ANNEX 1 – DEFINITION OF GROUNDWATER BODIES AND THEIR STATUS IN THE WATER FRAMEWORK DIRECTIVE (WFD)

The WFD defines a "**groundwater body**" (GWB) as a "coherent sub-unit in the river basin (district) to which the environmental objectives of the WFD must apply" (EU, 2000).

Therefore, a GWB is a groundwater management unit identifying a body of groundwater which should be managed to ensure that the WFD objectives of good quantitative and chemical status are met and to mitigate the potential risks of not achieving these (CIS, 2003; 2004).

Common criteria which were used by EU Member States to define the GWBs included:

- Aquifer Yield (i.e. how much groundwater can be stored and extracted from the aquifer);
- Transport mechanisms (i.e. velocity of groundwater and, therefore, of groundwater pollutants moving through the aquifer);
- Water abstraction from the aquifer for various uses;
- Any support to surface ecosystems by flow from the GWB.

As some aquifers are at the lower limit of water productivity or they do not support ecosystems or they are not currently used for abstraction (note: although potential future use of groundwater must be protected), this volume of groundwater is not assigned to GWBs reported under the WFD.

Furthermore, extensive aquifers were subdivided into manageable GWBs based on: aquifer boundaries, groundwater divides, geochemical boundaries[1], local authority / national boundaries, rivers and confined / unconfined areas. The national groundwater management realities at the time of relevant WFD implementation also influenced the delineation process. Subsequent GWB characterisation identified the risk of failing to meet WFD objectives based on: pressures, groundwater vulnerability, and interaction with associated surface waters and terrestrial ecosystems.

The definition of "**good chemical status**" and "**good quantitative status**" of groundwater bodies, according to the WFD, is provided below:

"Good chemical status" of a groundwater body is achieved if the concentrations of pollutants and changes of conductivity in the groundwater due to human activities: a) meet the quality standards established under relevant water legislation, b) show no evidence of impacts from saline or other intrusion, c) do not cause significant degradation of the chemical or ecological quality of associated surface water bodies, or failure of relevant environmental objectives, and d) do not significantly harm terrestrial ecosystems directly dependent to the groundwater body. Naturally elevated concentrations of substances do not impact good chemical status, as they are expected to be accounted for in the threshold values for these substances (EU, 2000; CIS, 2017).

"Good quantitative status" of a groundwater body is achieved if the alteration of groundwater level due to human activities: a) does not cause significant diminution of groundwater, b) does not result in failure of relevant environmental objectives for associated surface water bodies, c) does not significantly harm terrestrial ecosystems directly dependent to the groundwater body. The groundwater level balance is maintained if the average volume of the annual abstraction does not exceed the average volume of groundwater recharge in the long term. Alterations to groundwater levels may cause changes in groundwater flow direction temporarily, or

[1] Including saline and freshwater boundaries, the presence of organic matter (e.g. coal / oil formations), thermal gradients, microbial population of the aquifer (potentially leading to biological and geochemical degradation of pollutants), as well as confinement (confined aquifers have lower levels of dissolved oxygen – "redox potential").

continuously in a spatially limited area, provided that saline or other intrusions are not triggered or likely to be triggered (EU, 2000; CIS, 2017).

Sources:

CIS, 2003, Guidance N°2 - Identification of water bodies, Common Implementation Strategy for the Water Framework Directive (2000/60/EC) (https://circabc.europa.eu/sd/a/655e3e31-3b5d-4053-be19-15bd22b15ba9/Guidance%20No%202%20-%20Identification%20of%20water%20bodies.pdf) accessed 13 January 2020.

CIS, 2004, Groundwater body characterisation - Technical report on groundwater body characterisation issues as discussed at the workshop of 13th October 2003, Common Implementation Strategy for the Water Framework Directive (2000/60/EC) (https://circabc.europa.eu/sd/a/157c2240-b988-417b-9137-a14e89db41d8/Groundwater%20characterisation%20report.pdf) accessed 13 January 2020

EU, 2000, Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy(OJ L 327, 22.12.2000, p.0001 – 0073) (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32000L0060) accessed 13 January 2020.

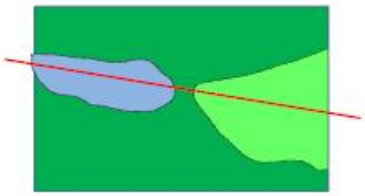
ANNEX 2 – EXAMPLE DELINEATION OF GROUNDWATER BODIES

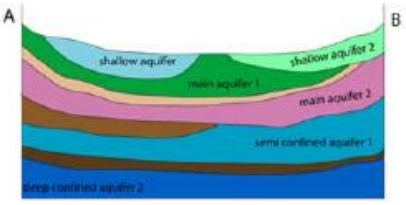
The WFD Reporting Guidance 2016 (EC, 2016) includes - among others - the following two examples on groundwater delineation:

- Example 1: GWBs made up of multiple aquifer segments assigned to single horizons
- Example 2: GWBs made up of multiple aquifers assigned to single or multiple horizons

Example 1

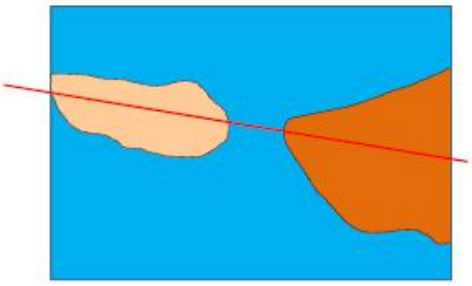
Hydrogeological context – Map view and sectional view



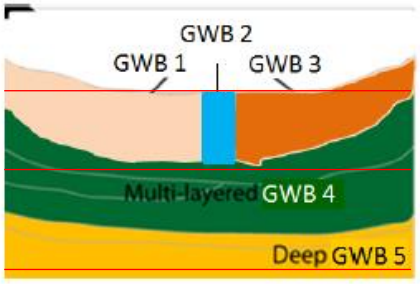


Delineated groundwater bodies

Example 1 – Map view



Example 1 – Sectional view



Horizon assignment – Vertical subsequential arrangement

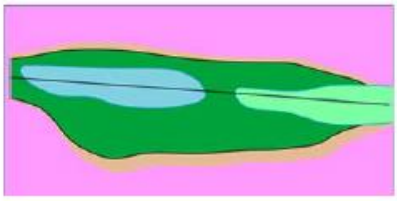
Horizon 1			
Horizon 2			
Horizon 3			

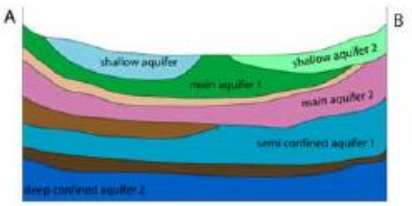
Indicative WISE WFD reporting for Horizon assignment to GWBs:

thematicIdIdentifier	horizons	
GWB1	1	
GWB2	1	
GWB3	1	
GWB4	2	
GWB5	3	

Example 2

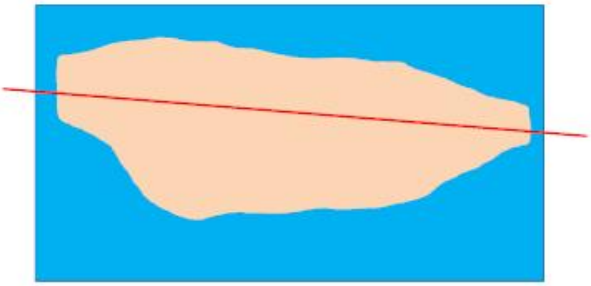
Hydrogeological context – Map view and sectional view



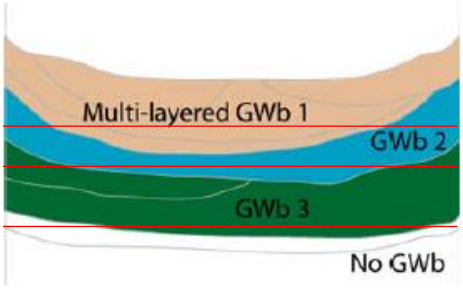


Delineated groundwater bodies

Example 2 – Map view



Example 2 – Sectional view



Horizon assignment – Vertical subsequential arrangement

Indicative WISE WFD reporting for Horizon assignment to GWBs:

thematicIdIdentifier	horizons	
GWB1	1	
GWB2	1,2	
GWB3	2,3	

Source:
EC, 2016, WFD Reporting Guidance 2016, Final Draft 6.0.6, pp.347-350 (https://cdr.eionet.europa.eu/help/WFD/WFD_521_2016/Guidance/WFD_ReportingGuidance.pdf) accessed 13 January 2021

ANNEX 3 – POTENTIAL LIMITATIONS OF THE ANALYSIS

Groundwater characterisation: Delineation of groundwater bodies and their area

Although the delineation of GWBs is at the discretion of MS, some common principles to the delineation of GWBs have been developed. The homogeneity of natural characteristics, the concentrations of pollutants and alterations to groundwater levels should be considered, as well as the capacity to estimate with adequate precision quantitative and chemical status (CIS, 2003)[2].

According to the latest WFD reporting, the EU-27, Norway and the United Kingdom identified 15,930 GWBs in 2016, covering an area of 4.6 million km^2. The number and the average area of GWBs reported per country varies widely. For example, there are 6 GWBs in Luxembourg vs 3773 GWBs in Finland. The same Finnish GWBs cover and area less than 10 000 km^2, whilst France reports only 645 GWBs over an area of 1,2 million km^2. In Finland, GWBs are mainly made up of eskers (small isolated gravel deposits developed within post-glacial moraine), whilst in France the GWBs represent the wide extents of continual outcrop of highly productive aquifers.

Thus, the variation in numbers and extents of GWBs reported is likely to be a combination of the legacy of groundwater management by individual Member States prior to WFD implementation and the geology and hydrogeology of the aquifers. The pre-WFD era of groundwater management can be a strong influence on how GWBs have been identified. In some MS, some less productive aquifers with low population density, which historically not been managed, and achieve the criteria of providing >10 m^3/d or potable supply to a population of 50, may not have been classified as a GWB to reduce the administrative burden for what may be a low-risk scenario for groundwater.

The delineation of water bodies is an iterative process, refined over time to the extent needed to adequately assess and manage risks to the achievement of the WFD objectives (CIS, 2003). Hence, new GWBs may be identified, and existing ones may be re-characterised, split or merged. In total, the number of reported GWBs has increased between the two cycles, from 13,962 to 15,930 GWBs along with the area covered by GWBs (from 4,567 million km^2 to 4,608 km^2). According to reported data in 2010 and 2016:

- Only 6 countries have not changed the number of reported GWBs. They all have a small number of GWBs (i.e. Belgium, Hungary, Latvia, Lithuania, Malta, the Netherlands, Slovenia);
- 18 countries have increased the number of reported GWBs, usually by one or two GWBs (the largest increase being in Sweden, from 3023 to 3311 GWBs).
- Norway only reported information on GWBs in the 2016 reporting period.

[2] Delineation should enable the accurate description of GWBs quantitative and chemical status. Thus, the boundaries of a GWB should, first and foremost, consider physical characteristics such as geological boundaries and hydrogeological features (CIS, 2004). But it may also take into account: major differences in groundwater status; the level of confidence and knowledge on geology and groundwater flows; protection needs; risk potential; economic importance; and water management aspects (e.g. administrative borders or the borders of the River Basin Districts) (CIS, 2004).

- There are no specific patterns between changes in the number of GWBs and changes in the total area covered by GWBs (i.e. some countries increasing the number of GWBs can see the area covered increase or decrease; and vice-versa).

Reporting choices for pressures and impacts

The detail of the reporting of pressures and impacts differs greatly among EU Member States, with some of them using a variety of pressure and impact types. For instance, Italy and Spain reported more than 20 pressure types. Belgium, Bulgaria, Germany, Greece, Finland, France, Hungary and Sweden reported more than 10 pressure types. Other coutries reported less than 10 pressure types.

In addition, only few cases of impacts on GWAAEs and GWDTEs are brought up in the reporting, although all EU Member States report that GWAAEs and GWDTEs are being considered in their status assessments.

Sources:

CIS, 2003, Guidance N°2 - Identification of water bodies, Common Implementation Strategy for the Water Framework Directive (2000/60/EC) (https://circabc.europa.eu/sd/a/655e3e31-3b5d-4053-be19-15bd22b15ba9/Guidance%20No%202%20-%20Identification%20of%20water%20bodies.pdf) accessed 13 January 2020.

CIS, 2004, Groundwater body characterisation - Technical report on groundwater body characterisation issues as discussed at the workshop of 13th October 2003, Common Implementation Strategy for the Water Framework Directive (2000/60/EC) (https://circabc.europa.eu/sd/a/157c2240-b988-417b-9137-a14e89db41d8/Groundwater%20characterisation%20report.pdf) accessed 13 January 2020