### INSPIRE Hydrogeology Use Cases

* **B.2.6 UC06: Providing data to undertake water balance to ensure compliance with the WFD**
* **B.2.7 UC07: Groundwater reporting for WFD**
* **B.2.8 UC08: Providing hydrogeological data to define significant pressure**

### B.2.6 UC06: Providing data to undertake water balance to ensure compliance with the WFD

This use case is related to example of use:

AQ-01: Water supply (water abstraction).

**B.2.6.1 Overview and involved actors**

The goal of this use case is therefore to deliver hydrogeological data to professionals responsible for establishing whether groundwater bodies are over or under abstracted according to the WFD. Examples of the professionals include regulators such as the Environment Agency of England and Wales.

**Actors:**

Geological surveys to provide geological information (Geological Surveys represent the Member States)

Other hydrometric organizations to provide relevant hydrological data, e.g. rainfall

Professionals responsible for ensuring compliance with the WFD, e.g. regulator in each member state.

Professionals responsible for establishing water supply system, for local government to support water management decision process as well as individual investors.

Water modellers.

**B.2.6.2 Narrative description**

The WFD requires that a groundwater body has “good status” in that it is not over abstracted. In order to ensure that a groundwater body is not over abstracted, then a water balance needs to be undertaken. The various inputs and outputs to the system need to be quantified and the balance calculated. Importantly the proportion of abstraction compared to recharge to the aquifer has to be determined. The water balance is created for an Assessment Point (AP) for each sub-catchment.

**B.2.6.3 Detailed description**

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| Use case description |  |
| Name | Providing data to undertake water balance to ensure compliance with the WFD |
| Priority | High |
| Description | The user selects the relevant geographic area and searches for hydrogeological and hydrological data: abstraction, baseflow, springflow, rainfall, potential evaporation. |
| Pre-condition | Hydrogeological and hydrometric data are available in line with INSPIRE specifications. A specific vocabulary related to the user requirements is available with a “mapping” between hydrogeological terms and user’s terms. |
| Flow of events – Basic path |  |
| Step 1 | The user selects on a geo-portal the area of interest and searches in a metadata catalogue for hydrogeological maps and other relevant hydrological data.  |
| Step 2 | The user displays the hydrogeological map and accesses detailed information about the groundwater resources location (useful groundwater aquifers) and hydrogeological parameters (potential discharge of the well, drawdown) |
| Step 3 | The user searches in a metadata catalogue for relevant hydrological data. |
| Step 4 | The user accesses the hydrological data to get the values of the properties and combines them with the hydrogeological data to perform a water balance for the required AP. |
| Step 5 | The user uploads the water balance back into a portal to provide information at the AP. |
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| Flow of events – Alternative path |  |
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| Post-conditions |  |
| Post-condition | The user has a set of hydrogeological and hydrometric data related to the selected area as well as a water balance for the relevant AP. |
| Data source: INSPIRE-conformant Geology data set provided by Member Sate |
| Description | Hydrogeological and hydrological data from national sources. |
| Data provider | Each Member State |
| Geographic scope | All EU Member States, with appropriate cross border cooperation where necessary |
| Thematic scope | Geology |
| Scale, resolution | Scale relevant to the application (tbd) |
| Delivery | INSPIRE Geology GML Application schema |
| Documentation | INSPIRE Geology Data Specification |

**B.2.6.4 Requirements from the use case**

Analyzing the use case, there is a need to provide the following objects and attributes:

Hydrogeological units with:

* their related polygons
* potential discharge
* water table depth
* aquifer type
* rock lithology

Well data in relation to borehole with:

* geologic unit thickness and depth
* water level
* any other properties (physical and chemical) measured

Generally to create water balance two main pieces of information are needed:

* Recharge (rainfall, river infiltration, river vanish point)
* Discharge – groundwater abstraction (water well, effluent stream, spring or seep)

Vanishing point, spring and seep are objects of interest in Hydrography DS (Annex I)

**B.2.6.5 Relationship with other INSPIRE Themes**

This use case has some relationships with the following INSPIRE data themes:

* Hydrology: HydroPointOfInterest;
* Geology: the geologic property of an aquifer.

### B.2.7 UC07: Groundwater reporting for WFD

This use case is related to example of use:

AQ-05: Groundwater quality and quantity assessment.

**B.2.7.1 Overview and involved actors**

The implementation of the WFD requires the handling of spatial data both for the preparation of the River Basin Management Plans and for the reporting to the Commission.

Article 15 of the Water Framework Directive (WFD) requires Member States to provide information to the European Commission concerning the river basin management plans (RBMP). The RBMP covers, among others a general description of the characteristics of the river basin district (RBD) required under Article 5 and Annex II WFD including the mapping of the location and boundaries of groundwater bodies (GWB) (Annex VII, WFD).

Recommendation for the form and scope of spatial information deliver under the WFD and the Groundwater Directive (GWD) were presented in “Updated Guidance on Implementing the Geographical Information System (GIS) Elements of the EU Water policy”.

Member States are obliged to deliver necessary data to fulfil Water Information System of Europe (WISE) managed by European Environmental Agency (EEA).

**Actors:**

Geological surveys to provide geological information (Geological Surveys represent the Member States)

Member States Environmental Agencies or other bodies responsible for reporting

European Environmental Agencies (EEA)

**B.2.7.2 Narrative description**

GWBs according to Article 2.12 WFD are defined as “a distinct volume of groundwater within an aquifer or aquifers”. Thus GWBs are three-dimensional. For the time being it is not possible to represent WBs three-dimensionally in geographic information systems as there are, in most cases, not enough data available to develop three-dimensional models of GWBs. Thus the representation of the feature will be as two-dimensional polygons.

The spatial data concerning GWB is a basis for general maps produce:

* Map 1: Quantitative status – Identification of bodies that are at “good quantitative status” and those that are at “poor quantitative status”;
* Map 2: Achievement/exceedance of standard for nitrates (value in Annex 1 of GWD or set according to paragraph 3 of Annex 1 GWD, and according to status assessment procedure in Article 4 of GWD);
* Map 3: Achievement/exceedance of standard for pesticides (combined total and individual value in Annex 1 of GWD or set according to paragraph 3 of Annex 1 GWD, and according to status assessment procedure in Article 4 of GWD);
* Map 4: Achievement/exceedance of threshold values set by Member States for other pollutants (considering in this category the list of substances as contained in Part B of Annex II of GWD and more generally any other pollutants contributing to the characterisation of groundwater bodies as being 'at risk', and according to status assessment procedure in Article 4 of GWD);
* Map 5: Trends - Identification of: (a) groundwater bodies with environmentally significant and sustained upward trends in pollutant concentrations, and (b) groundwater bodies in which trends have been reversed;

GIS data submitted by Member States will be also used to produce a WISE Reference GIS dataset of groundwater bodies by the EEA or its contracted partners.

GWBs provided by Member States will be merged into one dataset taking into account the description of the submitted GWBs (layered, depth range, aquifer type etc.) to produce a consistent dataset.

**B.2.7.3 Detailed description**

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| Use case description |  |
| Name | Providing groundwater data to WISE reporting |
| Priority | High |
| Description | The Member States are obliged to deliver Groundwater Bodies and Groundwater monitoring information to European Environment Agency (EEA) for Water Management Plans |
| Pre-condition | Hydrogeological data are available in line with INSPIRE specifications. The Reporting schema provide a framework for water related reporting(Water Framework Directive). Format of reporting sheets is defined in Water Information System for Europe (WISE) hosted by EEA |
| Flow of events – Basic path |  |
| Step 1 | The user selects on a geo-portal the area of interest and search in a metadata catalogue for groundwater maps with groundwater bodies.  |
| Step 2 | The user displays the groundwater map and accesses detailed information about the groundwater bodies (status) and monitoring stations (quality and quantity) |
| Step 3 | The user searches in a metadata catalogue for groundwater monitoring station data with information about aquifer unit thickness and depth, water level, physical and chemical properties |
| Step 4 | The user accesses the monitoring station data to get the values of the properties.  |
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| Flow of events – Alternative path |  |
|  | The user (EEA) selects on a geo-portal the area of interest and search in a metadata catalogue for groundwater maps with groundwater bodies and monitoring stations |
|  | The user (EEA) displays the groundwater map and accesses detailed information about the groundwater bodies (status) and monitoring stations (quality and quantity) |
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| Post-conditions |  |
| Post-condition | The user has a set of groundwater data related to the selected area. |
| Data source: INSPIRE-conformant Geology data set provided by Member Sate |
| Description | Groundwater data from national sources. |
| Data provider | Each Member State |
| Geographic scope | All EU Member States, with appropriate cross border cooperation where necessary |
| Thematic scope | Geology |
| Scale, resolution | Scale relevant to the application (tbd) |
| Delivery | INSPIRE Geology GML Application schema |
| Documentation | INSPIRE Geology Data Specification |

**B.2.7.4 Requirements from the use case**

Analyzing the use case, there is a need to provide the following objects and attributes:

The following data were requested as a minimum to be provided for each GWB (under Reporting

sheet GWB1):

* Unique code;
* Name (if available);
* X co-ordinate (Longitude) of the centroid of the GWB;
* Y co-ordinate (Latitude) of the centroid of the GWB; and
* Size (surface area (m2), unique identifier for the horizon where separate overlying bodies exist and, if possible, volume of aquifer (m3).

This was translated into the reporting schemas as follows:

In addition to the IDs assigned by Member States (MS\_CD), unique IDs will be generated at EC level (EU\_CD) to uniquely identify groundwater bodies in the WISE Reference GIS dataset. This is necessary to identify and visualise transboundary GWBs. With the IDs assigned by Member States only the Member State part of transboundary GWBs can be identified.

The structure of the WISE code will be defined by the data provider of the reference dataset according to the specifications given in the WISE GIS guidance document, second edition. The data provider will be the EEA or its contracted partner.

The following diagram illustrates a fictive example of MS GWB-IDs and European (WISE) GWBIDs

for a transboundary groundwater body.

There is a transboundary GWB between AT and CZ. Both Member States delineate the national parts of the transboundary GWBs and assign IDs (EUGroundwaterBodyCode=ATGK1200087,

CZ195). The boundaries of the GWB are harmonised at the country border and the GWBs are marked as transboundary. At EU level it will be identified which Member State parts of transboundary GWBs belong together and unique IDs for the total GWB will be assigned (ECGWB173).

To develop a more consistent picture of groundwater bodies it will be necessary to get information on aquifer types and the 3-dimensional characteristics of GWBs, as they might overlay each other.

GIS data to be reported for each groundwater body are specified in Guidance Document: Guidance for reporting under the Water Framework Directive (see Chapter 13). This data will allow the description and visualisation of GWBs and groups of GWBs. Furthermore the parameter horizon should also be characterised according to the groundwater body layer (e.g. alluvial deposit layer, “main” layer, deep horizon (cenoman), thermal or mineral water).

The definition of the parameter “horizon”, which will be used in the sense of the numerical position of groundwater body layer (e.g. 1 for the first horizon from the surface, 2 for the second horizon from the surface, 3 for the third horizon from the surface, 4 for fourth and deeper horizons from the surface).

The following attributes should be reported for each GWB

* Water body code
* Water body name
* Shape/GML file
* Groundwaters: boundaries of all groundwater bodies or groups of groundwater bodies identified.

For groundwater bodies or groups of groundwater bodies, if available:

* Layered (Y/N)
* Average depth to groundwater body (m)
* Average thickness of groundwater body (m)
* Assignment to a depth range where the main part of the GWB is situated in (depth ranges: 0-20m, 20-50 m, 50-200 m, >200m)
* Directly dependent aquatic ecosysteRBD (Y/N)
* Directly dependent terrestrial ecosysteRBD (Y/N)
* Geological formation – aquifer type (according to a predefined typology)
* Type of vertical orientation of GWB (indicated by category and visualised by symbols)
* Volume of aquifer (m3) (if possible)

Relevant point source discharges to groundwater:

* ID of significant point sources where data already available
* Latitude and longitude of each relevant point source (if possible)
* Type of point source (see GWPI3)
* Relevant diffuse source pollution to groundwater bodies
* WB Affected? (Y/N)
* Type of source (see GWPI4)
* Relevant abstractions from groundwater
* WB Affected? (Y/N)
* Latitude and longitude of each abstraction (if possible)
* Type of abstraction (see GWPI5)

Relevant artificial recharge of groundwater

* WB Affected? (Y/N)
* Type of Regulation/Alteration (see GWPI6)

Significant saltwater or other intrusion

* WB Affected? (Y/N)

Other pressures

* WB Affected? (Y/N)
* Type of Pressure (to be specified see GWPI8)
* Impacts
* Type of impact identified (see GWPI9)

Protected areas

* Water body within or overlapping with a protected area (Y/N)
* Type of protected area (provide a shape file only where information is NOT reported under any other Directive. Where information has been provided under other Directives provide the unique identifier (code) of the appropriate protected area)

For WISE reporting it is expected that except the GroundWater bodies the Groundwater monitoring station location will be required for reporting.

**B.2.7.5 Relationship with other INSPIRE Themes**

This use case has some relationships with the following INSPIRE data themes:

* Hydrography (HY): GWB is a subset of Water Body class which is the main element in WFD directive reporting as well as base information for Water Management Plans analyzes (water balance);
* Area management/restriction/regulation zones and reporting units (AM): there is a important relation between GWB and water related reporting units;
* Environmental Monitoring Facilities (EF): location and characteristics of Groundwater monitoring facilities will be provided by EF specification, but the link to GW monitoring measurement method and properties is needed in Geology DS;

### B.2.8 UC08: Providing hydrogeological data to define significant pressure

This use case is related to example of use:

AQ-04: Protecting ecosystems dependent on groundwater

**B.2.8.1 Overview and involved actors**

The goal of this use case is therefore to deliver hydrogeological data to professionals responsible for biological diversity

**Actors:**

Geological surveys to provide geological information (Geological Surveys represent the Member States)

Professionals responsible for biological diversity.

Soil experts

**B.2.8.2 Narrative description**

Groundwater dependent ecosystems (GDE) are a diverse and important component of biological diversity. The term GDE takes into account ecosystems that use groundwater as part of survival, and can potentially include wetlands, vegetation, mound springs, river base flows, cave ecosystems, playa lakes and saline discharges, springs, mangroves, river pools, billabongs and hanging swamps. The groundwater dependence of ecosystems will range from complete reliance to those that partially rely on groundwater, such as during droughts. The degree and nature of dependency will influence the extent to which ecosystems are affected by changes to the groundwater system, both in quality and quantity. The EU Water Framework Directive (WFD) requires those terrestrial ecosystems dependent on groundwater be identified and the anthropogenic pressures acting on the ecosystems analysed.

**B.2.8.3 Detailed description**

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| Use case description |  |
| Name | Managing the positive role aquifers play in supporting ecosystems |
| Priority | High |
| Description | The user selects the relevant geographic area and search for hydrogeological data: hydrogeological map (groundwater table level) and well data (geological profile) to estimate the risks associated with groundwater abstraction pressures on thecondition of groundwater dependent ecological features. |
| Pre-condition | Hydrogeological data are available in line with INSPIRE specifications. A specific vocabulary related to the user requirements is available with a “mapping” between hydrogeological terms and user’s terms (done by the data provider?). |
| Flow of events – Basic path |  |
| Step 1 | The user selects on a geo-portal the area of interest and search in a metadata catalogue for hydrogeological maps with groundwater bodies information.  |
| Step 2 | The user displays the hydrogeological map and accesses detailed information about the groundwater bodies location, useful groundwater aquifers and hydrogeological parameters (potential discharge of the well, regional discharge pressures, drawdown) |
| Step 3 | The user searches in a metadata catalogue for well data with information about geologic unit thickness and depth, water level changes, groundwater quality (physical and chemical properties) |
| Step 4 | The user accesses the well data to get the values of the properties.  |
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| Flow of events – Alternative path |  |
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| Post-conditions |  |
| Post-condition | The user has a set of hydrogeological data related to the selected area and is able to analyse data to provide information for decision makers. |
| Data source: INSPIRE-conformant Geology data set provided by Member Sate |
| Description | Hydrogeological data from national sources. |
| Data provider | Each Member State |
| Geographic scope | All EU Member States, with appropriate cross border cooperation where necessary |
| Thematic scope | Geology |
| Scale, resolution | Scale relevant to the application (tbd) |
| Delivery | INSPIRE Geology GML Application schema |
| Documentation | INSPIRE Geology Data Specification |

**B.2.8.4 Requirements from the use case**

Analyzing the use case, there is a need to provide the following objects and attributes:

Hydrogeological units with:

* their related polygons
* potential discharge
* water table depth
* rock lithology

The dependency of ecosystems on groundwater is based on some basic groundwater attributes :

flow or flux - the rate and volume of supply of groundwater;

level - for unconfined aquifers, the depth below surface of the water table;

pressure - for confined aquifers, the potentiometric head of the aquifer and its expression in groundwater discharge areas;

quality - the chemical quality of groundwater expressed in terms of pH, salinity and/or other potential constituents, including nutrients and contaminants.

**B.2.8.5 Relationship with other INSPIRE Themes**

This use case has some relationships with the following INSPIRE data themes:

* Bio-geographical Regions, Habitats and Biotopes, Species Distribution (BR, HB, SD): existence of some ecosystems in strong plant and animal communities relations with groundwater system.
* Geology (GE): the geologic property of an aquifer;
* Soil (SO): changing soil moisture level can cause drought;
* Sea region (SR): saline or other intrusion changing ecosystem condition;
* Land Use (LU).