significant trend depends on the average rate. Water abstractions causing the trend should be identified. (Trends caused by meteorological conditions or short declining trends caused by new water abstractions are not considered.). If the designated area is near the country border, **transboundary conciliation is needed**. - The GWB is also in *poor status* if the **groundwater abstraction exceeds the available groundwater resource**. This test is applied to subsurface catchment areas, thus shallow and deeper GWBs (except porous thermal GWBs) and corresponding dominantly recharge and discharge GWBs are merged in GWB-groups. **Recharge** consists of three components: (i) recharge from precipitation, (ii) recharge from surface water, (iii) flow from adjacent GWB or GWB-group. **Recharge from precipitation** is calculated by a spatially distributed (1x1 km grid) water balance model including precipitation (period 1991-2000), interception, surface runoff, evapotranspiration and storage in the unsaturated zone. Local recharge is ignored in dominantly discharge areas. **Recharge from surface water** (as a long-term average) is rare in Hungary, it is determined on a case-by-case basis. Although GWBs are grouped according to subsurface catchments, estimation of **flow from adjacent GWB-group** is still important (i) in the case of transboundary water bodies, (ii) between different types of GWBs, (iii) where the boundary in the deeper part does not represent a real no-flux boundary. The estimation is based on the results of regional groundwater flow models or simple calculations using maps of water levels and transmissibility. **The water demand of groundwater dependent ecosystems** also has three components: (i) baseflow and spring rates supplying aquatic ecosystems in water courses, (ii) a surplus of evaporation in shallow lakes and wetlands, (iii) a surplus of transpiration from groundwater (supplying GWDTE). **The water demand of aquatic ecosystem in rivers** is considered for small and medium water courses, where springs are frequent in the catchment or where the average groundwater level is above the bottom of the riverbed. Ecologically necessary low flow is estimated on the basis of required water depth, width and velocity. **The water demand of shallow lakes and wetlands** is estimated as the product of required water/wetland surface and the surplus of evaporation. The required water surface is estimated considering landscape-ecology aspects. **The water demand of vegetation in the discharge area** is estimated as the product of the area (where the groundwater should contribute significantly to the water supply of the vegetation) and the amount of capillary flow needed for surviving periods without precipitation. The potential area is delineated using a GIS procedure (convenient combination of soil type and groundwater level). The required part is a percentage of the potential one (default is 30%). **The amount of abstracted water** is the sum of the amount abstracted by wells (average for the period 2004-2007) and the outflow related to other water uses (e.g. drainage canals, gravel pits, decreased surface water level). 2. Surface waters test This test is applied for those GWBs where the hydromorphological classification shows a critical flow situation for a groundwater dependent water body and its reason is not evidently the use of surface waters. The GWB is classified as *poor status* if:

<table>
<tr><th colspan="2">11: Komarnanska Vysoka Kryha / Dunántúli – középhegység északi rész</th></tr>
<tr><td></td><td>- the remaining spring rate in low flow period (either due to abstraction by wells or the capture of springs) is smaller than the ecologically required flow;

- the decrease in baseflow caused by groundwater abstraction (in the whole catchment of the surface water body) exceeds half of the available surface water resource.

<u>3. Groundwater dependent wetlands and terrestrial ecosystems test</u>

This test (status evaluation) is applied to those GWBs where the available information shows significant damage to wetlands and GWDTEs.

- It is preferred, that the real effect on groundwater status is determined on a case-by-case approach, including the analysis of the role of groundwater levels and flow conditions in damage to biota and the reason for it (e.g. groundwater abstraction or other water use; climate change is not considered as a reason for poor status).

- A detailed analysis may not be possible because of limited available data. In this case, the GWB is of poor status if there are direct and indirect groundwater abstractions whose recharge area overlaps by more than 30% with the recharge area of the ecosystem.</td></tr>
<tr><th colspan="2">In the case of poor chemical status</th></tr>
<tr><td>Parameter(s) responsible for poor status</td><td>SK:

HU:</td></tr>
<tr><td>Further information on TVs</td><td>SK: Procedure and relationship to background levels

For establishing TVs as criteria, usage criteria were considered (drinking water standards). TVs were set by comparing the natural background levels to the criteria value (CV). When NBLs and CVs are compared, two situations may arise:

- NBL is below the CV. In this case, the TV was established above the NBL.

- NBL is higher than the CV. In this case, the TV should be equal to the NBL.

The TV is half of the interval between the determined NBL and the reference (drinking water standards). As the TV can be below the geogenic concentrations in groundwater, for example in the case of heavy metals, the TV will be assessed on the basis of the natural background level (TV = NBL).

HU: Procedure and relationship to background levels

TVs were established following the guidelines given in Annex II Part A of the GWD. Substances considered in the TV establishment are those listed in part B of GWD, as well as nitrates and pesticides. The TV of a given component for a water body was determined by taking into account:

- the 90% percentile value (NBL) of the available chemical data of non-polluted objects for a given water body (NBL was established for nitrate, ammonium, EC and sulphate);

- the geology and the hydrodynamics of the water body;

- Quality Standards (EQSsurfacewater and DWS) for the given substance.

In the case of water bodies where both EQSsurfacewater and DWS are applicable (e.g. for nitrates), TVs were established considering the more stringent criteria (i.e. EQSsurfacewater).

EQSsurfacewater is applicable only in the case of karstic water bodies feeding surface waters, for example by springs.</td></tr>
</table>

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<tr><th colspan="5">11: Komarnanska Vysoka Kryha / Dunántúli – középhegység északi rész</th></tr>
<tr><td></td><td colspan="4">In the case of trichloroethylene and tetrachloroethylene, the DWS for pesticides took account of the GW-QS.
For those GWBs where the NBL was higher than the DWS due to natural hydro-geological reasons, the TVs for ammonium, SO_4 and EC were defined by taking into account these higher values, as described in EU WFD CIS Guidance Document No. 18.
To achieve EQ objectives in cold karstic GWBs with springs, TVs for nitrates were defined to conform to EQSsurfacewater (25 mg/l). For other GWBs, nitrate TV equals DWS. In the case of sulphate and EC, TVs can be higher than the quality standard, considering the geology or hydrogeological regime of the water bodies.</td></tr>
<tr><td rowspan="2">TVs per GWB</td><td>GWB</td><td>Pollutant / indicator</td><td>TV (or range) [12]
(mg/l or µg/l)</td><td>Level at which the TV is established
(national, RBD, GWB)</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

[12] Insert the range of TVs if different TVs are applied within the national aggregated ICPDR GWB.