



# GROUNDWATER MONITORING IN EUROPE

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October 1996

<b>CONTENTS</b>	<b>Page</b>
<b>EXECUTIVE SUMMARY</b>	<b>3</b>
<b>1. INTRODUCTION</b>	<b>5</b>
<b>2. SUMMARY DESCRIPTION OF GROUNDWATER (QUALITY AND QUANTITY) MONITORING ACTIVITIES IN EACH COUNTRY</b>	<b>9</b>
<b>2.1 Austria</b>	<b>9</b>
<b>2.2 Belgium</b>	<b>12</b>
<b>2.3 Denmark</b>	<b>13</b>
<b>2.4 Finland</b>	<b>15</b>
<b>2.5 France</b>	<b>17</b>
<b>2.6 Germany</b>	<b>19</b>
<b>2.7 Greece</b>	<b>26</b>
<b>2.8 Iceland</b>	<b>27</b>
<b>2.9 Republic of Ireland</b>	<b>28</b>
<b>2.10 Italy</b>	<b>31</b>
<b>2.11 The Netherlands</b>	<b>32</b>
<b>2.12 Norway</b>	<b>37</b>
<b>2.13 Portugal</b>	<b>40</b>
<b>2.14 Spain</b>	<b>42</b>
<b>2.15 Sweden</b>	<b>45</b>
<b>2.16 United Kingdom</b>	<b>47</b>
<b>3. THE EEA GROUNDWATER QUALITY AND QUANTITY MONITORING DATABASE</b>	<b>55</b>
<b>3.1 Database description</b>	<b>55</b>
<b>3.2 Data Entry</b>	<b>56</b>
<b>3.3 Data Export</b>	<b>56</b>
<b>4. DATA SUMMARY</b>	<b>57</b>

<b>5. DISCUSSION</b>	<b>129</b>
<b>5.1 Groundwater quality</b>	<b>129</b>
<b>5.2 Groundwater Quantity</b>	<b>131</b>
<b>6. CONCLUSIONS</b>	<b>133</b>
<b>REFERENCES</b>	<b>135</b>
<b>ANNEXES</b>	
<b>ANNEX 1</b>	<b>RESPONSIBLE ORGANISATION DETAILS</b>
<b>ANNEX 2</b>	<b>DETAILED PARAMETERS</b>
<b>ANNEX 3</b>	<b>MW2 QUESTIONNAIRES - PART 1, III AND IV</b>

## EXECUTIVE SUMMARY

The aim of this report by the **European** Topic Centre on **Inland** Waters is to give an overview of the **current** groundwater quality and quantity networks and monitoring procedures within the **European Environment Agency (EEA) area**. The information for this overview was obtained through questionnaires distributed by the **EEA's** National Focal Points in 17 of the 18 EEA member countries. (Liechtenstein was not included at this stage). **All** countries **except** Belgium and Luxembourg returned the questionnaires. Some countries were also able to **include** computerised information on monitoring station types in their returns. A detailed inventory of the information obtained has also been created. The following information and topics are included in this overview:

- **name** of monitoring programmes;
- **monitoring** objectives (why monitoring is undertaken);
- responsible and collaborating organisations (addresses, contact persons, responsibilities);
- extent of network (geographical coverage, number of regions and sampling sites etc.);
- groundwater regions (**area**, sampling frequency, etc.) (groundwater quality only);
- monitoring network characteristics;
- observed variables (dimension, frequency, analytical methods, etc.);
- temporal coverage of monitoring;
- data storage and management details;
- data availability (**fees**, restrictions, reporting organisations, etc.);
- quality control and assurance procedures;
- report of observation (organisation, persons, addresses);
- sampling site details.

From the information obtained it 'appears that monitoring of groundwater quality has been undertaken in most **European** countries **since** the 1970s and '80s. France appears to have the oldest network dating **back** to 1902. In **contrast** the monitoring of groundwater quantity has a longer tradition in Europe with the oldest networks being in operation **since** 1845, and most since the beginning of the 20th Century.

Groundwater quality monitoring networks have developed as a result of national demands and the (hydro-)geological situation. As a result monitoring objectives **vary** a lot from country-to-country, though 'general surveillance' and 'the identification of trends in quality' are widespread goals **all over** the EEA **area**. In terms of quantity the respondents gave broadly similar objectives for monitoring **activities** such as for the collection of **basic** groundwater data, the management of groundwater resources and

water supply, and in support of (hydro-)geological studies investigating, for example, the reasons for temporal and spatial changes in groundwater levels.

All the quality and quantity networks described in the questionnaires are national in extent with the exception of regional networks in the German Länder and France (quantity only). The majority of sampling sites are distributed evenly within the whole groundwater areas and aquifer types (e.g. porous media, karst, artesian and deep groundwater). However many sampling sites of quality are concentrated around drinking water wells. The total number of sampling sites, the total aquifer area and as a consequence the sampling site density varies a lot. These differences are the result of differences in national objectives as well as differences in the (hydro-) geological situation and land use. Thus in quality networks sample site density ranges from 0.003 sites/km<sup>2</sup> to 0.57 sites/km<sup>2</sup>, and in quantity networks 0.004 sites/km<sup>2</sup> to 7.3 sites/km<sup>2</sup>.

Quantity networks comprise various types of observation points such as bored and dug wells, which are mostly used, but also driven wells and spring wells. The quantity variables observed are broadly the same; groundwater level (all countries), then groundwater temperature (nearly all) and also spring level and spring discharge. The frequency of measurement is, however, variable. For example, in the case of groundwater level nearly all countries have some continuous recording. More typically sampling frequency varies from weekly to 10 times a year. For groundwater temperature it varies from every 15 minutes to 2 times a month.

The number of measured water quality determinands varies from 15 to 106 between the monitoring networks. 'Basic' programmes often include between 14 and 51 determinands. The selected determinands appear to be adapted to national circumstances and at present cannot be readily compared at a European level. Not every determinand from a single sample is analysed by a single institution. However, the majority of countries have national standardised sampling and analytical methods as well as standardised regulations for precision and accuracy.

The information held in the inventory will be a very useful tool for further co-operation and development in the fields of water protection in the EEA area. For example, the information will be a key component in the implementation of the proposed groundwater monitoring network for the EEA area (as described in project MW3).

In addition to the report, the collected data from the questionnaires has been incorporated into a relational database. Tables are designed for comparing various aspects of data. Technical details of the database and the organisation of the tables are included in this report. An entity relationship diagram shows the relationships between the different tables. A hard copy of the database tables is also available from the ETC/IW. This report is included in the EEA's Catalogue of Data Sources (CDS). The CDS is available to all National Focal Points and forms part of the EIONET. The CDS is also scheduled to be made more widely available (for example, to members of the public) through the World Wide Web during 1997.

# 1. INTRODUCTION

This report is a summary of the activities undertaken for the 1995 European Topic Centre Project MW2/Task 4 *“Produce an inventory of current and planned water resources monitoring procedures and practices in the EEA member countries and international conventions with particular emphasis on monitoring of groundwater (quality and quantity) and surface water quantity.”*

The **basic** ideas for this task were

- to identify present and planned water resources (quality and quantity, groundwater) monitoring in EU Member States, Norway and Iceland in particular: sampling strategies (frequencies, number of sites, methods of sampling), **analytical** procedures and the dissemination of results;
- to review national and international quality assurance procedures (and identify the extent to which they are applied in **each** member state);
- to determine the extent to which the monitoring procedures are applied by the Member States, Norway and Iceland **vary**
- to judge the extent to which states have instigated measures to harmonise their water **resource** monitoring strategies and, where possible;
- to identify possible routes to harmonisation and the practical barriers and solutions for greater harmonisation on a **European** Union level

(from the **WRc** summary of the technical work programme for the 1994 subvention, p. 12/65, 30 January 1995)

As a **matter of fact** national **differences** in monitoring systems arise in fields like

- monitoring obligations due to national law
- number of observed parameters
- **limits of detection**
- number and types of **sampling** sites
- frequency of data collection
- quality assurance and quality control methods
- data collation and data treatment (statistically)

The **detection** of these **differences** within the EEA member countries is absolutely necessary for designing and establishing a **European** wide monitoring network by the EEA. Only data that are **comparable** will help to work **out** possible ways to solve urgent environmental questions of the future. These important topics cannot be treated by every country on its own. International co-operation **will** be the way, thereupon the demand for comparable data and **connected** environmental monitoring networks is indispensable.

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With the help of a questionnaire the information needed has been collected. The design of the questionnaire was the result of the broad experience of NERI and the contributions of the AWW and IH in February 1995. The questionnaire contains four parts: Part I general description of monitoring activities at the country level; Part II surface water quantity monitoring; Part III groundwater quality; and, Part IV groundwater quantity monitoring. Parts I, III and IV of the questionnaire are given in Annex 3.

The main headings used within Parts I, III and IV are summarised in Table 1.1 below. As Part II dealt with surface water quantity monitoring it is not discussed in this report - further details are given in Rees *et al.*, 1996.

*Table 1.1 Summary of contents of Parts I, II and IV of the MW2 questionnaire*

<b>Monitoring activities at country level</b>	<b>Groundwater quality</b>	<b>Groundwater quantity</b>
<b>Part I</b>	<b>Part III</b>	<b>Part IV</b>
groundwater - national extent of porous, karst and other groundwaters. national mapping and characterisation work	name of monitoring programme	name of monitoring programme
water resources - potential, consumption, % of consumption ground and surface waters	monitoring objectives (why monitoring is undertaken)	monitoring objectives (why monitoring is undertaken)
inland surface waters - main characteristics e.g. national hydrological regime, major river basins, lakes, wetlands	responsible and collaborating organisations (addresses, contact persons, responsibilities)	responsible and collaborating organisations (addresses, contact persons, responsibilities)
administrative organisations for groundwater quality and quantity monitoring, and surface quantity monitoring	extent of network (geographical coverage, number of regions and sampling sites etc.)	extent of network (geographical coverage, number of regions and sampling sites etc.)
	groundwater regions (area, sampling frequency, etc.)	
	monitoring network characteristics	monitoring network characteristics
	observed variables (dimension, frequency, analytical methods, etc.)	observed variables
	temporal coverage of monitoring	temporal coverage of monitoring
	data storage and management details	data storage and management details
	data availability (fees, restrictions, reporting organisations, etc.)	data availability (fees, restrictions, reporting organisations, etc.)
	quality control and assurance procedures	quality control and assurance procedures
	report of observation (organisation, persons, addresses)	report of observation (organisation, persons, addresses)
	sampling site details	sampling site details

After the validation of the questionnaire by the ETC/IW consortium and the EEA they were delivered to each National Focal Point (NFP) via selected ETC/IW members within the EEA area. The NFPs were responsible for the distribution of the questionnaires by contacting their national key organisations and key persons and ask



them to answer and **provide** hard copies as well as ASCII files of monitoring stations. Afterwards the **NFPs** were asked to return the answered questionnaires to the selected **ETC/IW** members. These members sent the questionnaires to the **ETC/IW** members AWW (groundwater quality and quantity) and III (surface water quantity) who were responsible for collecting and evaluating the questionnaires. Furthermore both organisations were obliged to load the data of the questionnaires **onto** a **database** and to produce reports.

The inventory started in February 1995 and was to be completed by the end of April 1995. The national answering **procedures** turned **out** to be **very difficult** due to administrative structures, divided responsibilities for national monitoring or decentralised monitoring systems. Most of the questionnaires were returned with long delays, the last arriving at the AWW by mid of September **1995**. To date no information has been received from Belgium and Luxembourg.

A short overview of the responses is given in Table 1.2.

Due to the short deadlines given within this task, the data supplied on the completed questionnaires were loaded into Excel spreadsheets to make the first data handling fast and simple. The design of the spreadsheets was made under the **consideration** of an easy loading **procedure** into a relational **database** (more technical details are given in **chapter 3** of this report). **Later** on this **database** was constructed as a draft model in MS-Access 7.0. In the future it **will** converted into a 'digital VAX-rdb' **database** in order to **ensure** save and fast data access.

The remainder of this report is based on answers given in the questionnaires. It describes the different national status of groundwater quality and quantity monitoring in Europe. For those countries who failed to respond, the relevant sections of the report are simply left blank. In the next **chapters** the following topics are described:

Chapter 2	National monitoring description (quality and quantity)
Chapter 3	Technical description of <b>database</b>
Chapter 4/5	Tables for <b>comparison</b>
Chapter 6	Discussion
Conclusions	

Supplementary information **such** as on organisation **names** and addresses are given in various annexes

## 6. CONCLUSIONS

This report **provides** an overview **about** groundwater quality and quantity monitoring activities in Europe. The report only **contains** data that were available via the MW2 questionnaires and the answers given. Consequently the report is limited to the information. This data collection had to be realised within a **very** strict timetable. As a **consequence** it was **quite** laborious for countries with **centralised** structure to succeed in answering in time. But due to the time available for this task it was not really possible for decentralised countries to deliver information within the deadline. Thereupon some of them **could** only give „average estimations“ on their monitoring systems due to the **fact** that their monitoring networks are differently **structured**. This **experience** may be a helpful instrument for further project planning. Also the data obtained from **all** member countries were variously detailed. Thereupon the evaluation **procedures** were not that easy.

Although **database** systems within the EEA member states are als6 often as different as the national monitoring objectives it is possible to adopt them for the data transfer into an EEA **core database** or for data transfers between countries and researchers. As pointed **out** in the discussion an EEA wide interface installation or a **common** use of the EIONET system **can** facilitate data transfer in future, even further inventories **can** be made faster and easier. Cost effectiveness is guaranteed as present systems **can** be widely used. This EEA groundwater **database** which **contains** surface and groundwater monitoring data -as described in the report- **will** assist these processes by providing

- a first overview of data available and responsible organisations for groundwater monitoring activities in **each** country
  - the state of monitoring activities, sampling site details, geographical and temporal extent of networks, measured variables and frequencies, sampling and analysing **procedures, database** infrastructures, reporting and organisations involved at country level
  - demonstrations of quality assurance **procedures** in **each** country which **may** be a key information for data comparison
  - **comparisons** of **monitoring** practices adopted in **each** of the member states, with **each** aspect of the monitoring **procedure** examined in turn
  - information **about** ways of harmonisation within the groundwater monitoring strategies of the member countries, with normally **one** central organisation co-ordinating the programme and having responsibility for maintaining the national database,
- , **All data collected** via the inventory **can** be a **very** helpful tool for further co-operation and development in the **fields** of water protection in the EEA **area**. For **example** the work for the MW3 project „Network Design“ already showed that the MW2 monitoring

inventory and data collection was a **very** good basis for the MW3 task reports. Thereupon this **database** is an important basis for the further harmonisation of the different national monitoring activities as well as the data management and storage. The need for these **procedures** were highlighted in the MW3 tasks reports (1995) too. These efforts **can lead** to a better **co-ordination** and handling for the solution of environmental problems. The solution of water problems is **one** of the main task for the further environmental **policy** of the **European** Community. Nowadays as good drinking water quality as well as the water resources themselves are more and more endangered by **human** activities. The water problem **can** destabilise all our living conditions. Careful management of water resources and protection by good water monitoring systems **will** help to handle these topics. A first step is initialised with the design for the EEA database.