Implementation of the EU Water Framework Directive (WFD) in Austria: Groundwater quality aspects –procedures applied and current state

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About 99% of the Austrian drinking water is abstracted from groundwater. Hence, groundwater and its protection is an important aspect within water management. Already in 1990 the legal basis for a country-wide GW-quality monitoring system was established, GW-monitoring areas were delineated and a monitoring system complemented by a comprehensive quality assurance programme was implemented. That means that valuable information for the implementation of the WFD was available.

Since Austria is a federal state with nine provinces, working groups under the lead of the competent authority, the Ministry for Agriculture, Forestry, Environment and Water Management, with experts from both the federal and provincial level have been established, to elaborate the national strategy for implementation - considering the provisions of the WFD and the CIS Guidance documents.

Key elements of this strategy are:

- delineation and characterisation of GW-bodies
- monitoring and
- risk assessment

In parallel to this process further background information was collated e.g. a hydrochemical map of Austria and tables and maps showing chemical background concentrations for the delineated GW-bodies.

The inventory according to Art. 5 WFD was finalized in accordance with the WFD timetable and the further implementation of the Directive is in good progress.

Derivation of background values for groundwater bodies In Germany

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Commissioned by the Working Group of the Federal States of Germany on water problems (LAWA) the authors developed a procedure to derive the background values for groundwater bodies in Germany based on existing data from groundwater monitoring networks. The procedure developed had been applied to 17 lithogenetical different groundwater bodies occurring throughout Germany with high relevance for water supply. In total data from ca. 25000 monitoring stations with one representative groundwater analysis each were used for the analysis. For each of the different groundwater bodies 30 - 40 hydrochemical (inorganic) parameters were evaluated. For each of the investigated parameters the concentration distribution in the individual groundwater bodies are separated into a natural background component and an influenced component. This is done by representation of the observed concentration distribution by the sum of two statistical distribution functions. In the contribution, the methodology developed will be described and selected results of the project will be presented.

Groundwater monitoring and assessment of BASELINE and threshold 'values' in Denmark and Europe.

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The Danish Action Plan for the Aquatic Environment was adopted in 1987 primarily as a consequence of the eutrophication of coastal waters. The Action Plan established water quality monitoring networks in all types of inland and coastal waters. The Geological Survey of Denmark and Greenland is hosting the national groundwater monitoring database, and is responsible for the annual national groundwater monitoring report. In 2000 the European Water Framework Directive (WFD) was adopted, introducing an integrated approach in the protection of the freshwater resources and aquatic and terrestrial ecosystems. This presentation gives a short introduction to the application of results from Danish monitoring programs in the assessment and definition of the natural BASELINE quality and groundwater thresholds of relevance for the implementation of the WFD and the daughter Groundwater Directive. A brief introduction to the selection of groundwater bodies across Europe chosen for testing of a groundwater threshold approach suggested by the EC Project BRIDGE is also given.

Implementing the Water Framework Directive and characterising baseline groundwater conditions. Work progress in Spain

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In the implementation process of the Water Framework Directive 504 groundwater bodies in Spain have been delineated. To obtain these the existing hydrogeological units have been used as an initial delineation. These are groundwater flow units with a well known conceptual model of recharge and discharge regimes for groundwater resources management purposes.

As additional used criteria are: river basin districts limits, impervious limits, influent river as a partition criterion, limits of human activities influence, aggregation of hydrogeological units, surface water or terrestrial ecosystems dependent on groundwater in zones where no aquifers are identified.

A quantitative status evaluation has been considered in the initial characterisation. It considers pressures (pumping, recharge, salt water intrusion) and potential risk of impact (overexploitation), and a chemical status evaluation. It analyses pressures (point source pollution, diffuse pollution and vulnerability) with their potential risk of pollution.

The existing monitoring network has been used to define the baseline groundwater conditions.

These studies have allowed to define the groundwater bodies in which a further characterisation is necessary.

Determining natural background concentrations of pollutant indicator species in Irish groundwater bodies

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For the purposes of the WFD, the EPA of Ireland has adopted a strategy for further characterisation of groundwater bodies. This includes the derivation of 'natural background' concentrations of naturally-occurring chemical species in groundwater. In practice, these can be said to be analogous with baseline concentrations. Systematic groundwater quality monitoring has only been conducted since the mid-90s and, as such, data are limited. A methodology for the derivation of natural background concentrations of key indicator species has been developed that takes into account the data availability for any particular groundwater body. A number of methods are available for use, including manual, statistical and graphical techniques, all of which have been used elsewhere in defining baseline concentrations. This talk presents a short summary of these techniques then discusses their application in the data-poor Irish context, with case examples. The concept and use of pollutant indicator species is also discussed

Characterisation and Risk Assessment in the Shannon River Basin

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The characterisation and risk assessment of water bodies in the Shannon river basin, including groundwater, is complete. The results, methodologies and guidance notes supporting this analysis for all river basin districts in the Republic of Ireland are available at www.wfdireland.ie. The emphasis in the Water Framework Directive on geographical information systems created an impetus resulting in the production of new national datasets from several organisations, which benefited the characterisation process, including a digital bedrock map, a digital river network and a digital terrain model. The pressure-pathway-receptor model was adopted for the groundwater risk assessment process. Lack of representative monitoring data and difficulty in representing pressure layers were the greatest cause of uncertainty in the risk assessment results. Risk assessment of groundwater dependent surface water and terrestrial ecosystems were a particular challenge for the Shannon river basin. Much of immediate further characterisation will focus on resolving these areas of uncertainty so that programmes of measures appropriate to each groundwater body can be developed.

Characterisation and Monitoring of Groundwater in aquifer areas across South West England to meet the requirements of the Water Framework Directive (WFD)

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The South West of England has some of the most varied hydrogeology within Europe, from igneous and metamorphic secondary aquifers in Cornwall to the Chalk across Dorset and Hampshire. To meet the requirements of the (WFD) therefore represents a significant challenge in the characterisation and identification of (ground) water bodies and establishing monitoring programmes for status and trend assessment.

The Environment Agency has undertaken a series of studies to characterise baseline groundwater levels and quality. Improvements have been implemented to the groundwater level and quality monitoring networks. However, a consistent approach for monitoring across secondary aquifer areas is required to be able to successfully implement the (WFD) throughout the region.

Natural Baseline Quality in European Aquifers: From BaSeLiNe to BRIDGE

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The EU BaSeLiNe project has established criteria for defining natural water quality baselines and to develop this concept as a standardised Europe-wide approach, This approach, based on geochemical principles is needed to be able to assess scientifically the natural variations in groundwater quality, to identify those naturally occurring elements which may breach guidelines for water quality, and to be able to assess quantitatively whether anthropogenic pollution is taking place. The project has focused on timescales influencing natural processes and the rates at which natural processes are occurring as well as historic trends and the extent to which pristine waters are being depleted by contaminated by waters moving into the aquifer. A total of 25 standardised reference aquifers are presented from 12 European countries. As well as giving the necessary scientific framework, the project results provide the basis for new policy and are being used most recently in defining Europe-wide quality guidelines in the BRIDGE programme.

Groundwater residence time –a key parameter for groundwater quality assessment

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Most groundwaters used for water supply in Europe have turnover times of less than 50 years and are therefore at risk from pollution. Any observed trend in water quality is potentially due to human impact. On the other hand, the absence of any young groundwater components provides strong evidence that baseline conditions predominate. The determination of the portion of recent water components is therefore a key parameter for any Baseline study or monitoring program. In many cases the knowledge of residence time is the only way to distinguish anthropogenic and naturally elevated concentrations of any parameters. In talk it will be presented how in particular environmental tracers can be used for (i) the determination of age and quantity of young groundwater components (ii) the quantification of timescales of old groundwaters.

Based on selected case studies from European aquifers, it will be demonstrated how groundwater composition varies as function of time. This has also implications for the design of monitoring programs (e.g. sampling frequency) or early warning tools which require a brief knowledge about the residence times of an aquifer.

Groundwater Body Delineation and Characterisation in England and Wales

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The Water Framework Directive sets out the planning process for river basin management. Groundwater Characterisation is an important part of this process.

Characterisation is an ongoing process that is being conducted by the Environment Agency in England and Wales. The 'Initial Characterisation' phase has now been completed and the results were submitted to the European Commission on 22nd March 2005. The reports are the culmination of over two year's work and represent a significant achievement for the Environment Agency.

For groundwater, 'Initial Characterisation' has involved the delineation of groundwater bodies followed by a pressures and impact analysis for each groundwater body. This was used to assess the risk of failing to meet the environmental objectives of the Directive by 2015.

The reports confirm that the groundwater environment is subject to significant pressures including:

- Point source pollution
- Diffuse source pollution
- Abstraction

Further Characterisation is expected to lead to more accurate assessments and therefore better focused and more effective measures.

The natural (baseline) chemistry of groundwater in England and Wales

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The extent of groundwater contamination and the impact of anthropogenic inputs to aquifers are difficult to quantify because of large natural variations in groundwater quality due to natural processes and inputs. A knowledge of the ***baseline*** quality is essential both for determining pollution and assessing the degree to which remediation is feasible and/or required. Groundwater baseline is defined here as the ***range in concentration (within a specified system) of an element or chemical substance in solution, derived naturally from geological, biological, or atmospheric sources***. Hydrochemical variations exist at a variety of scales as a function of the many complex geological, hydrogeological and climatic factors which control chemical evolution. The concentrations of some elements (e.g. As, Ba and U) may breach drinking water standards by entirely natural processes. The characterisation of groundwater chemistry in aquifers is difficult to establish for a plethora of reasons *inter alia* spatially biased sampling and long screen intervals allowing mixing of water of different compositions. The results of a collaborative study between the British Geological Survey and Environment Agency are presented to highlight progress in defining groundwater baseline.