APPLICATION OF THE EC DRINKING WATER DIRECTIVE IN SIX MEMBER STATES: APPENDICES

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APPENDICES

Application of the Directive in six member states is covered by the following appendices.

A. Denmark
B. Federal Republic of Germany
C. France
D. Italy
E. Netherlands
F. Spain
APPENDIX A

THE EC DRINKING WATER DIRECTIVE IN DENMARK
1. WATER RESOURCES IN DENMARK

Some 97-98% of the Danish water supply comes from groundwater and the remainder from lakes. None is derived from lowland rivers. The highest point in Denmark is 150 m above sea level and they have no equivalent of the upland sources which are used in, for example, France and the UK.

During the last ice age the north and south-east of the country were covered by glaciers and this has resulted in a somewhat complex geology in these regions with clay and glacial till overlying fissured chalk. In the south-west, outwash from the glaciers has produced sandy soils and gravels lying on beds of clay.

There may be two or more aquifers at different depths, separated by lenses of clay. Dissolved material passes between these aquifers at a slow rate although they may be connected at places where a clay lens terminates. For practical purposes the upper aquifer consists of a series of shallow, discrete basins of widely different size, the composition of whose water depends on circumstances.

The clay beds provide a barrier to the passage of nitrate and other contaminants but also contain reduced iron (Fe II). Bacteria in the ground can use this to reduce nitrate to nitrogen, in the course of which the iron is oxidised to Fe III. The capacity of the clay beds to reduce nitrate declines as the Fe II is oxidised at progressively greater depths.

In some places beds of peaty matter occur in the sub soils and the groundwater contains a significant concentration of coloured organic
matter. The sandy geology in the south-west has little buffering capacity and often contains pyritic material whose sulphur is oxidised to sulphate. This results in water which can be very acidic and may contain elevated levels of dissolved aluminium. In general high aluminium levels do not occur in the more highly coloured waters, probably because the peaty material either contains little aluminium or forms insoluble complexes which immobilise the metal.

Upper aquifers at 18-20 metres depth tend to have low pH, high nitrate and elevated iron and manganese. Lower aquifers at 118-135 metres tend to contain ammonia, phosphate and peaty organic matter (typical permanganate values 14-50 mg/l).

The deeper aquifer is 240 metres and the water about 1000 years old. The deepest aquifer tends to be connected to other reservoirs.

In the rural agricultural areas houses often use septic tanks and intensive animal units produce large amounts of slurry. In such areas small local supplies are often contaminated and may contain ammonia and sometimes bacteria.

2. WATER SUPPLY ARRANGEMENTS IN DENMARK

Copenhagen and other large towns have municipal water supplies which are of high quality. Efficient sewage and waste collection systems prevent pollution of the aquifers used for supply which are in any case often outside the boundaries of the town.

Two-thirds of the total volume of water supplied in Denmark comes from about 300 municipal water works.
Outside the major cities the population is dispersed into smaller communities distributed over relatively large areas. Sometimes communities form a syndicate to treat and distribute water and one third of the Danish water supply comes from 3700 private co-operative water works serving typically between 5 and 100 households. There are in addition some 150 000 private wells serving individual households and farms.

All water supplies in Denmark are the responsibility of the municipality, a syndicate or the individual household. No commercial private companies are involved and the Copenhagen water supply company belongs to the city authorities.

3. DRINKING WATER LAW


Parameters are listed according to the required monitoring frequencies and, since these are based on the Directive tables, substances are repeated in a number of tables. Guide levels and maximum admissible concentrations are given. More stringent limits are given for colour (15 mg/l), turbidity (0.5 mg/l), temperature (12°C), surfactants (100 µg/l) and phosphorus (687 mg P₂O₅/l). Less stringent values are set for sodium (175 mg/l) and permanganate value (12 mg/l). A general note allowing higher values with approval covers sulphate, sodium, potassium, dry residues,
nitrate, ammonium, Kjeldahl nitrogen and phosphorus. Total bacteria in closed containers has been omitted. National values have not been set for conductivity, calcium, substances extractable in chloroform, organochlorine components other than pesticides, suspended solids and barium for which guide levels only are given in the Directive.

The Ministry of the Environment is responsible for the administration of water supplies and this responsibility is exercised through the National Agency for Environmental Protection (NEPA) one of five agencies which comprise the Ministry.

Denmark is divided into 14 counties, each governed by a council, and which are sub-divided into a total of 275 municipalities, each governed by a local council.

The right of derogation for specific parameters has been delegated to local authorities. This is not approved by the European Commission, however, and they have instituted proceedings under Article 169 of the treaty.

The counties have the regulatory role and stand between the municipalities and the EPA but only two are said to exercise this role effectively. Both private and municipal supplies are regulated equally.

Licences, issued by the regional councils, are required for the abstraction of water but farmers, subject to certain conditions which include a minimum distance from the nearest source of contamination and a maximum abstraction of 3000 m³/year, have a right to abstract.
4. APPLICATION OF THE DRINKING WATER DIRECTIVE

4.1 Responsibility for monitoring

The standards and the prescribed monitoring frequency, which varies depending on the size of population served, are described in the Statutory Order from the MoE No.6 of 4.1.80, amended by SO No.468 of 16.9.83 and summarised in a SO issued in May 1985 of which an English translation is available. Sampling requirements are described in a circular dated 26.7.84.

Monitoring and analysis are carried out by the municipal authorities who agree a sampling programme with the supplier. There are about 50 laboratories who can carry out the chemical analysis. In Ribe County, for example, there are 27 municipal and 85 private waterworks, and three laboratories which are run as co-operatives. It seems that no distinction is made between operational sampling, which is probably minimal or non-existent for small works, and compliance sampling. In Copenhagen all analyses are considered to be relevant to compliance.

The standards were originally applied as percentiles (Janne Forslund was on the original EC committee which drafted the Directive) but this was abandoned since it was meaningless in the case of annual sampling frequencies.

The results are supplied to the Environmental Health Officer (EHD) at the county, who is medically qualified, whose job it is to evaluate them.
Water quality data are available to the public at municipal offices.

4.2 Analytical quality control

There is a mandatory nationwide scheme for which VKI, the National Water Quality Institute, is the laboratory. VKI may report on performance to the NEPA but does not itself have an audit function.

4.3 Sampling points

Sampling used to be done in the main distribution system since it was often difficult to sample at consumers' taps but this is now changing to sampling at the well and municipalities now sample more often at the tap. The local authority and the county officials have an absolute right of entry to homes, given by Departmental Order, for this purpose and also for inspections of the water and sanitary arrangements. For large supplies, as in Copenhagen, samples are also taken ex-works and in the distribution system. The choice of sampling point seems to be discretionary.

4.4 Sampling frequency

The tables on sampling frequency follow fairly closely the layout in the Directive but the frequencies for total coliforms, taste and odour, and turbidity fall short of the Directive's requirements. Total counts on the other hand exceed the requirements considerably. Many parameters are assigned to a frequency group where measurement is to be carried out when required and in special circumstances. They include all toxic parameters, aluminium, nine table C parameters plus faecal streptococci and sulphite - reducing Clostridia. Tables relate frequency to volume of water supplied. Reduced frequencies are permitted for groundwater where values recorded in the two
years previously have been uniform and significantly below the MAC, and where there are no indications that the quality of the water could deteriorate. This dispensation also appears to apply to microbiological parameters although this is excluded by the Directive. For plants supplying less than 700,000 m$^3$ per annum the frequency is set by the local council although there are minimum requirements for water used in food processing.

4.5 Action taken when a sample fails to meet the MAC

The regional offices automatically receive all the data on drinking water and the Regional Health Officer, who in any case receives the same data, must be notified if any sample exceeds the MAC.

The first step after an exceedance is to resample and check. An allowance must be made for analytical uncertainty. The local authority has the right to act on its own initiative but is not obliged to do so and can exercise its discretion. They usually prefer to rely on the regional authority. If the analysis of a sample gives a result which is deemed to constitute a risk to health, irrespective of the EC Directive MACs, the local authority must decide whether to act or not. The law has recently been changed so that ignorance of possible health effects is no longer a valid excuse. The local authority can, however, appeal to the Ministry of the Environment.

The discretion which local authorities are allowed and the widely varying diligence with which different municipalities consider questions of water quality lead to great inconsistencies.
Councils used to deal with water quality problems at the political level but have now learned to delegate to the bureaucrats/officers which has speeded things up and led to more logical decision making. Householders can be asked by the EHO to close a well if health is at risk but they are not always willing to do this and the well owner may refuse to comply with a request. In Ribe, for example, they have had one refusal in 500 requests. A refusal to close a well can result in a fine of DK30 000 (£2500) for a farmer and DK15-20 000 (£1300-£1700) for a domestic household.

The well owner may apply for a dispensation by filling in a form but if his application is refused he must comply with the MAC(s) within one year of his application (not the decision!). In Ribe one tenant was forced to leave a house because the water supply was judged unacceptable and the landlord was forced to change the supply in order to be able to let the property.

Where remedial measures are required within a given timescale these are specified by central government. No formal steps are taken to ensure that the measures have been taken but the municipality may ask for proof of action and the quality of the supply is rechecked. Dispensations are given reluctantly for nitrate up to 100 mg/litre but efforts are being made to eliminate these high nitrate supplies. Dispensations may be given for exceedance of other parameters which are not of health significance providing that they do not indicate contamination of a more serious nature. These include organics, residual solids, Mg, Ca, Na, K, NH_4, Cl, SO_4, NO_3, total P, P, Kjeldahl N. Dispensations cannot be given for Al, Fe or Mn but high levels may be
"ignored". High phosphate is acceptable if it derives from natural sources but not if it indicates sewage (septic tank) contamination.

4.6 Pollution incidents

The Danes make little or no use of running surface waters for public supply and their groundwater sources and few lakes are not particularly susceptible to accidental pollution.

They have experienced one incident involving phenol but such incidents are so unusual that they do not feel the need for a system to deal with them.

5. WATER QUALITY PROBLEMS IN DENMARK

Nitrate

This is the single most important and intractable water quality problem and has been dealt with in a separate WRc report. Very high levels can be found, the highest being 728 mg NO₃/l, which resulted in cases of the death of livestock from nitrate poisoning.

It is the intention to apply eventually a standard of 25 mg NO₃/l and this has been achieved for all the major municipal supplies but it will be progressively more difficult to reach for smaller supplies and nearly impossible for remote private supplies. Dispensations are given up to 100 mg/l but the owner is warned not to use the water for feeding babies.

Table 1 shows how nitrate levels in drinking water have been improved in Ribe, either by connection to municipal supplies or by deeper drilling.
Table 1. Nitrate levels in drinking water in Ribe County, Denmark

<table>
<thead>
<tr>
<th>Year</th>
<th>&gt;25 mg/l</th>
<th>&gt;50 mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>17</td>
<td>13</td>
</tr>
<tr>
<td>1985</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>1987</td>
<td>16</td>
<td>3</td>
</tr>
</tbody>
</table>

Acidity

Some aquifers occur in rock strata containing pyritic rocks. The progressive oxidation of sulphur produces very acidic water with pH values sometimes as low as 3.5-4.0. The water typically is free from nitrate which will have been reduced by the iron.

Aluminium

The acidic waters often contain high levels of aluminium, sometimes in excess of 200 µg/l, the MAC of the directive. No dispensation can be given because there is a technical remedy but the cost is so high (DK 10 000 or £1000 per house) that the results are ignored.

Colour

Peaty layers in the subsoil strata impart colour to some water sources. Such waters do not contain aluminium, either because it is not present in the rocks or because it is complexed by the organic matter. Chemical treatment is expensive, especially for small supplies and a new drilling may be required.
Aggressivity

Often a problem in private supplies.

Iron and Manganese

These metals occasionally occur in raw waters at levels in excess of the MACs.

Fluoride

A few supplies contain fluoride at levels above the MAC.

Ammonia

This occurs occasionally in individual private supplies when a well is situated too close to a septic tank and has been contaminated by sewage. Phosphate is also considered to be a possible indicator of sewage contamination.

Bacteria

Bacterial contamination of private supplies is second only to nitrate as a problem in drinking water quality. Chlorination is employed only in Copenhagen where surface waters are used. Elsewhere only groundwater is used and is not chlorinated.

Pesticides

Some of the author's sources claimed that Denmark did not have a significant pesticide problem but the NEPA and VKI hold the view that there has not yet been an adequate survey and they expect to find more as they look harder.
Solvents

Chlorinated solvents are occasionally found in aquifers close to large cities.

Hydrogen sulphide

This is occasionally present in groundwaters but is easily dealt with by aeration.

Cost implications

Farmers have an advantage in that they can usually offset expenditure on improvements against tax.

6. WATER TREATMENT VERSUS PREVENTION

A central conflict underlies Danish attitudes.

On the one hand the NEPA feels that farmers are responsible for most of the nation's water quality problems and that the only long term solution is to exert controls on agriculture.

The farmers, on the other hand, have provided the bulk of the nation's foreign exchange for years and now, in the face of EC surpluses, are seeing their incomes fall dramatically. The sort of curbs which the Danish government is talking about would reduce incomes still further. The farmers recognise that their activities cause problems in many areas and support the idea of protection zones, with tight controls in specific regions and none elsewhere.

The NEPA considers that the entire country needs to be a protection zone and that controls on agriculture must be universal and not confined to limited areas. The NEPA thus resists any use of
water treatment to solve the nitrate problem in the belief that, once it has been shown to be possible, the case for curbs on agriculture will be irrevocably lost. The EPA is also against controls on pesticides and fertilisers which are based on soil concentrations because the evidence is that universities, who are also short of money, would hire themselves out to farmers to calculate the maximum applications which will allow them to stay within the limit.

EPA estimate that between 50% and 90% of small supplies fail the Drinking Water Directive, usually for nitrate or bacteria. They would like to rationalise water distribution to connect everyone to mains supplies and have set up a committee "Water 2000" to consider the future of water. The committee is a disguise for the preparation of a report on the failure of existing rules, the absence of working protection zones and the poor quality of many small rural water supplies. They are seeking a case for restructuring water distribution which does not invoke the nitrate problem because, if it did, the farmers would relax on the grounds that an alternative solution would be found which did not require controls on them.

Treatment processes typically involve aeration to oxidise iron and manganese and coagulation to remove colour before rapid gravity sand filtration. The process observed at Kibe was in a works run by a co-operative supplying of the order of 100 households. The local regional officer in charge of water quality was also chairman of the works co-operative. The works itself was housed in a brick building, immaculately kept and fully automated. It had no paid staff and members of the co-operative came in to replenish the coagulant
dosing reservoirs and carry out minor maintenance on a voluntary basis. The cost of the works was shared between them and the water costs the average household DK600 (£50) a year.

The NEPA say that media pressure often forces the government to act even when the consequences are expensive and does not achieve the intended results. This was said in the context of the recently introduced measures to reduce the input of nutrients to the sea. There is a body of informed opinion in Denmark which doubts the likely effectiveness of these measures, even though there is much sympathy for the public concern which lay behind them.

There is a law requiring replacement of oil tanks every 20 years if they are not corrosion proof and the old or disused tanks must be removed or filled with clean sand after 20 years.

7. PROTECTION ZONES

Municipalities may designate protection zones at their discretion but do so only arbitrarily – eg within 6 or 12 metres of a river bank or within 150 metres radius of a well. No account is taken of hydrology and there is only an ad hoc or informal inspection system by municipal officers. Farmers may not even know such zones exist in their area. VKI regard them as ineffective.

A septic tank upstream of a well must be separated from it by at least 300 metres, in parallel by 150 metres, and downstream by 75 metres. This rule is enforced by the municipality or the county. Dispensations for quality infringement may be
withheld if wells are considered to be too close to a septic tank, building or other installation. This happens in around 60% of cases.

VKI consider that protection zones will not solve the problems of water contamination. There are 700 industrial sites around which boreholes invariably show contamination of the water.

8. COSTS AND PRICES

8.1 Metering

Metering is not yet universal but is becoming more widely used. For blocks of flats there is usually a single meter and the bill is apportioned between the flats in accordance with floor area. For unmetered premises with municipal supplies the charge for water is made according to something like the rating system in the UK.

Co-operatives can, of course, agree a charging basis amongst themselves. The cost of water is a sensitive issue and, where a private or small co-operative supply fails to meet quality standards, the solution is usually selected on the basis of least cost. Government would prefer to connect everyone to a municipal supply and eliminate small supplies but in many rural areas the distances involved would make the costs prohibitive. In granting dispensations for quality deficiencies the local authorities have some regard to the feasibility and the cost to the well owners of remedial measures.

Typical water costs range from few tens of pounds per year to over £100.
9. REMEDIAL MEASURES

The well owner pays the costs for drilling a new well. Typical costs might be £3000 for a farmer or £1500-2000 for a private householder.
APPENDIX B

THE EC DRINKING WATER DIRECTIVE IN THE FEDERAL REPUBLIC OF GERMANY (FRG)
1. WATER RESOURCES IN THE FEDERAL REPUBLIC OF GERMANY (FRG)

The total area of the FRG is 249 000 km² which is utilised as shown in Table 1. This shows that approximately half of the area is used for agriculture. Total available water supplies have been estimated as 115 000 Ml/d and total water supplied is 12 000 Ml/d indicating a 10% use. Domestic supplies are said to be 9000 Ml/d representing 75% of the total used.

Sixty-four percent of potable supply is derived from true groundwater. If bankside filtrate and enriched groundwater are also considered as groundwater this figure rises to 80%. Spring water accounts for 9% of the supply and the remainder is abstracted from surface waters (see Table 2). However, after treatment, most of the water abstracted from surface waters is passed through the ground before distribution to the consumer.

Geological conditions in Germany vary widely. Whereas some areas of the FRG near the North Sea coast are below sea level, the Alps in the south reach heights up to 3000 m. Figure 1 shows the major aquifers in Germany and indicates that a large area of north Germany, and also some parts in the south, have aquifers with high recharge rates (up to 500 mm/year). The overlying material is loosely packed and highly permeable, and the aquifers tend to be shallow. The waters from these aquifers are often soft and rich in humic acids, iron and manganese and, where the land is used for agriculture, problems with nitrate and pesticides are likely. In the centre of Germany chalk and limestone aquifers, which have variable recharge rates, are widespread. These groundwaters tend to be hard and can also be affected by pesticides and nitrate arising from agricultural activity.
Table 1. Utilisation of the surface area in the FRG

<table>
<thead>
<tr>
<th>Utilisation</th>
<th>Area (km²)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>122 000</td>
<td>49.1</td>
</tr>
<tr>
<td>Forestry</td>
<td>73 300</td>
<td>29.5</td>
</tr>
<tr>
<td>Surface water</td>
<td>4 300</td>
<td>1.7</td>
</tr>
<tr>
<td>Built-up area</td>
<td>25 300</td>
<td>10.2</td>
</tr>
<tr>
<td>Others – eg recreation</td>
<td>23 800</td>
<td>9.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>248 700</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Table 2. Sources of drinking water in the FRG

<table>
<thead>
<tr>
<th>Source</th>
<th>M m²/y</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater</td>
<td>2 661</td>
<td>64</td>
</tr>
</tbody>
</table>
| Surface water:
  bankside filtrate            | 258    |     |
  enriched groundwater          | 417    |     |
  river water                   | 21     |     |
  lake water                    | 150    |     |
  reservoir water               | **295**| **1 141** |
| Spring water                  | 362    | 9   |
| **Total**                     | **4 164**| **100** |
Figure 1

Major aquifers in the Federal Republic of Germany

- Areas with high renewal rates
- ** Areas with variable renewal rates
- + Areas with low renewal rates
In the Rhine Valley extensive use is made of bankside filtration. As the area beside the rivers is also used for intensive agriculture, particularly for special crops such as vines, fruit and vegetables, these waters can be affected by nitrate and pesticides but also by other anthropogenic contaminants originating from the river water.

The River Ruhr provides the water supply for most of the population of the large industrial Ruhr area. The water is abstracted from the river, treated and then passed through the ground before supply to the consumer. Similar treatment is applied to water abstracted from raw-water storage reservoirs. As the treatment of these waters is often only slow sand filtration, problems with pesticides and other organics can occur and the water can pick up iron and manganese during its passage through the ground.

Thus German water resources are prone to similar problems to those encountered in the UK.

2. WATER SUPPLY ARRANGEMENTS IN GERMANY

The homes of approximately 98% of the 62.4 million population of the Federal Republic of Germany (FRG) are connected to the public water supply system, consisting of 6300 public water supply undertakings. The remaining 2% receive their water from a large number of private wells.

The water supply systems are generally operated by the municipalities (local authorities) with the Mayor being responsible for the quality of water supplied, and he has to inform the local health authority if standards are exceeded.
In some cases several municipalities have formed consortia (Zweckverbände) to operate treatment works and trunk mains, with the municipalities operating the local distribution system and undertaking the collection of charges. Often the bulk supply is only used to top up the local sources and to cover peak demand. Each municipality contracts to take up to a certain amount of water and the capital and operating cost contributions are related to the amount of water contracted.

Some municipalities have contracted the supply of water to publicly quoted limited companies such as Gelsenwasser. The municipalities are often shareholders in these companies but do not necessarily have the majority share holding. The chief executive of the company (Prokurist) is personally responsible for the quality of the water supplied and has to inform the local health authority if standards are exceeded.

3. DRINKING WATER LAW

The EC Drinking Water Directive 80/778 has been implemented in the FRG by amending the existing Drinking Water Regulations of 1975. The amended regulations of 22 May 1986 on Drinking Water for Foodstuff Production (Trinkwasserverordnung-Trinkw V) came into force on 1 October 1986.

The legal basis for the Drinking Water Regulations (Trinkw V) is paragraph 11 of the Federal Epidemic Law (Bundes-Seuchengesetz- version 18 December 1979) and paragraph 10 section 1, subsections 1 and 2 of the Federal Foodstuff and Consumer Goods Law (Lebensmittel und Bedarfsgegenständegesetz of 15 August 1974) as drinking water is also considered to be a foodstuff.
The Federal Epidemic Law empowers the Federal Minister for Family Affairs, Youth and Health, with the agreement of the Federal Council (Bundesrat), to issue Federal Drinking Water Regulations. The Federal Epidemic Law, however, provides only the powers to issue regulations to control those parameters detrimental to health, in particular microbiological parameters.

The Federal Foodstuff and Consumer Goods Law provides the basis for controlling those parameters which are of little or no significance for human health but which could lead to the water not being used for drinking because of its appearance or other negative effects. It ensures that drinking water is of "impeccable (einwandfrei) quality".

Before the initial Drinking Water Regulations of 1975 were published the technical guideline (DIN 2000) (modified for the second time in 1959 and several times since) laid down the properties required of drinking water in public supplies. It required that drinking water must be free from pathogens, must not be dangerous to health, must be low in organic dissolved substances and must be appetising, clear, fresh, without colour, smell and taste. These requirements have been incorporated into the Drinking Water Regulations of 1975 and 1986 and are now legally binding. DIN 2000, which still exists, also formulated some technical guidelines for the construction and operation of water treatment plants, which were also incorporated into the Drinking Water Regulations. Another guideline (DIN 2001) set similar requirements for private water supplies.

The long delay between the publication of the EC Drinking Water Directive in 1980 and the translation into German law in 1986 was largely due
to the unwillingness to extend the scope of the regulation to aspects other than health. (It should be noted that the EC Commission did not start any infraction proceedings against the FRG.)

The Drinking Water Regulations of 1986 have two initial sections covering the properties required of drinking water and of water used in food production. It then sets out the obligations of persons in charge of drinking water supplies and the supervisory functions of the health authorities and, lastly, penalties. This layout is more or less identical to that of the 1975 text. Five annexes deal with microbiological analysis methods, limit values for 13 chemical substances and groups of substances, acceptable errors for the determination of certain disinfectant residuals, parameters and limit values relating to assessment of the quality of drinking water (3 organoleptic parameters, 4 physico-chemical parameters and 10 chemical parameters), and lastly, the extent and frequency of monitoring. Thus, the parameters contained in the Drinking Water Regulations are divided into three groups:

Microbiological parameters - laid down in paragraph 1 and their method of determination in Annex 1.

Chemical parameters (toxic chemicals) detrimental to health - Annex 2.


The microbiological parameters listed in paragraph 1 and the chemical parameters given in Annex 2 are controlled under the Federal Epidemic Law as the exceedance of the limit values for these
Figure 2 Control of parameters in the drinking water regulations

Drinking Water Regulations

Parag. 1

Annex 2

1-12 (but not 12 pesticides)

State Implementation Regulations

Annex 4

2, 3, 5, 6

(1, 4, 7 - End)

Water Company

Local Health Authority
parameters is considered to be a potential risk to human health. Annex 4 contains those parameters which are included in the EC Directive only to ensure the general "impeccable" quality of the drinking water. Because of the low significance for health these parameters are controlled under the Federal Food Law. Figure 2 shows a diagrammatic layout of the control of the different parameters contained in the drinking water regulations. The microbiological parameters, the chemical parameters in Annex 2 (excluding parameter 13-pesticides) and parameters 2,3,5 and 6 of Annex 4 are directly controlled by the Drinking Water Regulations, whereas the States (Länder) have the power to change by state regulations the maximum allowable concentrations (MACs) for the remaining parameters given in Annex 4 if this is required because of local circumstances and provided it is not detrimental to human health.

The Drinking Water Regulations also allow the control of chemical substances not listed in the Annexes and of radioactive substances if they are present at concentrations likely to cause a risk to human health. The Drinking Water Regulations contain a "minimisation clause" which requires concentrations of chemical substances "which can contaminate or negatively affect the drinking water to be reduced as far as possible by applying "best available technology" at acceptable cost taking into account the specific circumstances of each case. This clause was introduced to avoid any deterioration in drinking water quality in compliance with Article 11 of the EC Drinking Water Directive.

The following parameters contained in the EC Drinking Water Directive have not been incorporated into the Drinking Water Regulations:
i. Parameters for which no values or only guide values were given in the EC Directive:

Silica, total hardness, dissolved oxygen (saturation), free CO$_2$, total organic carbon, hydrogen sulphide, cobalt, beryllium, vanadium, suspended solids, chloroform extractable substances.

ii. Parameters below analytical detection limit:
Kjeldahl nitrogen, dissolved or emulsified hydrocarbons.

iii. Parameters which are covered by other parameters:

Chloride, calcium, dry residues.

iv. Parameters not incorporated for special reasons:

Taste dilution number, phenol, selenium.

v. Parameters which are covered by the drinking water treatment regulations:

Phosphorus, total hardness, pH, alkalinity.

vi. No toxicologically substantiated limit value:

Boron, copper, zinc, barium, antimony.

In addition the lists of toxic substances in the EC Directive (Annex D) and the German Regulations (Annex 2) are different, nitrate, fluoride and some organo-chlorine compounds having been added to the German list, and selenium and antimony having been omitted. The limit values (MACs) given in the EC
Directive have been adopted for all "toxic substances" except for arsenic (0.04 instead of 0.05 mg/l) and lead (0.04 instead of 0.05 mg/l).

The EC Directive MACs have been adopted for the pesticides and PCBs, PCPs, PBBs and PBTs. However, these MACs do not come into force until 1 October 1989.

Annex 4, which lists the parameters relevant to the assessment of the quality of the drinking water, contains certain parameters listed in Annex 1 of the EC Directive under A (organoleptic parameters), B (physico-chemical parameters) and C (undesirable substances) with the exceptions already discussed.

Values are given for some parameters (e.g. conductivity) for which MACs are not included in the EC Directive, and different values for the MACs are given for some other parameters e.g. for turbidity (1.5 FTU (Formazine units) instead of 4 JTU (Jackson units)) and sulphate (240 instead of 250 mg/l). A footnote to Annex 4 states that short term exceedance of the limits for colour, turbidity, iron and manganese, can be ignored. The Regulations also permit exceedance of the MACs for sulphate, ammonium, potassium and magnesium if the subsoil contains high levels of these substances, and for iron and silver if they are used in the water treatment process.

4. ADMINISTRATION OF THE DRINKING WATER REGULATIONS

Figure 3 shows the supervisory structure for drinking water in Germany. Legislative powers on drinking water lie with the Federal Government, in particular the Ministry of Family, Youth and Health. With agreement of the Federal Council
Figure 3 Supervisory structure and co-ordination of different institutions involved in monitoring drinking water.
(Bundesrat), the Minister for Family, Youth and Health issues the Federal Drinking Water Regulations which must be implemented by the States (Länder) and are applicable in all States except for those aspects of the Regulations specifically delegated to the States (e.g. implementation of Annex 4). Bavaria and Lower Saxony have issued their implementation regulations for the drinking water Regulations, whereas in North Rhine-Westphalia, Baden-Württemberg and Schleswig Holstein the state regulations are still being prepared. Hesse and Rhineland-Palatinate have issued implementation regulations only for Annex 4, whereas Saarland, Berlin, Bremen and Hamburg have so far made no plans for preparing enabling legislation.

Most States had to issue special regulations to specify the authorities responsible for the implementation of the Drinking Water Regulations. In the city States (Hamburg, Bremen and Berlin) the local health departments of the communes are responsible for the implementation of the Drinking Water Regulations. In the other States the district and district-free towns are responsible for the implementation of the Regulations as "lowest" State authorities (and not as self-administering district or town authorities). The health authorities (Gesundheitsämter), which are technical authorities of the district or district-free towns, have major supervisory, regulatory and advisory roles. Because of the different administrative structures of the various States different authorities are responsible in the various States for issuing special dispensation for exceeding limit values (MACs) according to paragraph 4 of the regulations, and these are indicated in Table 3. In the Saarland and
Schleswig-Holstein, which do not have regional administrations (Regierungsbezirke), this power is held by the Ministers for health. In Hesse and Rhineland-Palatinate the regional authorities (Regierungspräsident) are responsible. In the other States the competent authorities are the district administrations and in the city States the commune authorities responsible for health.

In general, water supplies which are owned by several town districts (Stadtkreise) (usually bulk supplies provided by consortia-Zweckverbände) are controlled by the regional administration (Regierungspräsident) whereas water supplies which are wholly owned by district-free towns, co-operatives or communes are controlled by the district administration (Landratsamt).

All other water supplies, e.g. private supplies, are controlled by the lowest administrative authority (Untere Verwaltungsbehörde).

The local health authority (Gesundheitsamt), the water office (Wasserwirtschaftsamt), the lowest water authority (Untere Wasserbehörde) and the public order authority (Ordnungsamt) (which includes the police) are all departments of the district administration (Landratsamt).

Within the district administration, the local health authority is responsible for checking on drinking water quality. The local medical officer, a medical doctor (Amtsarzt), is the head of the local health authority and ultimately responsible for monitoring drinking water quality and for laying down the quality to be achieved.
Table 3. Responsible authorities for the administration of drinking water in the different states of the FRG.

<table>
<thead>
<tr>
<th>Land</th>
<th>Competent Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baden-Württemberg</td>
<td>District (Kreis) authorities, local police authority in the case of §11.1(7) for implementing measures necessary to eliminate pollution and to avoid pollution.</td>
</tr>
<tr>
<td>Bavaria</td>
<td>District (Kreis) authorities.</td>
</tr>
<tr>
<td>Berlin</td>
<td>Health department of local district office.</td>
</tr>
<tr>
<td>Bremen</td>
<td>Local police authority. Health Senator in case of §5.(2) (authorisation to use sea water for the preparation, treatment and cleaning of fish and equipment on fishing boats at sea).</td>
</tr>
<tr>
<td>Hamburg</td>
<td>Health Department of local district offices. Highest Health Authority (of the Land) for public water supply installations.</td>
</tr>
<tr>
<td>Hesse</td>
<td>District presidents (as lowest authority of the government)/magistrates of the district free towns.</td>
</tr>
</tbody>
</table>

Administrative District President in case of §4, §5.3 and §10.2. (authorisation to use drinking water exceeding MACs,
## Table 3. Continued

<table>
<thead>
<tr>
<th>Land</th>
<th>Competent Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>authorisation to use water in foodstuff</td>
</tr>
<tr>
<td></td>
<td>production exceeding MACs and the request</td>
</tr>
<tr>
<td></td>
<td>for additional analysis.)</td>
</tr>
<tr>
<td>Lower Saxony</td>
<td>Rural districts and district free towns,</td>
</tr>
<tr>
<td></td>
<td>independent towns and communes.</td>
</tr>
<tr>
<td>North Rhine-Westphalia</td>
<td>District authorities</td>
</tr>
<tr>
<td>Rhineland-Palatinate</td>
<td>District police authorities. Local district police authority in case of §5.3, §11.1, 2 and 5 (authorisation to use water for foodstuff production which does not meet drinking water MACs and to carry out monitoring at certain places and times or for parameters other than the normal ones).</td>
</tr>
<tr>
<td>Saarland</td>
<td>District presidents (as lowest State authority)/Lord Mayor of the district free towns.</td>
</tr>
<tr>
<td></td>
<td>Minister for family, health and social affairs for §4 and §5.3 (authorisation to use water for drinking and foodstuff production exceeding the MACs).</td>
</tr>
<tr>
<td>Land</td>
<td>Competent Authority</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Schleswig-Holstein</td>
<td>District presidents and mayors of the district-free towns (district health authority).</td>
</tr>
<tr>
<td></td>
<td>Minister for Social Affairs for §4 (drinking water exceeds MACs)-Ministry for Nutrition, Agriculture and Forestry for §5.2 (use of sea water for preparation of fish on boats at sea).</td>
</tr>
</tbody>
</table>
The local medical officer reports for technical advice to the higher medical officer who is at the administrative district level (Regierungsbezirk) or, where this level of administration is missing, to the State medical officer. For administrative matters he reports to the head of the district administration (Oberkreisdirektor) or for district-free towns to the head of the town administration (Oberstadtdirektor). The location of the waterworks, not the distribution system, determines which local health authority is responsible.

The States are responsible for surface water quality which is controlled by the Water Management Law (Wasserhaushaltsgesetz) of 30 September 1986. The lowest water authority at the district (Kreis) level is responsible for the control of discharges to surface waters, although in towns where both the lowest water authority and the drainage department (responsible for discharges to sewers) are offices of the town, the higher water authority at the administrative district (Regierungspräsidium) level is responsible for the control of discharges to surface waters.

The lowest water authority is also responsible for issuing abstraction licences and for the quality of the raw water used for the abstraction for drinking water. It issues permits to allow the water company to analyse the raw water quality.

The water office is available for technical advice to the lowest water authority and to the water company or local health authority. This office carries out inspections of water supply companies.
5. APPLICATION OF THE DRINKING WATER DIRECTIVE

5.1 Responsibility for monitoring

The Drinking Water Regulations (paragraph 8) require that the operator or owner of a drinking water installation must monitor or instruct somebody else to monitor drinking water quality.

The arrangement for the monitoring depends on the water company and the State. Mainly for cost reasons small companies often rely entirely on outside laboratories for both compliance and operational samples. Large companies, such as Gelsenwasser in North Rhine-Westphalia, have a comprehensive self-monitoring programme.

The results of the compliance monitoring carried out by the water company and the independent laboratory are forwarded to the local health authority. For instance Gelsenwasser which has an annual water supply of 296 million m³ sends the results of approximately 80 000 individual analytical results (which also includes raw water analyses) once a year to the local health authorities in its area in the form of computer print outs. None of the local health authorities seems to have the time and manpower to digest the results of the monitoring, especially as drinking water is only a very small part of the duties of the local medical officer.

If self-monitoring is practised, 10% of the required samples for the microbiological parameters are taken by independent laboratories as "compliance" samples and the remainder by the water company. For instance in the case of Gelsenwasser, 10% of the samples for microbiological parameters are taken by the Hygiene
Institute, an independent laboratory, and 90% by Gelsenvasser. Both take two-thirds of their samples at the works and one-third in the distribution system. The distribution samples are taken at treated water service reservoirs and water towers, but also from specially installed hydrants.

In contrast all microbiological samples for the water supply of Karlsruhe are taken by the Engler Bunte Institut, an independent laboratory. Distribution samples are taken from treated water storage reservoirs and water towers but also from taps in public buildings e.g. libraries, town offices, schools.

Each waterworks, including its associated protection zone, is examined every three years by the local health authority with the assistance of the water office (Wasservirtschaftsamt). Safety, plant operation, stand-by equipment such as chlorination equipment, and lids to service reservoirs etc, are checked and water samples can be taken if desired. The findings of the inspection must be submitted to the water company in writing and kept for 10 years.

Every half-year the waterworks is inspected by the health authority. Samples can be taken during the inspection. However, when an independent laboratory (eg the Hygiene Institute) carries out the compliance monitoring, then usually no extra samples are taken during the exercise.

If the local health authority is concerned about the quality of the drinking water it can request whatever analysis it deems necessary. It must, however, provide a reason for wanting the extra analyses.
Health office staff are entitled to enter premises, take samples etc at any time. The cost of all monitoring is borne by the water company.

5.2 Analytical quality control

By the end of 1988 North Rhine-Westphalia is planning to introduce an approval system for laboratories wishing to analyse drinking water. The two State-owned laboratories in Düsseldorf and Münster will be responsible for checking and supervising the laboratories. Each laboratory wishing to analyse drinking water will have to apply to the State for certification.

Baden-Württemberg also has two State-owned laboratories, the Medical Examination Institute (Medizinisches Landesuntersuchungsamt) which analyses for microbiological parameters and the Chemical Examination Institute (Chemisches Landesuntersuchungsamt) which analyses for chemical parameters. These State-owned laboratories again have the function to supervise (by spot visits) the laboratories involved in the analysis of drinking water. They are also responsible for monitoring bulk supplies.

Rhineland-Palatinate, Hesse and Lower Saxony have issued regulations for certification of laboratories wishing to analyse drinking water. These regulations require the laboratories to operate Good Laboratory Practice (as defined by OECD) and to participate in external ring tests. The certification is carried out by the State laboratories.

5.3 Sampling points

Sampling tends to be random in terms of time but fixed in terms of location. The Hygiene Institute (in common with other independent laboratories
taking compliance samples), for instance, has the right to take samples at any time at the works. Distribution samples are usually taken at water towers and service reservoirs, but also at specially installed hydrants or from taps in public buildings such as schools, offices and libraries. If a hydrant is used for taking distribution samples an employee of the water company usually accompanies the employee of the independent institute to install the hydrant. This requires in practice a day's notice but as this is applied only to large distribution systems it is felt that the water company can not influence the water quality in the distribution system during this period.

In 1976, in response to the 1975 Drinking Water Regulations, the monitoring points were decided jointly by the interested parties. For Gelsenwasser, for instance, the lowest water authority, the local health authority, the Hygiene Institute and the water company decided jointly where to monitor. This schedule has not been re-defined since the introduction of the new Drinking Water Regulations in 1986, although minor changes have been incorporated over the years to take into account changes in the water supply system.

5.4 Sampling frequency

The required sampling frequency is given in Annex 5 of the Regulations. Table 4 shows the sampling frequency required for "current monitoring" (C2 monitoring) which is restricted to the microbiological parameters (E. coli, total coliforms and plate counts), the aesthetic parameters (turbidity and colour), conductivity and measurement of residual disinfectant. If continuous monitoring of conductivity and residual
Table 4. Comparison of Sampling Frequencies with FRG with those specified in the EC Directive

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Population 1</th>
<th>10,000</th>
<th>50,000</th>
<th>100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>EC Disinfected</td>
<td>Non-Disinfected</td>
<td>EC Disinfected</td>
</tr>
<tr>
<td>Taste (Qualitative)</td>
<td></td>
<td>12</td>
<td>-</td>
<td>60</td>
</tr>
<tr>
<td>Odour (Qualitative)</td>
<td></td>
<td>12</td>
<td>48</td>
<td>24</td>
</tr>
<tr>
<td>Turbidity capacity</td>
<td></td>
<td>12</td>
<td>48</td>
<td>24</td>
</tr>
<tr>
<td>Conductivity</td>
<td></td>
<td>12</td>
<td>48</td>
<td>24</td>
</tr>
<tr>
<td>Residual 2</td>
<td></td>
<td>12</td>
<td>365</td>
<td>-</td>
</tr>
<tr>
<td>Chlorine or chlorine dioxide</td>
<td></td>
<td>24</td>
<td>48</td>
<td>24</td>
</tr>
<tr>
<td>coli E coli</td>
<td></td>
<td>24</td>
<td>48</td>
<td>24</td>
</tr>
<tr>
<td>total coliforms</td>
<td></td>
<td>24</td>
<td>48</td>
<td>24</td>
</tr>
<tr>
<td>C2</td>
<td></td>
<td>3</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>Taste and odour (Quantitative)</td>
<td></td>
<td>3</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>Temperature 3</td>
<td></td>
<td>3</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>p4</td>
<td></td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Nitrate 4</td>
<td></td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Nitrite 4</td>
<td></td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Ammonia 3</td>
<td></td>
<td>3</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>6</td>
<td>48</td>
<td>24</td>
</tr>
<tr>
<td>bacterial counts 22°, 37°</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Population assumes a water consumption of 200 l/person/day.
2. Spot sampling not required if continuous monitoring is carried out.
3. Competent authority lays down frequency of monitoring.
4. Nitrate and nitrite are parameters of Annex 2 for which periodic monitoring is required which is once/year for populations <13700 and twice/year for populations>13700.
disinfectant is practised, spot sample monitoring is not required. However, monitoring for nitrate, nitrite and ammonia is not included in the list of parameters requiring C2 monitoring, whereas turbidity has been added.

The German Drinking Water Regulations do not contain a separate listing for "minimum monitoring" frequency (C1 monitoring). In agreement with the requirements of the EC Directive monitoring frequency for disinfected water is twice that for non-disinfected water. The sampling frequency in the German Regulations for the parameters requiring "current monitoring" is twice that laid down in the EC Directive. The sampling frequency is based on the amount of water supplied (1 sample for each 30 000 m³ non-disinfected water and 1 sample for each 15 000 m³ disinfected water supplied) rather than population served.

Parameters 1 to 12 listed in Annex 2 (toxic chemicals), which include nitrate, nitrite but not ammonia, must be monitored once a year for works smaller than 2.7 Ml/d and twice a year for works larger than 2.7 Ml/d unless the relevant authority requires a different monitoring frequency. The monitoring is carried out by independent laboratories and the samples are taken at the works outlet. In addition operational samples are taken by the water company. The frequency depends on the size of the supply and the water company.

The monitoring frequencies are not laid down for parameter 13 (pesticides) of Annex 2, parameters 1,4 and 7-17 in Annex 4 or any other parameters requested by the competent authorities. The competent authority decides which of these parameters need to be monitored and at what
frequency but must state why the monitoring is required (apparently so far no local health authority, the competent authority, has dared to request monitoring).

Monitoring for Trihalomethanes (THMs) is specified under the regulations governing the chemicals which can be added for the treatment of drinking water (Trinkwasseraufbereitungs- verordnung). Guidelines for THM recommending a limit value of 25 µg/l for total THMs expressed as annual mean concentrations have been issued by the Federal Health Office (Bundesgesundheitsamt).

The number of samples taken for operational reasons varies widely for the different parameters. Iron is analysed frequently but there is no requirement to report exceedance of the MAC to the local health authority. The main incentives for action are consumer dissatisfaction/complaints.

5.5 Action taken when a sample fails to meet the MAC

The German Drinking Water Regulations use the term "limit value" (Grenzwert) rather than "maximum admissible concentration". For chemical parameters the limit values are defined as maximum values as in the EC Directive. For microbiological parameters the limit value is exceeded if E. coli are found in any water sample. For total coliforms the limit value is exceeded if more than 2 samples out of at least 40 contain coliforms. This is equivalent to the EC requirements (95%-ile compliance). Internally any exceedance of the limit value is treated as a failure. Externally only 95% exceedance is reported which for small works means that any exceedance is reported. For plate counts only continuous deterioration needs to be reported.
The operator or, in general, the owner of a water supply installation must inform the local health authority if a limit value is exceeded. It is a serious offence if failures are not reported and the person responsible for the water supply can be prosecuted personally. Any changes in the water quality, or any unusual occurrence in the catchment area or the plant itself which could lead to a risk to health from the consumption of the water, must also be reported to the local health authority.

Any microbiological failures must be reported immediately, even at weekends, by phone to the local health office together with steps taken to remedy the problem.

The local health authority can request remedial measures such as an increase in the chlorine dose, flushing of distribution system or, in extreme cases, can issue an order to the consumers to boil the water.

The public order authority (Ordnungsamt, which includes the police department) has the power to close down a waterworks on advice from the local medical officer and to impose fines for non-compliance with instructions. To save time, however, the medical officer can instruct the water company directly to shut down a works but the public order authority must still issue subsequently an official closure notice.

Closing down of a works is only ordered if alternative supplies can be provided. If no alternative supply is available it is considered to be more important to continue the supply of water to maintain hygiene standards to safeguard the population against water-borne disease than to
discontinue the supply. The population can be protected by boiling the water or by using bottled water.

The local health authority can conduct supplementary investigations as to the reasons for the failure. In the case of Gelsenwasser, the Hygiene Institute is contracted to investigate the reasons for any microbiological problem. It must continue sampling until it is satisfied that the quality is acceptable again. The results of the investigation must be forwarded to the local health authority.

Iron and manganese have no hygienic relevance. There is therefore at present no legal requirement to make improvements in respect of these parameters. The presence of iron and manganese can, however, lead to consumer complaints. For substances listed in Annex 4 (except parameters 2, 3, 5 and 6) the main response of the water companies is to satisfy the consumer and therefore improve its image rather than to meet the MAC.

The Drinking Water Regulations allow the competent authority (usually the local health authority) to permit, for a limited time and up to a maximum value, the limit values laid down in the Regulations for parameters in Annex 2 to be exceeded provided this does not constitute a health risk. Permission is only granted if the request contains an improvement plan for meeting the limit value within a specified time period. The consumer must be informed if values are being exceeded.
The Federal Health Office (Bundesgesundheitsamt) makes recommendations based on toxicological considerations by how much the limit value may be exceeded; these are used by the local health authorities for issuing derogations.

The responsibility of the water company ends at the water meter. The lead problem is therefore not truly addressed by the drinking water regulations. If a consumer has a lead pipe, the water company would recommend flushing before use of water or pipe replacement. The addition of any new chemical to the drinking water (eg phosphate to control lead) must be published in the local press and gazette.

6. WATER QUALITY PROBLEMS IN THE FRG

The two parameters causing most problems in Germany are pesticides and nitrate. Turbidity, taste and odour, pH, conductivity, iron, manganese and lead are of less importance. For the latter three parameters the Regulations do not require measurement of these parameters, particularly not at the tap. In addition temporary exceedance of the iron and manganese parameter is permitted in the Regulations.

6.1 Pesticides

Delays are in force in Germany for the pesticide parameter until 1 October 1989, justified by the fact that for many of the pesticides used in Germany analytical methods with adequate detection limits are not available. The Federal Health Office (Bundesgesundheitsamt) has issued a list of 17 pesticides (see Table 5) which should be analysed in groundwater unless it is known that they are not used in the catchment. In addition
Table 5. Pesticides and main degradation products requiring monitoring if they are used or found in groundwater catchment areas
(Proposal-Federal Health Office)

The following pesticides should be monitored if they are used in the catchment area.

1 Aldicarb
2 1,3-Dichloropropene
3 Mecoprop
4 Atrazine
5 Sebutylazine (Secbumeton)
6 Terbutylazine
7 Simazine
8 Cyanazine
9 Metazachlor
10 MCPA
11 2,4-D
12 Chlorotoluron
13 Metobromuron
14 Metoxuron
15 Monuron
16 Lindane
17 Bentazon
18 Isoproturon
19 Endosulfan (surface waters only)

The following main degradation products should be monitored if the relevant pesticides are found in groundwaters.

<table>
<thead>
<tr>
<th>Pesticide</th>
<th>Main degradation product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aldicarb</td>
<td>Aldoxy carb and</td>
</tr>
<tr>
<td></td>
<td>Aldicarbsulfoxide</td>
</tr>
<tr>
<td>Metazachlor</td>
<td>2,6-Dimethylaniline (=2,6-Xyldine)</td>
</tr>
<tr>
<td>MCPA</td>
<td>2-Methyl-4-Chlorophenol</td>
</tr>
<tr>
<td>2,4-D</td>
<td>2,4-Dichlorophenol</td>
</tr>
<tr>
<td>Chlorotoluron</td>
<td>5-Chloro-p-Toluidine</td>
</tr>
<tr>
<td>Metobromuron</td>
<td>para-Bromoaniline</td>
</tr>
<tr>
<td>Metoxuron</td>
<td>3-Chloro-4-Methoxyaniline</td>
</tr>
<tr>
<td>Monuron</td>
<td>para-Chloroaniline</td>
</tr>
<tr>
<td>Linuron</td>
<td>3,4-Dichloranilin</td>
</tr>
</tbody>
</table>

The following main degradation products should be analysed if it is known that the relevant pesticides are used in the catchment area.

<table>
<thead>
<tr>
<th>Pesticide</th>
<th>Main degradation product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pendimethalin,</td>
<td>Nitroaminoaromatics</td>
</tr>
<tr>
<td>Trifluralin</td>
<td>Nitroaromatics</td>
</tr>
<tr>
<td></td>
<td>Aminoaromatics</td>
</tr>
<tr>
<td>Alachlor</td>
<td>2,6-Diethylaniline</td>
</tr>
<tr>
<td>D N O C</td>
<td>Diarnino-o-cresol[, Nitroamino-o-cresol]</td>
</tr>
<tr>
<td>Anilazine</td>
<td>2-Chloroaniline and Triazine residues</td>
</tr>
</tbody>
</table>

B30
the list contains the main pesticide degradation products which should be analysed if certain pesticides are found in groundwaters or if it is known that certain pesticides are used in the catchment. In addition the German Drinking Water Commission is preparing guidelines for the local medical officers on 'safe' concentrations of pesticides based on toxicity data. These guidelines are intended to assist the local medical officer to decide what action is required after 1 October 1989 when the delay expires. It is not envisaged that by that date all water supplies will be able to comply with the pesticide parameter but that an extended transition period will be required (perhaps up to 10 years).

Discussions are also currently being held in Germany on whether to ban all pesticides likely to exceed 0.1 μg/l in groundwaters by not approving new pesticides and by refusing renewal of the approval of existing pesticides which could enter groundwaters in significant quantities. In addition a list of pesticides which are permitted to be used in water protection zones has been published (see discussion on protection zones).

6.2 Nitrate

At present interim regulations for nitrate are in force. The final decision on the suitability of the drinking water for public supply, however, rests with the local medical officer. To assist the local medical officer the Federal Health Office (Bundesgesundheitsamt—Bundesgesundheitsblatt 29(6) 6 June 1986) has issued guidelines which recommend that, if the MAC of 50 mg NO₃/l is exceeded, derogations can be issued for a limited period according to paragraph 4 of the Drinking Water Regulations for drinking waters containing up to
90 mg NO₃/l. The derogations must contain improvement plans to meet 50 mg NO₃/l in the future.

The attitude of the local health officers to nitrate in drinking water, however, varies apparently widely. For instance, one local health officer insisted that bottled water should be made available to infants because the drinking water was found to contain 51 mg/l of nitrate. The bottled water is supplied free of charge by the local health authority.

The actions required for dealing with the nitrate problem vary in the different States. Whereas in Hesse and Lower Saxony the operator must inform the consumer that the water exceeds the limit value, in North Rhine-Westphalia this information is published by the health authorities and in Bavaria the Ministerial order simply states that this information must be given. In Hesse, the authorisation to exceed 50 mg/l nitrates is limited to 2 years whereas the other States do not have specific time limits. Only the Hesse order explicitly states that derogations cannot be granted for water with a nitrate concentration exceeding 90 mg/l. In Lower Saxony, Rhineland-Palatinate and North Rhine-Westphalia water may be supplied above 90 mg/l nitrate but all take-off points must be labelled "water unfit for drinking - consumption may harm health". In Bavaria this requirement is only applicable to private and individual supplies.

6.3 Protection zones

Water protection zones have been in existence in Germany for many years. The Federal Water Resources law (Wasserhaushaltsgesetz 5th amendment
1986) provides the legal means to control agricultural activity in water protection zones especially the control of nitrate and pesticides, the parameters which pose the greatest problems in terms of meeting the Drinking Water Regulations in Germany.

In Baden-Württemberg new regulations have been published regulating the activities and compensation payments in water protection zones. These regulations allow the restriction of the use of fertilisers in water protection zones (none of the earlier water protection regulations in the FRG included provisions to control nitrate). As the water protection zones usually do not cover the total catchment areas of groundwater supplies (aquifers), it is envisaged that the water protection zones will be expanded and the farmers will be persuaded to apply good agricultural practice in those areas of the catchment not covered by the protection zones. Compensation is being paid to farmers for loss of yield resulting from the restrictions imposed on the use of fertilisers. Annex 2 of the regulations provides also a list of the pesticides which can be used in water protection zones. Compensation for having to use potentially more expensive pesticides is included in the lump-sum payments farmers receive for restricting the application of nitrate and for using approved pesticides. If farmers believe they are entitled to higher compensation payments they have to provide detailed evidence as to extra costs and reduction in income incurred by complying with the regulations (see detailed discussions on protection zones in Report PRS 1849-M/1)

In North Rhine-Westphalia the State water law is being amended to allow water companies to ban the application of certain pesticides in water
protection zones. The water company will, however, have to pay compensation. Compensation will be based on the difference in costs between the previously used pesticide (e.g. atrazine is being banned in water protection zones) and the cost of the 'new' easily degradable pesticide, which is allowed to be used in water protection zones. The head of the administrative district (Regierungspräsident) will decide on the amount of compensation. The water law will also provide powers to restrict fertiliser application in water protection zones.

7. PUBLIC AVAILABILITY OF INFORMATION ON DRINKING WATER QUALITY

The detailed results of the monitoring are usually not available to the public. On request Gelsenwasser, for instance, provides a summary sheet giving the annual average concentration of the compliance and operational samples. However, the public is legally entitled to see during the day those analytical data related to chemicals added for the treatment of water.

The local health authority has access to results for operational samples if required. They are kept for 10 years. According to Gelsenwasser no such request so far has been made, probably because the authorities receive most of the data already.

The annual reports of the water companies also provide summary data of the water quality supplied.

8. WATER TREATMENT TECHNOLOGY

The aim in the FRG is that all drinking water should be of a quality equivalent to uncontaminated groundwater. Advanced treatment using ozone and
activated carbon has therefore been applied to most surface water sources, including bankside filtrate, likely to be contaminated with anthropogenic compounds and surface water is generally passed through the ground after treatment before supply to the consumers. Groundwater usually receives no treatment and is often not even chlorinated. Thus any contamination present in groundwater is not removed. To avoid having to install treatment on large numbers of groundwater sources, the general aim in the FRG is to prevent contamination of the groundwater by controlling the activities in the catchment areas of the groundwater sources.

Water treatment to remove nitrate is considered in the FRG as a last resort and there is also a strong feeling in Germany against installing carbon treatment for the removal of one or two pesticides. It is felt that to introduce substance-specific treatment would create a precedent and would provide no incentive to control the substance at source.

However, one water company, Gelsenwasser, is considering spending £33 million for activated carbon treatment at one of their largest works (Haltern) mainly to control atrazine. Hopefully to avoid having to spend these large sums, the head of the administrative district (Regierungspräsident) of Münster issued an order on 13 April 1987 banning the use of all registered water-threatening pesticides (including atrazine) in the 900 km² catchment area of the works. The courts have set aside the ban on appeal by the farmers because of the timing (the pesticide parameter comes into force only on 1 October 1989) rather than the principle. The appeal will be heard soon. The reason for considering applying carbon treatment is
the fear that the company may be taken to court for supplying water exceeding the standard for a "toxic" chemical.

9. PENALTIES

Operators or owners of water supply plants who intentionally or negligently supply water exceeding the microbiological parameters (total coliform and E. coli) and disinfectant residues, and the chemical parameter values of Annex 2, may be fined or imprisoned for up to two years.

The operator or owner of a supply plant can also be fined up to DM 50 000 if he intentionally or negligently fails to meet his obligations to notify the authorities that values have been exceeded or fails to conduct analyses, submit analysis reports or co-operate with supervisory authorities.

A fine of up to DM 50 000 may also be imposed if the values of the parameters laid down within Annex 4 of the Federal Regulations or amended by State regulation are intentionally or negligently exceeded.

No prosecutions have so far been reported.

10. STATUS OF PRIVATE SUPPLIES

Individual or private supplies are in principle subject to the same regulations as public supplies according to the definition of water supply plants in §6 of the Drinking Water Regulations. Only the monitoring frequencies tend to be different as private supplies rarely exceed 1000 m³ of water per annum.
Although the frequency of monitoring is specified in Annex 5 of the Drinking Water Regulations, the Regulations permit the competent authorities to lay down less frequent monitoring. For the chemical, physico-chemical and organoleptic parameters of Annexes 2 and 4, the competent authorities decide whether monitoring has to be conducted and, if so, for which parameters and how often.

The Health Authorities are not really able to supervise the large numbers of private supplies because of lack of staff and resources. The information obtained from the competent authorities seems to indicate that in some regions there are no inspections at all. The obligation of the owner of the supply plant to notify the authorities if values are exceeded is only rarely applied because of the lack of monitoring. No derogation can be granted in these circumstances and it may well be that the values for microbiological parameters or nitrates in particular are exceeded in some cases without anyone knowing.

Owners of private sources are unwilling to monitor the quality of their water because of the cost of the monitoring and fears of having to improve the supply. The conviction that the water from one's own well which has been used for generations cannot be bad also plays an important role.
APPENDIX C

THE EC DRINKING WATER DIRECTIVE IN FRANCE
1. WATER RESOURCES IN FRANCE

Of water supplies in France 32% are derived from surface waters and 68% from groundwater. The north-eastern and central parts of France are supplied from chalk and limestone aquifers like those in East Anglia and parts of the Severn-Trent area in the UK. These are susceptible to contamination by agrochemicals. The movement of a contaminant front through the unsaturated zone to the water table may take from a few years to decades.

The geology of Brittany resembles that of the south-west of the UK but there are shallow aquifers in the shale which are sometimes used for supply. These have a relatively rapid recharge rate but are subject to contamination from the intensive smallholding/market gardening type of agriculture favoured in that region.

In the Paris region extensive use is made of abstractions from lowland rivers such as the Seine, the Marne and the Oise. These rivers receive sewage and industrial discharges and are subject to accidental pollution incidents.

There are also regions of France such as the Vosges, where the water sources are soft and aggressive.

From this it can be seen that French water resources are prone to broadly the same kinds of problems as are encountered in the UK.
2. WATER SUPPLY ARRANGEMENTS IN FRANCE

Municipalities (local authorities) are responsible for water supply. The Mayor is the individual responsible for ensuring that quality standards are met. Often a number of municipalities will form a syndicate for water supply, sharing the cost between them. In this case they must appoint a chairman of the syndicate who will be responsible for water quality. Some 40% of municipalities and syndicates have elected to sub-contract the water supply to a private company, usually one of the three largest, the Compagnie Générale des Eaux (CGE), Lyonnaise des Eaux (LDE) and SAUR. Each contract is negotiated separately and may differ from others in a variety of ways, such as in the ownership of assets, although there are usually certain common features. The Maire of the municipality, or the chairman of the syndicate, remains ultimately responsible for ensuring compliance with water quality legislation even when the supply is sub-contracted.

In these circumstances the contracted company nevertheless has a considerable interest in the way in which legislation is implemented and interpreted.

The companies do not seem to be highly centralised and autocratic but, on the contrary, each supply contract imparts a fair degree of autonomy.

3. DRINKING WATER LAW

The Drinking Water Directive is not yet formally implemented in France although the new decree is expected to be finally approved by ministers and published in the autumn 1988. It has been delayed

Under the new decree, any use of water taken from the natural environment for consumption must be authorised, unless it is for the personal use of a family when it is subject only to declaration. The authorisation will be granted by Prefectoral order, following consultation with the Health Council of the Département or the Higher Public Health Council in the case of large-scale projects, in accordance with criteria which will be laid down in a Ministerial order. This authorisation replaces the catchment authorisation needed previously. In addition the establishment or modification of any public water supply plant will need to be declared to the competent authorities.

Water must not be likely to place the health of those who consume it at risk. This principle, stated in the Public Health Code and the existing (1961) decree, is incorporated into the draft decree. It must also satisfy the quality requirements listed in an annex to the new decree.

Individual limits for substances are contained in an annex to the decree arranged almost as in the Directive but with pesticides and allied products separated out. In most cases the text states that the levels of the substances in drinking water must be less than or equal to the values given. No guide levels are included. More stringent limits are given for colour (15 mg/l) and turbidity
Kjeldahl nitrogen has a limit of 2 mg/l rather than 1 mg/l as in the Directive. MACs are omitted for potassium and total bacterial counts in closed containers. National values have not been included for six parameters - conductivity, calcium, substances extractable in chloroform, boron, suspended solids and barium - but values are included for the remaining six.

In addition to the limit for total polycyclic aromatic hydrocarbons at 0.2 µg/l a separate limit of 0.01 µg/l is given for benzo (3,4) pyrene. For pesticides the limits of 0.1 µg/l and 0.5 µg/l for individual substances are given as in the Directive, but additionally limits are given for aldrin and dieldrin (0.03 µg/l) and hexachlorobenzene (0.01 µg/l). PCB and PCT are listed separately with a limit of 0.5 µg/l.

Drinking water legislation and quality monitoring are the responsibilities of the Ministry of Health but distribution is the responsibility of local authorities whose interests are represented by the Ministry of the Interior. The Ministry of Agriculture is responsible for certain categories of supply to small rural agricultural communities and the Ministry of Finance has an interest in the charging system.

France is divided into 99 départements each having an elected Conseil Général and its own budget. Within the départements are Communes with a locally elected Conseil Municipal headed by the Maire. Within each département a Prefect (renamed Commissaire de la République) carries out the function of the State and each of the Ministries, including the Ministry of Health, is represented in his Prefecture.
Over the years more power had become invested in the state and was held increasingly by non-elected individuals. This was a source of growing discontent and in 1986 the relative powers and responsibilities of the state and local authorities were re-defined. A number of responsibilities were transferred to the Conseils Généraux or to the Maires from the state and the size of the Prefect's department was reduced.

Water quality, however, remains the responsibility of the state and the Direction Départementale de l'Action Sanitaire et Sociale (DDASS) under the Prefect must monitor water quality and assess compliance with legislation. DDASS takes decisions on the procedure to be followed when standards are infringed.

4. APPLICATION OF THE DRINKING WATER DIRECTIVE

4.1 Responsibility for monitoring

Under the new decree the operator is responsible for supervising water quality and for "permanent monitoring". Compliance monitoring is laid down in the decree as a minimum specification but the Prefect may modify the programme or order supplementary analyses. Compliance samples are taken by DDASS and the analyses are carried out by authorised laboratories. Analysis costs are borne initially by the operator; tariffs will be laid down by an order and there is the possibility of obtaining refunds from the state. Permanent monitoring is not specified in detail in the decree and is left to the discretion of the operator. Results are made available to DDASS on request.

DDASS may use its own regional laboratory if it has one but is quite likely to sub-contract the work to a nominated laboratory. In the Vosges region 75%
of the work goes to one laboratory and the remainder elsewhere on the principle of "not putting all the eggs in one basket". The local director feels that sub-contracting gives him more flexibility. The regional laboratories are partly responsible for regional analysis but also have the task of co-ordinating municipal laboratories.

In the event of a problem, such as exceedance of the MAC, the supplier may have to provide as much data relevant to that parameter as DDASS requires.

Nationally the Ministry of Health is responsible for setting standards; below this is the regional authority and at the bottom is the local DDASS, who have to take decisions on quality.

CGE are not very satisfied with the existing responsibilities for monitoring. They have greater confidence in their own analytical laboratories but would accept having to use third party self-monitoring. They feel strongly that real control must rest with the supplier, who has the greatest vested interest in maintaining water quality and the best knowledge of the system.

The DDASS units vary greatly in quality and approach throughout France. In Vosges the local head of the water section of DDASS regularly visits the water treatment plants and abstraction points in his area and expects to be thoroughly familiar with local conditions since he regards this as essential in making decisions relating to water quality problems.

This is not necessarily a reliable particular case on which to generalise but a conflict between the
highly involved DDASS technical personnel, who are usually sanitary engineers, and the more system-oriented superiors may be resolved differently in different areas. This could account for the views expressed by CGE personnel.

4.2
Analytical quality control

There does not seem to be a nationwide system of AQC. The regional laboratories are responsible for co-ordinating the laboratories in their region and they distribute check samples where there is evidence of analytical problems. Laboratory staff at the University of Nancy, which was visited and which is the main contractor to the Vosges DDASS, gave only a vague reassurance when asked about AQC.

The central laboratory of CGE carries out checks on their own laboratories and the public laboratories, and also distribute check samples, but they too have no formalised AQC system.

4.3
Sampling points

These are specified in the decree and include sampling from raw water sources, ex-works and in distribution. In principle the water is sampled partly at fixed points and partly at random. Ideally the sampling point should be as close to the meter (the curtilage) as possible but few meters have adjacent sampling points. In practice the DDASS staff tend to sample at the same places as a matter of convenience. They have great difficulty in sampling at consumers' taps because of problems of access. They rely heavily on sampling at the houses of retired people and make use of public buildings, such as schools, and drinking fountains. One consequence is that samples taken, for example from a school during
vacation time, inevitably reflect the condition of the internal plumbing system rather than the supply.

4.4 Sampling frequency

Frequencies are laid down in Annex 2 of the decree which is based upon Annex 2 of the directive. Substances are divided into microbiological and physico-chemical parameters. These are further divided into sub-groups which are then allocated to raw water, ex-works and distribution system measuring points. Further tables relate frequency of measurement in distribution or raw and treated water to population served and volume delivered respectively. For the parameters for which frequencies are laid down in the Directive, the French regulations generally meet or exceed the Directive's requirements, with the exception of total coliforms generally and taste and odour measurement at low populations.

4.5 Actions taken when a sample fails to meet the MAC

Under the decree derogations may be granted by Prefectoral order, after consultation with the Department of Health Council, for parameters which qualify under Articles 9 and 10 of the Directive.

These are for a limited period in the case of exceptional meteorological conditions and emergencies and all derogations carry a maximum limit which is determined locally.

There is a widespread recognition now that cutting off the water supply creates problems, including loss of supply to hospitals, fire fighting etc, air locks, pressure drop leading to infiltration and subsequent bacteriological problems which are, in
almost all cases, far worse than carrying on
supplying water which is in breach of the
Directive. Cutting off the water is thus now very
much a last resort.

According to the decree all exceedances must be
notified to DDASS. Current practice is that a
single value of a parameter which exceeds the MAC
is recorded but does not have to be reported. The
MAC is not necessarily taken as an action level. A
supply for which one parameter hovers around the
MAC, occasionally exceeding it by no more than 10%,
would not necessarily involve remedial action. On
the other hand a supply for which a parameter was
showing a steady increase, even if its value was
well within the MAC, would be investigated and the
cause identified so that, if possible, the rise
could be checked before the MAC was exceeded.

In practice if a parameter exceeds the MAC for two
samples in succession DDASS must decide whether the
supply can be allowed to continue. In nearly all
cases there is no risk to health and the supply is
not cut off. A temporary derogation can be granted
and a programme of amelioration may be agreed which
must be completed to an agreed timetable. If for
any reason the timetable should slip the derogation
would be extended. When a derogation is issued the
public must be informed and this is done by placing
a notice on the bulletin board at the Prefecture.

The only parameter for which there are formal
written rules governing the issuing of derogations
is nitrate. These are described in another report
(WrC Report No PRD 1849-M). At nitrate
concentrations between 50 mg/l and 100 mg/l nursing
mothers and infants must be warned not to drink the
water and above 100 mg/l the general populace must be warned not to drink it. For other parameters the circumstances under which derogations may be issued are left to the discretion of the DDASS.

In allowing derogations the DDASS official has access to advice from local medical authorities, his own contacts and the Conseil Départementale d'Hygiène.

Pesticides and fluoride present a more intractable problem and there are no satisfactory methods of removing them by treating the water. Programmes of amelioration may not be possible in the short term and derogations may be more enduring than for other parameters. CGE suggested that Product Liability Legislation (PLL) may prove to be a greater spur to improving water quality than the Drinking Water Directive.

4.6 Penalties

Article 46 of the Public Health Code sets out penalties of imprisonment of 11 days to one year and/or fines of FF 500 to 30 000 for any person supplying water which is unfit for consumption or any licensed concern failing to monitor the quality of the water supplied.

The decree of 1 August 1961 (Article 15) states that the operating authorisation can be suspended or withdrawn if "the quality of the water, the operating conditions or the layout of the plant are not in line with the terms of the decree".

The new decree, which repeals the 1961 decree, contains no specific provisions on administrative sanctions. Even in the absence of specific
provisions, however, the withdrawal of an authorisation is always possible since general administrative law is applicable.

The civil liability of water suppliers has been called into question – undoubtedly one of very few such cases – in proceedings between one of the largest supply companies and consumers. The values of some parameters were exceeded on several occasions over a number of years. The Court of Appeal awarded damages of FF 3000 to each inhabitant in 1986 on the grounds that there was a contract between these inhabitants and the company. No health disorders could be proved.

4.7 Pollution incidents

France makes extensive use of lowland surface waters which are vulnerable to pollution incidents. In the past it was forbidden to supply water which exceeded the MAC for any parameter but the problems caused by cutting off the supply were so great that this rule was relaxed. Subsequently DDASS were able to allow the supply to be maintained subject to suitable warnings to the public. Even this created difficulties, however, because the supplier was not always able to contact the DDASS officials when an incident occurred at night, during the week-end and over holiday periods.

More recently, therefore, the water suppliers have secured a concession under which, following a pollution incident, the supplier may continue to distribute water at his own discretion for up to 6 hours, providing he is confident that there will be no risk to public health, although he must inform DDASS. After this period DDASS must either issue clear instructions or permit the supply to
continue. (This information was supplied by CGE personnel and it is not clear how universally this dispensation is used.)

Monsieur P Schuhof, Chairman of the Water Distribution Commission, has summarised the French position regarding the procedure to be used in the event of a major pollution event affecting a source used for public supply - "The decision to distribute water which is not potable in the sense of prevailing standards, but undoubtedly consumable without danger, or to the more serious decision to stop supply..... would not be taken on the basis of fixed mathematical criteria but on the basis of a complete analysis of the situation..... Water distributors, far from wishing to acquire direct responsibility in these decisions, would like to see relatively specific rules enabling them to take decisions in the field and at all times, in accordance with the security and well-being of all."

4.8
Particular water quality problems in France

These can be categorised as natural, man-made short term and man-made long term.

Natural

Temperature. Exceedance of the temperature maximum is of no significance to health but warm water is considered objectionable on aesthetic grounds. In parts of continental Europe some supplies derived from surface waters inevitably fail the temperature parameter in summer. In France the situation is exacerbated by the presence of power stations discharging cooling water upstream of some abstraction points for potable supply.
There is no practicable solution to this problem since it would be prohibitively expensive to install refrigeration equipment, especially for a seasonal problem.

**Fluoride.** Some water sources in France naturally contain fluoride at concentrations up to, and occasionally in excess of, the fluoride MAC of 1.5 mg/l.

Water cannot be supplied in France if the level exceeds 4 mg/l but may be used in special circumstances if the level is between 1.5 and 4.0 mg/l, subject to certain restrictions and providing the public are informed.

There is no practicable method of removing fluoride during conventional water treatment.

There is an additional complication in France in that if the concentration of fluoride in the supply is below 0.5 mg/l retailers sell fluoridated salt, whereas if the level is above this they may not. Inevitably there are supplies in which the concentration hovers at about 0.5 mg/l and analytical error ensures that recorded monthly values alternately fall above and below 0.5 mg/l, leading to an impossible situation as far as the distribution of fluoridated salt is concerned. The authorities are seeking a more workable definition of this limit.

**Aggressivity.** The aggressivity of soft waters can be reduced by simple treatment but soft water areas are also often characterised by the existence of a number of small supplies which are untreated because of their size and inaccessibility. A
number of such supplies fail to comply with the Drinking Water Directive. For example in a report dated 1986 1.9% of the population of Champagne Ardennes, 9.6% of the population of Lorraine and 21.9% of the population of Alsace received water which failed the Directive in respect of aggressivity.

Other inorganic ions. A small proportion of supplies fail to meet the MAC for sodium, manganese, iron, chloride and sulphate but in the three regions referred to above only around 1% of the population are affected and there are no health risks so that derogations would be in order.

Man-made short term

Pesticides. The contamination of surface waters by atrazine, occasionally at levels in excess of the MAC of 0.1 µg/l, is considered to be short term because the source can, in principle, be found and dealt with.

Bacteria. The report referred to earlier states that in the Champagne Ardennes region 4.5% of the population receive water from supplies for which more than 60% of the samples fail the bacteriological parameter and 8.8% receive water from supplies for which 30-60% of samples fail. For the Lorraine region the figures are 0.6 and 3.2% and for Alsace 0.2 and 1.1% respectively.

The origin of these organisms is not discussed but the report quotes an epidemiological study carried out by the Ministry of Health as showing that there are twice as many cases of gastroenteritis in "bad
water" areas as in areas where the quality of the water is satisfactory.

Maps show that the areas principally affected do not coincide with the areas affected by aggressivity where the water is soft.

**Man-made long term**

**Nitrate.** This has been the subject of a separate report (PRD 1849 M). Nitrate is the only parameter for which France has a formal protocol in respect of derogations.

Less than 0.04% of the population receive water with more than 100 mg nitrate/l, about 1.25% water with between 50 and 100 mg/l and about 1.5% water with an average concentration between 40 and 50 mg/l (but which occasionally exceeds 50). The public must be advised that pregnant women, nursing mothers and children should not consume the water when it contains between 50 and 100 mg/l nitrate, and that no-one should drink it when the concentration exceeds 100 mg/l. The supplier may continue to distribute the water providing there is a plan for improvement within 5 years.

Source replacement is used wherever possible but in some cases it has been necessary to install denitrification plant, the price of which is borne by the consumer. A protection zone policy is in force and in parallel a national propaganda campaign is aimed at persuading farmers to adopt practices which will reduce the quantities of nitrate which reach groundwater. Despite this there is still in many regions a rising trend in
groundwater nitrate concentration as a result of historical agricultural inputs.

Solvents. The contamination of groundwater by solvents used for dry cleaning, degreasing and similar applications is now common in aquifers underlying urban areas. There are few cases where levels have approached the MAC of the Drinking Water Directive but concentrations are still rising.

Pesticides. The Directive MAC is applied as an absolute formal limit. The Bureau des Recherches Géologiques et Minières (BRGM) say that pesticides are not found in groundwaters but, in a response on behalf of France to a questionnaire circulated prior to a seminar organised by the European Institute for Water at Como on 5/6 May 1988, Hopitault of the Institut Pasteur says that there is no regular programme of surveillance of pesticide levels in surface or groundwaters in France. He also states that derogations are given for supplies with levels in excess of the Directive MAC where health is not considered to be at risk and where no alternative supply exists. It is probably reasonable to conclude that, while BRGM have not found any of the pesticides for which they have analysed in any of the groundwater sources they have investigated, others have found them and a more comprehensive survey may well reveal more problems. This view is supported by Jean Fried, Professor in Hydrogeology at the University of Strasbourg.

Fluoride. A relatively isolated case of pollution by fluoride involves mine tailings in the south of France. A mine discharges fluoride-rich tailings
into a bund which is allowed to discharge over a weir to a stream feeding a reservoir. The river below the reservoir is abstracted for potable supply. The mine obtained a permit from the Ministry of Industry to expand its activities, as a result of which the fluoride level at the abstraction point has reached 2 mg/l and is still rising. The water supplier (CGE) obtained permission to exceed the MAC temporarily as a special case while lengthy negotiations with the mining company were completed. As a result the overflow from the tailings reservoir will be diverted, at the mining company's expense, to another stream which joins the first river downstream of the abstraction point and where greater dilution is available. The Ministry of Health was unable to force the mining company to act because it had a valid licence to operate.

5. PROTECTION ZONES

In theory every well must have a protection zone within which all activities are strictly controlled but in practice such zones have been established for only about 12% of wells and even in these cases controls are not always enforced. Unofficially the effectiveness of the protection zone policy is questioned. There is little difficulty in controlling new activities within the zones but it is more difficult where there are well established farms and industries. There are doubts too about the practicability of policing protection zones unless adequate resources are allocated for the purpose.

The establishment of protection zones involves two legal issues:
- the laws under which their provisions will be enforced and the penalties for infringement. These are discussed in a paper "Pollution of Groundwaters and Agricultural Activities in France" by Professor N Despaux and Monsieur V Coulet of the University of Social Sciences at Toulouse.

- the law of 1964, which deals with all forms of water pollution, and of 1976, which covers classified installations for environmental protection, provide a legal basis for restrictions within a protection zone. However, the diversity of national and local bodies with some responsibility for water has led to difficulties in defining competence to deal with particular issues. Accordingly, in 1987 a Decree set up an interministerial committee to co-ordinate ministerial responsibilities and actions in water pollution.

In addition in 1984 CORPEN was set up to bring together experts and interested parties with a view to establishing a programme for dealing with nitrate pollution of water.

Legal action against polluters can be taken under criminal law or under civil liability law.

No new penalties were introduced specifically under the criminal code for offences involving water pollution and the penalties specified under existing legislation are applicable.

Under civil liability the injured party must prove negligence, misjudgement or failure to obey
regulations. In case of damage to crops it is usually easy to identify the individual or organisation responsible but for groundwater pollution this is often more difficult.

The writers conclude that in France the existing legal provisions are not adequate to assure the protection of groundwater, particularly from agricultural pollution, as much for prevention as for prosecution.

6. PUBLIC AVAILABILITY OF INFORMATION ON DRINKING WATER QUALITY

Under the new decree the supplier is not obliged to provide information directly to members of the public. He may instead refer them to DDASS, who will give them whatever information is available within DDASS. Individual consumers are also entitled to ask the Maire about the quality of drinking water but he too can refuse, in which case the individual consumer can approach DDASS directly. Since the supplier does not provide operational data to DDASS, such information is not available to the public. DDASS acts as a buffer between the water distributor and the public. If any parameter has a value which exceeds the MAC, DDASS will know about it, have a reason for permitting the supply to continue and be able to defend the decision if the need arises. The decision is deemed to have the authority of the Minister. The Ministry will have been informed in any case and perhaps consulted before the decision was made.

There is pressure at the Département level for dissemination of information. Under a law on public access to information promulgated in 1978
results of analyses taken for compliance purposes are official documents and must therefore be made available to any person who so requests. Each month, therefore, the information on water quality for that month is displayed on a bulletin board at the offices of the local health authority. This system has been criticised, however, because of the lack of uniformity in the way the data are presented. Some regions give full data with comments, others fewer data and without comment.

In the Vosges region in the northeast of France three areas, Champagne/Ardennes, Alsace and Lorraine, have together prepared a report containing maps and tables showing the location of supply districts where water quality fails to meet the EC MACs for bacteria, aggressivity, nitrate, fluoride, sodium, chloride, sulphate, hardness, manganese and iron, and the severity of the problem. For each parameter there is a page of text describing the health and aesthetic implications of the parameter. For example:

Nitrate

"... The evaluation of the risk to man from an excess of nitrate in the diet is based on epidemiological studies, clinical observations and animal experiments which confirm a toxic effect .... and a very slight carcinogenic effect in adults..."

Sodium

"... the essential part played by sodium in hypertension ..."
Iron and Manganese

"... an excess of iron provokes cellular metabolic anomalies ... too much manganese ... gives rise to troubles of the nervous system and abnormal growth."

This frank account of the regions' water quality problems is part of a policy to give people more information about the quality of the water supply and in a form which is easier to understand than tables of figures. Here again DDASS is acting as a buffer between the supplier and the customer.

At the national level the Ministry of Health has published country-wide maps of water quality. One for instance shows the location of fluoride problems and another nitrate problems.

6.1 Local organisation and data storage

The DDASS office at Epinal, serving the Vosges Prefecture, has 11 staff dealing with water for a fairly typical 1% of the population. They deal with all aspects of water supply, including quality monitoring, the inspection of treatment works and water sources and the establishment and operation of protection zones.

Water quality data are kept at the local DDASS offices. Every DDASS office has an identical computer system and the same software and has a direct link to the Ministry of Health. The Ministry can telephone a local office and call up any quality data by type or source so that it has immediate direct access to the most recent drinking water quality data for the whole country. The computer records also hold technical details of
each water source and the status of the protection zones, if any, in all of their 1196 catchments, as well as the names and telephone numbers of all relevant personnel.

The computer receives data direct from the analytical laboratory and carries out 17 checks on the incoming data for self consistency (e.g. pH versus hardness; sulphur present but no smell problem) and detects anomalies or unusual results. It also records whether the data were obtained during normal operation, and can be regarded as typical, or under exceptional conditions (e.g. flood, pollution incident, mains flushing etc) and must be regarded as atypical.

In 1989 a new system will be available which makes use of 16 digital maps at twelve levels of scale. Initially this will be operated manually much as the present system is but during the next phase it will be fully interrogable using GEM and a mouse to call up any source or point in the distribution network and show the details of local water quality. The system will also be linked to administrative information, including standard letters to the Mairie, for example, into which the appropriate analytical data can be inserted.

In the longer term the DDASS would like to be able to incorporate epidemiological information into the system so that they can examine links between water quality and health.

The unit at Epinal also deals with all sewerage operations in their region but this is sub-contracted because they do not have the effort
themselves. This is not considered to be satisfactory and there is no automated system for data collection and retrieval.

7. COSTS AND PRICES

The water price is made up of several elements.

1. Drinking water
   
   a. Depreciation
   b. Operating costs (treatment and distribution)
   c. Abstraction fee (to Agence Financiere du Bassin)

2. Sewerage
   
   a. Depreciation
   b. Operating costs (collection and treatment)
   c. Discharge fee (to Agence Financiere du Bassin)

3. FNOE tax

4. VAT

The average charge in Epinal is FF 4-5 per cubic metre of water and the 'real' cost of water is less than FF 2. The price has to cover all the costs since it is forbidden to subsidise the water budget. CGE say that there is considerable consumer resistance to price increases and that they regard this as a constraint on expenditure.

The cost of sampling and analysis throughout France was quoted as FF 12 million, which includes all
costs but not capital. The budget for capital, largely computing, was quoted as FF 5 million.

These figures seem on the low side. During a seminar on the Drinking Water Directive at the European Institute for Water in May 1985 the costs of sampling and analysis for full compliance with the Directive in France were given as FF 0.1 per person per year for populations greater than 1 million, FF 2 for populations greater than 500 and FF 10 for populations greater than 50. These seem likely to imply a national cost probably in the region of FF 50 million.

DDASS has a fixed financial allocation for sampling and analysis and this must cover both routine and exceptional items. There are no special adjustments and, in the event of a problem, the distributor is probably required to supply extra data. Within his budget the local DDASS officer may make any deals he likes with contracting laboratories.

8. WATER TREATMENT TECHNOLOGY

Three plants run by CGE treat water from the rivers Seine, Marne and Oise. The plants at Mery-sur-Oise and Choisy-le-Roi on the Seine have three-stage processes and powdered carbon is used in case of a pollution event or a taste-and-odour problem. The last stage is ozone plus biological granular carbon filtration, incorporated by sacrificing some filter beds and accepting the loss of volume. During periods of high demand they can by-pass the GAC beds with part of the flow and re-blend the water. The layout of the works at Noisy-le-Grand on the Marne where the river separates the works, the two
parts of which are linked by a bridge, did not permit this and there is no ozone plus GAC but PAC (5 mg/l) is used routinely instead. When they can afford it they will build GAC filter beds and adopt the same three stage process here. In case of pollution the PAC level is raised to 100 mg/l.

CGE were worried about a nuclear power plant constructed recently some distance upstream on the Seine and they built a pipe to connect the Choisy-le-Roi works to the Noisy-le-Grand abstraction point on the Marne. Should there be a spillage into the Seine they can switch to the Marne for supply. The electricity industry paid nothing for this. The cost was met about one third by the Agence du Bassin and two thirds by the company but the customers will eventually have to pay in the price of water.

Municipalities are likely to be content to manage water supply and distribution when there are no major quality problems. When DDASS begins to require ameliorative measures to deal with a quality problem and more sophisticated treatment processes are needed, they are likely to find it difficult to muster the necessary technical and managerial resources. It is at this point that they are likely to consider contracting the supply to one of the companies. It is possible to speculate, therefore, that the water companies will tend to have contracts in regions where there are or have been long term quality problems. Any deterioration in raw water quality or the adoption of a tougher policy by DDASS on infringements would thus probably increase the market for the water companies.
9. PRIVATE SUPPLIES

Supply from a private network providing water for a large number of people (private local supplies: camping sites, hotels, tourist amenities in mountainous areas etc) are subject to authorisation in the same way as public supplies (Article 24 of the Public Health Code and the new decree). They are also subject to the same monitoring and supervision obligations - and must respect the same standards.

The new decree exempts water used for family purposes from the authorisation obligation; such use must simply be declared to the DDASS. The owner of a supply source is made aware of the advisability of monitoring and analysing the quality of his water. He is not, however, subject to any obligation. The DDASS may decide in some cases to analyse water from family supplies.
APPENDIX D

THE EC DRINKING WATER DIRECTIVE IN ITALY
1. INTRODUCTION

1.1 Physical and demographic details

Italy consists of a long peninsular, some 1100 km in length stretching from the Alps into the Mediterranean Sea, together with the larger islands of Sicily, Sardinia and Elba and about 70 smaller islands. It is bordered to the north by Switzerland, on the east by Yugoslavia and on the west by France. It has long coastlines on the Adriatic, Mediterranean, Tyrrhenian and Ligurian Seas. The total land area of Italy is 324 000 km², being about one-third larger than the UK (240 000 km²).

The Italian peninsula is for the most part mountainous, though, between the Apennines which form its spine and the East coastline, there are two large fertile plains; Emilia-Romagna in the north and Puglia in the south (see Figure 1 for the location of these areas). The Alps form the northern limit of Italy and contain several peaks which range from 3 500 to 4 500 metres in height.

The chief rivers are the Po (650 km) which flows through Piedmont, Lombardy and Veneto, the Adige (Trentino and Veneto), the Arno (Florentine Plain) and the Tiber (flowing through Rome to Ostia).

The area which consists mainly of the Po river basin is especially important. It covers about one fifth of the country, has over two-fifths of the population, is economically the principal area of Italy and produces the bulk of the wheat, maize, rice, hemp, sugar beet and vines. In the south of the country the land is less productive and olives, vines, fruit and vegetables predominate.
There are great economic and social differences between the north and the south of Italy. The north is highly industrialised and the standard of living is much higher than in the south. This latter area, which includes Sardinia and Sicily, is known collectively as the "Mezzogiorno" and still relies to a great extent on agriculture.

The total population of Italy (1985) is just over 57 million giving an average population density of about 176 inhabitants/km$^2$ (cf UK with 233 inhabitants/km$^2$).

The distribution of the population, though, varies markedly throughout the country. This can be seen from Table 1 which gives details of the respective areas, population and population density for each of the 20 administrative regions.

Thus the population density ranges from 35 inhabitants/km$^2$ in the Valle d’Aosta region to over 400 inhabitants/km$^2$ in the Campania region which includes the principal town of Naples (see Figure 1 for the location of these regions).

1.2 Climate

Climatic conditions vary greatly, due partly to the distance from the northern frontiers to southern Italy and Sicily and partly to the mountain ranges. The Riviera coast in the north is famed for its mild winters but the Po basin has a continental climate with cold winters and hot summers. Temperatures range from $-10 \, ^\circ\text{C}$ in the north in winter to $+40 \, ^\circ\text{C}$ in the south during the summer. Rainfall is usually adequate in the central and northern parts of the country which also experience a great deal of fog during the winter.
Table 1. Distribution of population

<table>
<thead>
<tr>
<th>Regions</th>
<th>Area (km²)</th>
<th>Resident pop estimate (1983)</th>
<th>Population density per km² (1983)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piedmonte</td>
<td>25 399</td>
<td>4 431 064</td>
<td>174</td>
</tr>
<tr>
<td>Valle d’Aosta</td>
<td>3 262</td>
<td>113 418</td>
<td>35</td>
</tr>
<tr>
<td>Lombardia</td>
<td>23 856</td>
<td>8 891 318</td>
<td>373</td>
</tr>
<tr>
<td>Trentino-Alto Adige</td>
<td>13 613</td>
<td>875 780</td>
<td>64</td>
</tr>
<tr>
<td>Bolzano-Bozen</td>
<td>7 400</td>
<td>432 231</td>
<td>58</td>
</tr>
<tr>
<td>Trento</td>
<td>6 213</td>
<td>443 549</td>
<td>71</td>
</tr>
<tr>
<td>Veneto</td>
<td>18 364</td>
<td>4 361 527</td>
<td>238</td>
</tr>
<tr>
<td>Friuli-Venezia Giulia</td>
<td>7 846</td>
<td>1 228 280</td>
<td>157</td>
</tr>
<tr>
<td>Liguria</td>
<td>5 416</td>
<td>1 789 225</td>
<td>330</td>
</tr>
<tr>
<td>Emilia Romagna</td>
<td>22 123</td>
<td>3 952 304</td>
<td>179</td>
</tr>
<tr>
<td>Toscana</td>
<td>22 992</td>
<td>3 581 291</td>
<td>156</td>
</tr>
<tr>
<td>Umbria</td>
<td>8 456</td>
<td>813 507</td>
<td>96</td>
</tr>
<tr>
<td>Marche</td>
<td>9 694</td>
<td>1 420 829</td>
<td>147</td>
</tr>
<tr>
<td>Lazio</td>
<td>17 203</td>
<td>5 056 119</td>
<td>294</td>
</tr>
<tr>
<td>Abruzzi</td>
<td>10 794</td>
<td>1 236 060</td>
<td>115</td>
</tr>
<tr>
<td>Molise</td>
<td>4 438</td>
<td>331 670</td>
<td>75</td>
</tr>
<tr>
<td>Campania</td>
<td>13 595</td>
<td>5 563 230</td>
<td>409</td>
</tr>
<tr>
<td>Puglia</td>
<td>19 347</td>
<td>3 946 871</td>
<td>204</td>
</tr>
<tr>
<td>Basilicata</td>
<td>9 992</td>
<td>614 522</td>
<td>62</td>
</tr>
<tr>
<td>Calabria</td>
<td>15 080</td>
<td>2 098 137</td>
<td>139</td>
</tr>
<tr>
<td>Sicilia</td>
<td>25 708</td>
<td>5 006 684</td>
<td>195</td>
</tr>
<tr>
<td>Sardegna</td>
<td>24 090</td>
<td>1 617 265</td>
<td>67</td>
</tr>
</tbody>
</table>

324 000
(including the smaller islands)

1.3 Administrative structure

Under the 1948 Constitution, legislative power is held by the two-chamber Parliament consisting of the Senate and the Chamber of Deputies or Lower House. The President, who is elected by joint sessions of both Houses of Parliament, is the Head of State. He appoints the Prime Minister, and on the latter’s recommendations, the other ministers. Executive power is exercised by the Council of Ministries, over which the Prime Minister presides as President of the Council.
Figure 1. Regions and principal towns of Italy.
The country is administratively divided into 20 regions, which have a fair degree of autonomy, 94 provinces and more than 8000 municipalities (communes). Five of the regions have a special status and act as autonomous regions. These are Valle d’Aosta, Trentino-Alto-Adige, Truili-Venezia-Giula, Sicily and Sardinia. The other regions operate as decentralised units of central Government. A Government Commissioner, located in each regional capital, supervises the administrative functions of the State and coordinates them with those of the regions. The special regions have a governmental structure similar to that of a municipality, with a directly elected council, an executive board and a president. The regional council may propose legislation for its area to the national Parliament on a range of subjects, including public health.

Each province has two separate administrations: the provincial administration (which is the decentralised unit of the central Government with an elected council and a President), and the municipalities in the province. The coordinator of the central Government’s administration of the province is the governor or prefect, who is appointed by and is responsible to the Ministry of the Interior. His duties includes the publishing and carrying out of national laws and supervising certain public health duties. He is assisted by advisory groups and councils such as the Council for Health and Hygiene.

Each municipality, like a province, has three organs of government; the council, the board and the Mayor. The functions of the council include the provision of health services. As an officer of central Government, the Mayor must publish the
laws, regulations and announcements of the State and assume certain functions with regard to public works and public health. The municipalities are subject to strict administrative and financial control by the provincial and central governments. Their organisation and administration are examined by provincial inspectors and when a municipality is found not to be performing its duties fully, the central Government or the provincial authorities can take appropriate action to rectify the situation.

2. WATER RESOURCES

2.1 Groundwater

Aquifers in Italy can be divided into three main groups:

- Alluvial
- Limestone
- Sandstone and Volcanic

The Alluvial aquifers occur along the major river valleys or in structural depressions. The most important, by far, in Italy is the Po valley. The aquifers in this structurally controlled valley are several hundred metres thick and make up one of the major water resources of Italy. The areas around Turin, Milan, Paruna, Bologna and Venice, mainly lying on the Po Alluvium, use about 730 m$^3$/s which represents 72% of the groundwater extracted in Italy. Groundwater is drawn mainly from shallow aquifers and because the Po Valley is a major agricultural region where irrigation is practised, the water quality is threatened by diffuse sources of pollutants, fertilisers and pesticides as well as by industrial pollutants in urban areas.
The Limestone aquifers are concentrated along the mountainous areas; the Alps in the North and the Appenines down the spine of Italy. A feature of limestone aquifers is the development of karst with sink holes, caverns and springs. Major springs yielding more than 1 m³/s are concentrated mainly in the central Appenines east of Rome.

The Arenaceous (sandstone/conglomerate) and Volcanic aquifers occur in the mountainous regions interbedded with the karstic limestones or, in areas of recent volcanic activity, overlying the older bedrocks.

Groundwater flow in the alluvial aquifers and certain sandstone aquifers tends to be intergranular but in the limestones, hard sandstones and volcanic lavas, it is generally by fissure.

2.2 Supplies

About 95% of the population are served by public water supplies. There are almost 12,000 water supply systems and these supply nearly 6,000 million m³/year (some 15% of this total, however, is lost by leakage). It is claimed that all of this water is disinfected before distribution, usually by ClO₂ (and occasionally by NaOCl). Chlorine is being phased out because of the risks involved since Italy lies within an earthquake zone. It should be mentioned that in addition to these potable supplies, many communities, notably in the larger cities and in the south of the country, have dual distribution systems and also distribute water of a lower quality which is used for such purposes as street cleaning, irrigation of municipal gardens and parks and for fire-hydrants.
The present situation regarding potable supplies is characterised by the existence of a large number of small plants with 75% of them supplying less than 5 l/s. Thus almost 50% of the water supplied by the municipalities is produced by about 60 undertakings out of the total of 12 000 in the country.

The water supplies are derived, 87% by volume from groundwater (37% springwater and 50% groundwater), 9% from surface water and 4% from other sources. It is this heavy reliance on groundwater sources which largely ensures the quality of Italian water supplies.

Even in municipalities where surface water sources are used, there are usually alternative groundwater sources available for use when difficulties occur with the surface waters. In fact only about 3% of the total number of treatment plants are supplied solely by surface water.

The respective sources of water for the 20 regions of Italy are given in Table 2. This shows, for each region, the number of water supply systems, the percentage by volume of the water supplies derived from springs, groundwater, surface water and other sources (all based on the maximum levels of supply) and the total amount of water supplied/annum. It will be seen that there are considerable variations in the sources used and in some regions, notably Liguria and Puglia, surface water sources are widely used and can contribute more than 30% of the total treated.

The trend is for surface water to increase in importance in Italy as the groundwater resources are now fully utilised. Thus on a 50 year
Table 2. Sources of Italian water supply systems in the various regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Water supply systems no.</th>
<th>Springwater* %</th>
<th>Groundwater* %</th>
<th>Surface water* %</th>
<th>Other sources* %</th>
<th>Water supplied/annum (000 m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piedmonte</td>
<td>1 578</td>
<td>21</td>
<td>69</td>
<td>6</td>
<td>4</td>
<td>484 160</td>
</tr>
<tr>
<td>Valle D’Aosta</td>
<td>209</td>
<td>72</td>
<td>25</td>
<td>&lt;1</td>
<td>3</td>
<td>380 319</td>
</tr>
<tr>
<td>Lombardia</td>
<td>1 873</td>
<td>15</td>
<td>84</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>1 109 008</td>
</tr>
<tr>
<td>Trentino-Alto Adige</td>
<td>857</td>
<td>70</td>
<td>27</td>
<td>2</td>
<td>1</td>
<td>232 254</td>
</tr>
<tr>
<td>Bolzano-Bozen</td>
<td>350</td>
<td>60</td>
<td>36</td>
<td>3</td>
<td>1</td>
<td>88 885</td>
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<tr>
<td>Trento</td>
<td>507</td>
<td>77</td>
<td>22</td>
<td>1</td>
<td>1</td>
<td>143 369</td>
</tr>
<tr>
<td>Veneto</td>
<td>884</td>
<td>22</td>
<td>61</td>
<td>14</td>
<td>3</td>
<td>440 027</td>
</tr>
<tr>
<td>Friuli-Venezia Giulia</td>
<td>321</td>
<td>36</td>
<td>22</td>
<td>3</td>
<td>39</td>
<td>172 172</td>
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<tr>
<td>Liguria</td>
<td>618</td>
<td>14</td>
<td>46</td>
<td>34</td>
<td>6</td>
<td>292 460</td>
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<tr>
<td>Emilia-Romagna</td>
<td>913</td>
<td>12</td>
<td>71</td>
<td>12</td>
<td>5</td>
<td>345 642</td>
</tr>
<tr>
<td>Toscana</td>
<td>1 367</td>
<td>25</td>
<td>49</td>
<td>23</td>
<td>3</td>
<td>354 154</td>
</tr>
<tr>
<td>Umbria</td>
<td>577</td>
<td>35</td>
<td>55</td>
<td>1</td>
<td>1</td>
<td>126 586</td>
</tr>
<tr>
<td>Marche</td>
<td>322</td>
<td>59</td>
<td>30</td>
<td>&lt;1</td>
<td>10</td>
<td>60 003</td>
</tr>
<tr>
<td>Lazlo</td>
<td>399</td>
<td>77</td>
<td>17</td>
<td>6</td>
<td>1</td>
<td>752 266</td>
</tr>
<tr>
<td>Abruzzi</td>
<td>264</td>
<td>89</td>
<td>10</td>
<td>1</td>
<td>&lt;1</td>
<td>150 217</td>
</tr>
<tr>
<td>Molise</td>
<td>84</td>
<td>94</td>
<td>1</td>
<td>5</td>
<td>&lt;1</td>
<td>36 673</td>
</tr>
<tr>
<td>Campania</td>
<td>211</td>
<td>63</td>
<td>28</td>
<td>3</td>
<td>6</td>
<td>414 789</td>
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<tr>
<td>Puglia</td>
<td>25</td>
<td>68</td>
<td>&lt;1</td>
<td>32</td>
<td>&lt;1</td>
<td>204 448</td>
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<tr>
<td>Basilicata</td>
<td>96</td>
<td>96</td>
<td>4</td>
<td>&lt;1</td>
<td>-</td>
<td>39 059</td>
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<tr>
<td>Calabria</td>
<td>377</td>
<td>73</td>
<td>24</td>
<td>1</td>
<td>2</td>
<td>162 595</td>
</tr>
<tr>
<td>Sicilia</td>
<td>447</td>
<td>49</td>
<td>37</td>
<td>3</td>
<td>3</td>
<td>335 999</td>
</tr>
<tr>
<td>Sardegna</td>
<td>225</td>
<td>32</td>
<td>11</td>
<td>36</td>
<td>21</td>
<td>111 540</td>
</tr>
</tbody>
</table>

* % of total volume supplied based on maximum levels of supply
timescale it is predicted that future supplies will be derived 37% from springs, 36% from groundwater and 27% from surface water. This will mean additional treatment facilities to maintain the present quality of the distributed water.

The problems encountered in meeting the needs of water supplies in some regions have led to some quite amazing engineering feats. One outstanding example was the construction in 1928 of an aqueduct with a capacity of 5 m$^3$/s to transport springwater under gravity from the central mountains to the region of Puglia some 250 km away.

3. WATER SERVICES

3.1 Administration

The municipalities (local authorities), acting under the general control of the central government, are responsible for water services. The local elected Mayor is held legally responsible and it is he who must ensure that quality standards are maintained. The municipalities manage about 97% of the public supply. This they achieve either by operating the service themselves, or, as in most cases, with other municipalities in a co-operative association. (The remaining 3% of public supply is provided by a small number of private undertakings.)

There are a number of special water supply organisations which have been created by specific laws. These are usually in the south of Italy or the larger islands. They are responsible for the water supply for several municipalities or even for more than one region. These bodies are:
o Apulian Water Board, responsible for the region of Apulia, part of region of Calabria and part of the region of Basilicata;

o Sicilian Water Board, responsible for the water supply to some 300 municipalities though excluding some of the most important;

o Sardinian Water and Sewage Board, responsible for the region of Sardinia.

In the south of the country there are a number of industrial development areas and the consortia which manage these are also responsible for the supply of industrial quality water.

Water for irrigation is provided under the aegis of the Land Improvement and Irrigation Boards.

4. DRINKING WATER LAW

4.1 Incorporation of the Drinking Water Directive

The Directive 80/778/EEC of 15 July 1980 relating to the quality of water intended for human consumption (the Drinking Water Directive) has been transposed into Italian law by two separate provisions. These were by:

o Prime Minister's Decree No 41 of 8 February 1985 (for convenience referred to as PMD 1985) and

o Presidential Decree No 236 of 24 May 1988 (PD 1988)

PMD 1985, which was prepared by the Ministry of Health, is classed as an Administrative Act (comparable with a government regulation) and partially incorporated the Drinking Water Directive
into Italian law. It was drafted along similar lines to the Directive but nevertheless differed in a number of significant ways. Thus, for example, many of the guide and limit values established for particular parameters to describe the quality required for drinking water differed from those given in the Directive.

PD 1988, on the other hand, has the force of law and is described as a "delegated decree in execution of Law No 183 of 16 April 1987 on the coordination of policies regarding Italian membership of the European Community of the adjustment of Italian legislation to the regulations issued by the Community." It supercedes PMD 1985 and brings about the total incorporation of the Directive into Italian law. The Decree also contains a number of principles and criteria in addition to those given in the Directive. These had been established by Law No 183 of 16 April 1987 and involve:

- regulations on the marketing and use of dangerous substances and preparations in agriculture;

- restoration and protection of the environment to maintain the fundamental interests of the population and the quality of life;

- protection, conservation and improvement of natural resources and heritage through:

  - regulations and restrictive measures designed to protect and to improve the environment;

  - inspection and control measures.
The Decree was also prepared by the Ministry of Health. However, for this Decree it worked in collaboration with the Ministry of the Environment and was assisted by the Ministries of Public Works, of Agriculture and Forestry, of Industry, Commerce, Trade, Treasury and the Minister for European Affairs.

The importance given to environmental aspects in the regulations for the quality of drinking water is one of the consequences of the recent creation of the Ministry of the Environment.

It should be mentioned that even though PD 1988 has brought about the total incorporation of the Drinking Water Directive into Italian law and has eliminated many of the differences established by PMD 1985, a number still remain. In particular these concern the limit and guide values specified for individual parameters. In some cases the Decree sets stricter standards than are given in the Directive (or at least establishes values for certain parameters where no values are given in the Directive) whilst in others it specifies less stringent values. These differences are listed below:

More strict than the Directive

- Lower guide value of 5 mgNO$_3$/l is given for nitrate (Parameter 20, Directive 25 mgNO$_3$/l);

- A lower guide value of 0.5 mg/l (Directive 2 mg/l) is given for oxidisability (Parameter 24);
Establishes values for certain parameters for which no values are given in the Directive

- A range of $6.0 < \text{pH} < 9.5$ is given for the maximum admissible values of pH (Parameter 6 - Directive only a maximum admissible value of 9.5 is given);

- A recommendation of 15 to 50 °F is given for total hardness (Parameter 16, Directive no value given. However in Table F for minimum requirements for softened water a hardness of about 15 °F is stated);

- An MAC of 30 µg/l is given for "other organochlorine compounds not covered by Parameter 55" (Parameter 32) with the proviso that it must be met by 8 May 1991;

- An MAC of 1000 µg/l is given for copper (Parameter 35);

- An MAC of 3000 µg/l is given for zinc (Parameter 36).

Less strict than the Directive

- A dilution number of 3 at 12 °C is given for taste (Parameter 4-Directive dilution number of 2 at 12 °C);

- No MAC is given for potassium (Parameter 14, Directive 12 mgK/l);

- No guide value is given for the zinc content of water left standing in the distribution system (Parameter 36, Directive 5000 µg/l after 12 hours);
o No guide value is given for barium (Parameter 42, Directive 100 μgBa/l);

Other differences

o Provision is made for the value for non-ionic detergents (sub-division of Parameter 31) though as yet no values have been specified. This is not considered by the Directive;

o Total bacteria counts (Parameters 61 and 62) are to be undertaken at 22 °C and 36 °C (Directive, 22 °C and 37 °C).

In addition to the differences recorded above, PD 1988 establishes a different Annex II (Patterns and frequency of standard analyses for monitoring) and Annex B (Table of minimum frequency of standard analyses) from those given in the Directive. The Italian versions are reproduced in Tables 3 and 4, respectively.

The Decree also establishes wide restrictions of use and controls on private property and on industrial and agricultural activities in order to protect the environment and water resources. Of special interest are:

o creation of protection zones to safeguard springs and wells (groundwater) and intakes (surface water); (see Section 5.8);

o introduction of a register designed to control pollution caused by the use of agrochemicals (pesticides, fungicides and weedkillers);
Table 3. Patterns and frequency of standard analyses for monitoring

<table>
<thead>
<tr>
<th>Minimum monitoring</th>
<th>Normal monitoring</th>
<th>Periodic monitoring</th>
<th>Occasional monitoring</th>
</tr>
</thead>
</table>

**Organoleptic and physicochemical parameters**

1 Colour  
2 Turbidity  
3 Odour  
5 Temperature  
4 Taste  
6 pH  
7 Conductivity  
8 Chlorides  
9 Sulphate  
11 Calcium  
12 Magnesium  
13 Sodium  
14 Potassium  
15 Aluminium  
(+ other minimum monitoring parameters)  
(+ other normal monitoring parameters)  
16 Total hardness  
17 Dry residues  
18 Dissolved oxygen  
19 Free CO₂

**Undesirable chemical parameters**

41 Residual chlorine  
22 Ammonium  
20 Nitrates  
21 Nitrates  
24 Oxidisability  
25 Total organic carbon  
40 Suspended solids  
33 Iron  
37 Phosphorus  
38 Kjeldahl nitrogen  
(+ other normal monitoring parameters)  
43 Silver  
42 Barium  
30 Boron  
32 Other organo chlorine compds  
31 Surfactants – anionics and non-ionics  
not covered by Parameter 55  
29 Phenols  
28 Hydrocarbons  
34 Manganese  
35 Copper  
36 Zinc  
27 Chloroform extractables  
39 Cobalt

**Toxic chemical parameters**

46 Cadmium  
48 Chromium  
51 Lead  
52 Antimony  
55 Pesticides  
44 Arsenic  
45 Beryllium  
47 Cyanides  
56 PAH  
49 Mercury  
50 Nickel  
53 Selenium  
54 Vanadium
| 58 Faecal coliforms | 59 Faecal streptococci (+ other minimum monitoring parameters) | 61/62 Total bacteria (+ other normal monitoring parameters) | 60 Clostridia Pathogenic staphylococci Pathogenic enterobacteria Faecal bacteriophages Enteroviruses Pseudomonas aeruginosa Protozoa Organisms Algae Fungi |
Table 4. Table of minimum frequency of standard analyses

<table>
<thead>
<tr>
<th>Population served</th>
<th>Minimum monitoring</th>
<th>Normal monitoring</th>
<th>Periodic monitoring</th>
<th>Occasional monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum number of samples/year</td>
<td></td>
<td></td>
<td>Frequency to be determined by the competent national authorities as the situation and opportunity arises</td>
</tr>
<tr>
<td>Up to 500</td>
<td>At the discretion of the competent authorities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500 to 5000</td>
<td>6(*)</td>
<td>At the discretion of the competent authorities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 000 to 10 000</td>
<td>12</td>
<td>6(3)</td>
<td>6(*)</td>
<td></td>
</tr>
<tr>
<td>10 000 to 50 000</td>
<td>60</td>
<td>12(6)</td>
<td>12(1)</td>
<td></td>
</tr>
<tr>
<td>50 000 to 100 000</td>
<td>120</td>
<td>12(6)</td>
<td>12(2)</td>
<td></td>
</tr>
<tr>
<td>100 000 to 150 000</td>
<td>180</td>
<td>18(12)</td>
<td>12(3)</td>
<td></td>
</tr>
<tr>
<td>150 000 to 300 000</td>
<td>360</td>
<td>36(18)</td>
<td>12(6)</td>
<td></td>
</tr>
<tr>
<td>300 000 to 500 000</td>
<td>360</td>
<td>60</td>
<td>12(10)</td>
<td></td>
</tr>
<tr>
<td>500 000 to 1 000 000</td>
<td>360</td>
<td>120</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Over 1 000 000</td>
<td>360</td>
<td>180(120)</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Note: Figures in parentheses indicates values given in the Directive where they differ from PD 1988
* At the discretion of the competent authorities

The requirement on drinking water supply undertakings to set up or at least to make use of their own laboratories for quality control of distributed water.

PD 1988 also covers derogations (reduction of standards, see Section 5.9) and prorogations (lengthening of time periods before compliance with the requirements of the Directive must be achieved - see Section 5.10).

Finally it establishes a system for monitoring the quality of water supplies (see Section 5.3) and of penalties to be imposed for the distribution or
use of water unfit for human consumption and for failing to abide with the requirements of the Decree (see section 5.7).

Further details of the application of PD 1988 are given in the following section.

5. APPLICATION OF THE DRINKING WATER LAW

5.1 Definition of an MAC

An MAC has not been defined in the Decree. It has been accepted throughout that it is the maximum level permissible and, in fact, some Italian authorities have expressed considerable surprise that any other interpretation could have been made or suggested.

The Decree does make reference, though, to MAVs (Maximum Allowable Values). These are values set for certain parameters which can exceed the MAC for a limited period of time. MAVs are decided by the Ministry of Health working in collaboration with the Ministry of the Environment following reference to the Steering Committee on Health. When MAVs are granted, appropriate methods for treatment of the affected waters also have to be specified.

Recently (30 August 1988) the Ministry of Health together with the Ministry of the Environment have published a Decree (of 14 July 1988) which outlines MAVs for certain parameters which may be granted following initiatives by the regional authorities of areas finding it difficult to meet the limits established by PD 1988. These MAVs can last until 31 December 1991. Details of the parameters concerned and the respective MAVs and values set by PD 1988 and the Directive are given in Table 5. This also contains comments to be taken into account when applying the MAVs.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Expression of the results</th>
<th>Maximum admissible value (HAV)</th>
<th>MAC given in PD 1988 &amp; EC Directive</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>mg/l NH₄</td>
<td>10</td>
<td>0.5</td>
<td>The MAV may only be reached if it is ascertained that the ammonia is of geological origin and that the raw water does not present any signs of biological contamination. Under certain conditions, higher values of ammoniacal nitrogen may facilitate the growth of micro organisms and may cause the corrosion of distribution pipes.</td>
</tr>
<tr>
<td>Nitrate</td>
<td>mg/l NO₃</td>
<td>100</td>
<td>50</td>
<td>Water with nitrate values above 50 mg/l cannot be used for drinking purposes for infants and children below the age of one year nor used habitually for people at risk of haematological difficulties.</td>
</tr>
<tr>
<td>Oxidizability</td>
<td>mg/l O₂</td>
<td>10</td>
<td>5</td>
<td>The percentile compliance should be 90% calculated on the total of the analytical results over a reference period of 3 years.</td>
</tr>
<tr>
<td>Sodium</td>
<td>mg/l Na</td>
<td>350</td>
<td>175</td>
<td>The percentile compliance should be 80% calculated on the total of the analytical results over a reference period of 3 years.</td>
</tr>
<tr>
<td>Dry residues</td>
<td>mg/l after drying at 180 °C</td>
<td>3000</td>
<td>1500</td>
<td>Adoption of the MAV's given above may alter the taste, colour and odour of the water. In these circumstances it is permissible to vary proportionally the values for these parameters.</td>
</tr>
<tr>
<td>Taste, colour, odour</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Table 5. Continued

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Expression of the results</th>
<th>Maximum admissible value (MAV)</th>
<th>MAC given in PD 1988 &amp; EC Directive</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesium</td>
<td>mg/l Mg</td>
<td>125</td>
<td>50</td>
<td>The MAV may be reached (due to special hydrological conditions of the basin used for drinking water supplies) provided that the sulphate value does not exceed 500 mg/l.</td>
</tr>
<tr>
<td>Manganese</td>
<td>mg/l Mn</td>
<td>0.2</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td>mg/l Fe</td>
<td>1</td>
<td>0.2</td>
<td>The MAV may vary according to the ambient temperature of the air (from 8 °C to 30 °C) of the geographical zone in question. For one year from the time that this law comes into force and for zones with fairly high ambient temperatures, 2 mg F/l may be permitted.</td>
</tr>
<tr>
<td>Fluoride</td>
<td>mg/l F</td>
<td>3-1.4</td>
<td>1.5-0.7</td>
<td></td>
</tr>
<tr>
<td>Sulphate</td>
<td>mg/l SO₄</td>
<td>500</td>
<td>250</td>
<td>The MAV may be reached in certain areas where there are special hydrological conditions of the basin used for drinking water purposes.</td>
</tr>
</tbody>
</table>
5.2 Responsibilities

The agencies of central government involved in the provision of water services are the Ministries of Public Works, of Agriculture and Forests and of Health. The newer and more junior Ministry of the Environment acts largely in an advisory capacity for water supply.

The Government exercises control over water supply by setting standards (prepared and issued by the Ministry of Health) and then by enforcing them through the local public health authorities (Unita Sanitarie Locali, USL). This service, which reports to the Ministry of Health, consists of about 650 units spread throughout the country and operates some 96 laboratories.

It should be mentioned that the USL has the responsibility of ensuring public health standards for all matters in their area. One important aspect of this is the quality of food and particularly that of wine and olive oil. Even though water is also classified as a foodstuff, USL does not seem to have the same interest in it. Thus, in some areas it leaves the monitoring of water for compliance with the standards set virtually to the producers themselves (ie the municipalities). There are many cases, especially in the more rural areas, where USL has neither the necessary equipment nor the skilled manpower required to monitor the supplies except in rather a rudimentary fashion.

Further details on the responsibilities and authorities held by the individual organisations are given below.
5.2.1 Central authorities

i. Responsibilities delegated to the Ministry of Health, of the Environment and of Public Works:

- Direction and coordination of all third parties, both public and private, for all activities connected with the application of the Decree;

- Modification, variation and addition to the standards set;

- Technical methodology and criteria for:
  - Evaluation of groundwater, brackish and marine water destined for human consumption;
  - Protective measure for waters destined for human consumption;
  - Treatment of waters for human consumption;
  - Definition of areas to be protected as water resources;
  - Installation of water supply pipes;
  - Treatment of drinking water and related works;
  - Development of groundwater resources;
  - Information systems regarding the properties of waters to be used for human consumption.
ii. That delegated to the Ministries of Health and of the Environment and the Steering Committee on Health:

- Establishing MAVs and associated treatment methods (see Section 5.1 above).

### 5.2.2 Regions

Regional responsibilities include:

- Identification of the areas to be protected for water resources;

- Control of activities within protection zones;

- Coordination of information regarding water to be used for human consumption within the Region;

- Power to substitute communal authorities which do not take appropriate action to protect local waters;

- Relief organisations to handle emergencies involving the quality of drinking water;

- Adoption of plans of action for the treatment and improvement of the quality of water;

- Exercise of the power of suspension of raw water supplies;

- Sole health control authority between communes, provinces and regions for water mains.
5.2.3 Municipalities (Local authorities)

These are responsible for:

- Operation of water services; this involves the treatment of water, distribution, sewerage and treatment of wastewaters;

- Executive duties to ensure PD 236 is enforced. This responsibility also applies to the special water supply organisations and the private water supply companies (see Section 3.1);

- Power of initiative in informing the regions of the advisability of a derogation of an MAC;

- Monitoring of the quality of public water supply (the special water supply organisations and private water supply companies also have this responsibility).

5.3 Monitoring

The quality of public water supplies in Italy is monitored by two completely separate exercises. These are:

- internal controls carried out by all bodies operating water supply plant;

- external controls carried out by public health inspectors from the Unità Sanitarie Locali (USL).

When the quality of water is in doubt, the usual procedure is to take and analyse a repeat sample. USL is required only to report data on cases of non-compliance to the regions and to central government. Often these reports are accompanied by requests for additional funding to tackle the local
problems involved. The Ministry of Health is currently seeking ways of increasing its access to local data on water quality.

The patterns and frequency of standard analyses and the minimum frequency of standard analyses specified by PD 1988 differ somewhat from those given in the Directive (see section 4.1 and Tables 3 and 4). The reference methods of analysis given in both documents are, however, similar.

5.4 Analytical quality control (AQC)

There is no nationwide system of AQC at present. Some is undertaken locally, though, and it is likely that the level will increase in the future.

Larger water supply undertakings such as ACEA (for Rome) and AMAC (for Bergamo) already carry out internal checks on their analytical results. It is unlikely though that more rural undertakings will have either the necessary manpower or expertise to undertake this exercise.

Instituto Superiore Di Sanita (ISS - Technical Division of the Ministry of Health) provides advice on technical matters related to health. This covers all aspects of relevant laws, limits applicable and the methods and frequency of analysis. As such it will carry out checks on AQC for individual water undertakings if specifically requested.

It is worth mentioning that as ISS deals with all technical matters related to health, it has a large staff and employs about 1400 people. However, of these, only about 100 are engaged on environmental matters whilst perhaps 20 deal with water supplies.
As a consequence this imposes considerable limitations on the extent of help that it can offer for AQC.

5.5 Sampling points

PD 1988 specified that checks must be made at all points along the water supply from the source to the point where it is made available to the consumer. Sampling points specifically mentioned are:

- springs
- wells
- surface water intakes
- storage reservoirs
- treatment plants
- distribution networks
- water tankers (either for transport by roads or by ships)

No provision has been made for checking at the consumer's tap. This has been done, though, on rare occasions following complaints from the consumers.

5.6 Action taken when repeat samples fail to meet an MAC

There is a widespread belief, perhaps well founded because of the reliance on groundwater sources, that the water supply in Italy is safe and that it is not normally necessary to turn off a supply when values for MACs are exceeded. Usually the problem is with the bacterial content of the distributed waters and this is tackled by increasing the level of disinfection. In other cases the problem can be overcome by switching sources, normally from surface to groundwater.
Furthermore, and especially where non-toxic parameters are involved and with single source supplies, it is accepted that turning off the supplies will cause potentially more harm than by continuing to supply water which is in breach of the Directive.

PD 1988 does, however, set out actions to be carried out when an MAC is exceeded. The system to be followed is described below:

- Exceedence of an MAC can be discovered by the public health inspectors, during internal checks by the water undertaking, by hospitals, factories or environmental associations;

- In that case, the region, the commune and the operating water undertaking have to be informed and have to adopt those measures for which they have responsibility;

- On receipt of the information, the body receiving it must evaluate it and form an opinion as to the potability of the supply;

- Evaluation of the potability of the supply must be carried out taking account of the notes associated with the parameter(s) concerned in PD 1988 and of the "general criteria and methodology for determining the characteristics of water" (to be issued by the Ministry of Health in collaboration with the Ministry of the Environment);

- If the water is not accepted as being fit for human consumption, suitable actions taken either in parallel or as alternatives, have to be considered. These are:
The operating water undertakings, having temporarily suspended the water supply, may urge the Region to apply a derogation;

The population affected may be supplied from mobile water tanks;

Emergency involvement by the Civil Protection Service may be requested since this Service has the power to drill new wells, to bring mobile water treatment plant into the affected area and to lay emergency water mains.

The Civil Protection Service’s powers override the regulations regarding public contracts and water supplies and its importance in dealing with emergency water supplies has been increasing over the last few years.

PD 1988 grants the regions the power to prepare measures for emergency water supplies in order to return the public supplies to normal as soon as possible.

It is expected that the Government will issue further detailed regulations for action to be taken to deal with cases of water deemed to be not fit for human consumption.

USL can ask water undertakings for their analytical data when problems arise. The undertakings, however, are not obliged to supply this information. Furthermore, only USL data and not those from the undertakings are used for the basis of additional local regulations issued to protect areas at risk.
5.7
Penalties

Deliberate or accidental actions which harm water intended for or distributed for human consumption are punishable, under Italian Penal Code, by prison sentences, or in less serious cases by fines. PD 1988 introduces a number of other offences which are also punishable by imprisonment or by fines. These cover:

- The supply of water for human consumption which does not conform with the quality standards specified by PD 1988. This is punishable by a fine not exceeding 2 million lira (about £800) or by detention for a period of not more than 3 years;

- Use of water in the food industry which does not conform with the quality standards specified by PD 1988. This is punishable by a fine not exceeding 2 million lira (about £800) or by detention for a period of not more than 3 years;

- Fines (not exceeding 3 million lira - about £1200) can be imposed for
  - failure to keep record cards for the use of pesticides and other approved chemicals in agriculture;
  - failure to obey restrictions associated with protection zones (see Section 5.8);
  - failure to implement plans for the improvement of water supplies enforced in cases of derogations.
5.8
Protection zones

PD 1988 seeks to protect water supplies by controlling and restricting the actions taken by private property owners and by industry and agriculture. Thus it introduces protection zones in order to safeguard spring and wells (groundwater supplies) and intakes (surface water supplies).

Zones of two types are specified. These are:

- Total Protection Zones. These must have a radius of not less than 10 m around the source. This may be increased though if warranted by local circumstances. As the name implies no activity at all is allowed within these zones;

- Limited Protection Zones. These should have a radius of not less than 200 m. They may, however, be decreased in size if warranted by local circumstances. PD 1988 prohibits a wide range of activities considered to be incompatible with the protection of the source in these limited protection zones. These are:

  - spreading or injection of effluents, sludges or sewage;
  - storage of organic manures;
  - soakaways for the dispersion of storm waters;
  - cemeteries;
  - use of pesticides and fertilisers;
  - quarrying;
  - dumping of domestic waste;
o dumping of solid or liquid industrial waste, of dangerous substances or of radioactive materials;

o collection and scrapping of motor vehicles;

o housing and grazing of animals;

o laying of new drains or of installing cesspools. In fact, the competent local authorities and especially the local commune must arrange for existing drains and soakaways to be removed from these zones.

A further class of protection zones, ie up to 1 km around the source, is under consideration but has not yet been adopted.

In addition to the creation of protection zones, the Decree also requires that in order to protect surface water intakes, the banks of the lakes and rivers from which the source is taken should be improved and that the discharge points for storm water and sewage should be sited away from the water supply intakes.

5.9 Derogations

Powers of derogation, similar to those given in the Drinking Water Directive, are included in PD 1988. Exercise of such powers, however, is subordinated to the outcome of a Plan for Action which must be adopted by territorially competent regional authorities when applications for derogations are received. The Plan of Action must cover at least the following:

o identification of the cause of the problem;
5.10 Delays

The Decree allows for delays; that is, extension of the period of time before compliance with the requirements given in the Decree for particular parameters must be achieved, in a manner similar to that described in Article 20 of the Directive.

Provision for a delay is provided by a decree issued by the Ministry of Health and the Ministry of the Environment acting on an application received from the region involved which has the power of initiation. For this, the region must:

- specify the objective, method and timing of the delay;
- identify causes of the problem;
- present a plan for the improvement of the waters concerned aimed at meeting the requirements of PD 1988 within the specified time period;
o integrate the improvement plan with additional measures taken by the Ministry of Health and the Ministry of the Environment.

Activation of the delay procedure is not a sufficient basis for it to be automatically accepted. Thus the government must be sure of the need for the request, that it fits in with the National Water Improvement Plan and that it will be accepted by the Commission who examines all such delays issued, according to the requirements of Article 20 of the Directive.

A description of the request for one such delay, that for Atrazine and Molinate, is given in Section 6.2.

5.11 Public availability of information on drinking water quality

PD 1988 does not recommend any specific system of information for consumers on the quality of drinking water. It does, however, require operating bodies and the Health Service via its local offices, and acting under existing health legislation, to adopt "immediate provisions" as soon as the results of analysis or inspection indicate any possibility of risk to human health.

The right to information about the environment is affirmed in the law which created the Ministry of the Environment and a further law is being drafted to make this right more generally recognised. Many regions have, in fact, already adopted similar laws which do ensure an effective system of environmental information.

At present it is felt that PD 1988 does not give equal importance to informing the general public as it does for the authorities. However, following
the integration of the Protection of Groundwater Directive (80/68/EEC) into Italian Law, which it is anticipated will contain specific requirements for the public right to information and of the need to harmonise this Law with others, it can reasonably be expected that the Government will introduce new measures concerning the easier access to this information by the public (perhaps by setting up a publicly-assessible computerised information network).

It should be mentioned that in some areas (for example, around Bergamo in the Lombardia region) the public have already been granted access to public health authority and water undertaking data.

6. PRESENT ARRANGEMENTS FOR WATER SUPPLY

PD 1988 was announced at the end of May 1988 and as a consequence its requirements have not been fully implemented. Accordingly a description of the present, ie pre PD 1988 arrangements, is given below.

6.1 Rome

ACEA (the operating company for Rome) has ample good quality supplies and as a consequence has few problems in meeting the requirements of the Drinking Water Directive. Water is taken mainly from groundwater sources with a total capacity of about 20 m³/s (though only about 15 m³/s is regularly abstracted). It does have surface water supplies (capacity 0.5 m³/s) taken from a lake some 50 km from Rome. This water is treated by pre-chlorination (ClO₂), flocculation, clarification, filtration (rapid sand) and post-chlorination (ClO₂). It is mixed in the ratio of about 1:10 with groundwater from a 5 m³/s source before distribution.
Water is sampled for compliance with the required standards at the source, in the aqueduct and at fixed points throughout the distribution system and especially at the end of distribution systems. About 60 samples are taken each day for checks on bacterial content and about 30 for residual chlorine and other parameters (some 30 parameters are analyzed for on a routine basis).

When the bacterial content exceeds the MAC (and is confirmed by repeat sampling and analysis) the disinfection level is increased to give a chlorine residual of 0.2 mg/l. In this case, the mayor of the commune affected has to be informed by the public health authorities so that he can issue instructions that drinking water has to be boiled before use.

ACEA report that there have been only two cases where a system has had to be closed down due to the quality of the water distributed. These both involved problems with supplies derived from the surface water source. One concerned the presence of methyl bromide and the other of radioactivity (perhaps due to a discharge from a local hospital) in the distributed water. In these cases, the problems were resolved by supplying the affected systems with water taken from other parts of the interconnected network which had been fed by groundwater-derived supplies and allowing the pollutants in the surface water to disperse.

ACEA has excellent relationships with the local health authorities (USL in Rome, the Ufficio Interzonale) who have their own laboratories and take samples for analysis from the distribution network at the same points as ACEA. Local health authorities do not have to inform ACEA when samples are to be taken.
The local health authorities notify ACEA when they are not satisfied with the quality of the distributed water. Main problems in the past concerned high levels of bacteria and the quality of water supplied at public drinking fountains. The latter problem is of low priority for ACEA since, although these fountains are a public service, nobody pays for the water supplied. It is usually left to the local mayor to try to resolve the problem.

Main complaints received from the public about water supplies concern the hardness (about 30 °F) and the smell of chlorine. Consumers can ask for special analyses of their water supply and can see the results obtained.

In some parts of Rome there is a dual distribution system which supplies commercial water (ie of a lower quality) in addition to drinking water.

6.2 Bergamo (Lombardy region)

AMAC (the operating company for Bergamo) derives its raw water supplies from wells (10%) and from mountain springwater (90%). These are treated usually by pre-chlorination (ClO₂), pressure filtration and post-chlorination (ClO₂).

The water is sampled at the source and at several points in the distribution network every day. These samples are analysed for compliance within AMACs own laboratories (bacterial testing is sometimes sub-contracted to an outside commercial laboratory). Two 'menus' of analyses are in use. These deal with:
i) "routine" monitoring (carried out each day) which involves the analysis for colour, taste, pH, turbidity, conductivity and chlorine residual. The microbiological quality of some of these samples is also checked.

ii) "full" analysis (carried out each week) for appearance, colour, taste, pH, turbidity, conductivity, alkalinity, residual on drying, ammonia, nitrate, nitrite, chloride, sulphate, oxidisability, chlorine residual, surfactants, zinc, chromium, cadmium, nickel, copper and lead. The microbiological content (bacteria, fungi and coliforms) of some of these samples is also checked.

It problems with the quality of water are discovered during these analyses, a repeat sample is taken and analysed. USL also undertakes limited sampling and analysis of the quality of distributed water, taking samples at fixed points in the distribution system.

USL notifies AMAC when they are not satisfied with the quality of the distributed water. AMAC claims, though, that this information often arrives too late and that they are usually already aware of the problem.

USL does not normally ask AMAC for their analytical data except in cases where problems have occurred. The public in Bergamo, though, do have access to both USL and AMAC analytical data on request.

Major problems have occurred in this area due to the presence of pesticides (mainly Atrazine and Molinate) in the groundwater. A delay of the MAC for Parameter 55 (see Section 5.10) has been
granted and an MAV of 1 µg/l has been instituted. It is expected that further extensions (up to 2 µg/l) will be permitted.

In 1986, for example, some 50 networks, supplying water to 200,000 people, were affected by high levels of these pesticides. Attempts were made to reduce the level in supply by blending with better quality water taken from deeper aquifers and by additional treatment. In the past groundwater was abstracted from 3 layers 20-150 m deep. However, a further layer 250-300 m deep is now being utilised and about 30 new wells have been sunk into it. The additional treatment involves the use of Granular Activated Carbon (GAC). This is claimed to be efficient but costly since the GAC has a life of only 1-2 months. Furthermore the area is served by many small works which do not have GAC facilities.

Even though the Government has introduced measures to restrict or prohibit the use of these pesticides it is expected to be many years (10-20) before the levels in the groundwater begin to fall significantly.

Other problems with the quality of water supplies in the area concern turbidity and, occasionally, nitrates.

The cost of water supplied to the consumer in this area is about 20 p/m³.

6.3 Puglia region

EAAP (the operating company for the Puglia region) derives its raw water supplies (20 m³/s) 30% from springwater, 45-50% from surface water and 20% from groundwater. Some of this springwater is obtained from the central mountain region, some 240 km away,
and is conveyed by aqueduct to the treatment plant. The water is normally treated by rapid gravity filtration and chlorination (ClO₂ or NaOCl) before distribution. Sometimes though the water only receives chlorination before distribution.

EAAP have a number of local laboratories for examining the quality of water in the various municipalities served. These employ 8-10 analysts each. The water is sampled at the source, at the treatment plant and at fixed points in the distribution system. Samples taken twice a day from these sampling points are analysed for turbidity, pH, conductivity, temperature, alkalinity, temporary and permanent hardness, dissolved oxygen content, chlorine residual, calcium, magnesium, chloride, ammonia, nitrate, nitrite, phosphate, oxidisability, surfactants, sulphate, silica, aluminium, chromium, manganese and sulphur. The microbiological quality of some of these samples is also checked.

In addition to the analysis described above, further samples are analysed twice a week for potassium, iron, lead, zinc, cadmium, fluoride, ammoniacal and Kjeldahl nitrogen and aluminium.

A few problems with the quality of drinking water have been reported. These concern high levels of aluminium, turbidity, oil (from illegal discharges from industrial zones), ammonia (due to contamination by sewage) and bacteria. In the latter case, the problem was treated by increasing the disinfection to leave a chlorine residual of 0.2 mg/l.
EAAP does not pass its analytical data on to USL unless specifically requested when unresolved problems occur. The public can obtain access to EAAP's data but only through USL or the local mayor.

USL in this area has few staff involved in checking the quality of the water supplies and tends to rely on the water undertaking (EAAP) to ensure quality is maintained. It is claimed (by EAAP) that at times USL has only sufficient staff to check on the residual chlorine content. Nevertheless USL states that it does carry out spot checks usually analysing for colour, odour, taste, pH, conductivity, chloride and free chlorine. These are usually carried out at weekly intervals. Monthly checks are also made and, in addition, to the parameters listed above, are analysed for turbidity, temperature, hardness, residue on drying, calcium, sulphate, ammonia, nitrate, nitrite, iron, phosphate, cadmium, chromium, lead and microbiological quality.

USL claims that it finds few problems with the quality of the distributed water. When problems do occur, repeat samples are taken and analysed before EAAP are notified.

Occasionally problems have been found with high levels of chloride caused by intrusion of sea water (near Lecce) and by bacteria (following a burst main). No problems are reported though for phosphates or nitrates. USL expects that there are problems due to pesticides but, at present, does not have the necessary equipment to analyse for them. It intends to make greater use of commercial laboratories to analyse water samples and to employ more staff and equipment itself.
7. WATER QUALITY PROBLEMS IN ITALY

The quality of Italian water supplies is generally good and normally meets the requirements of the Directive. It can be argued that this is due largely to the almost total reliance on groundwater supplies. Even so a number of problems concerning the quality of water supplies have occurred and these are described below.

By far the most serious water supply problem concerns pesticide levels (mainly Atrazine and Molinate) found in groundwater resources in the region of Lombardia. This has resulted from the extensive agricultural use of these pesticides in this area. More than 200 000 people served by some 50 distribution networks have been affected. It is being tackled by blending the affected water with good quality water taken from deeper aquifers and by introducing additional treatment (GAC). A suspension of the MAC for pesticides (Parameter 55) has been granted and an MAV of 1 μg/l (likely to be increased to 2 μg/l) has been established. This action, which was taken following agreement with the European Commission, also involved:

- The Ministry of the Environment issuing a number of regulations containing precautionary restrictions on the use throughout the country of formulations containing initially Atrazine and latterly Molinate;

- Making it obligatory to keep a "Log Book" recording all purchases and use of approved substances (which included Atrazine and Molinate);
The Ministry of Health is issuing a number of regulations laying down the maximum dosage and permitted use of weed killers and including Alachlor, Bentazone, MCPA, Metolachlor, Pendimethalin, Piridate, Propanil, Simazine and Trifluralin.

The suspension of the MAC for Parameter 55 is being granted by the Government on a rolling 6-month period basis. The latest of these, and said by the Ministry of Health to be the last, was granted in May 1988 and will extend until the end of the year.

Other problems with water supply in Italy concern:

- Temperature – this affects supplies to some communities (particularly in the south of Italy and the larger islands) which tend to rely more on surface water sources;

- Nitrate – the areas affected by higher nitrate levels resulting from intensive agriculture are Marche, Emilia-Romagna, Lombardia and Piedmont. Supplies to about 100,000 people are affected. Highest level reached in the groundwater was close to 100 mgNO₃/l. This was found in Marche but then only in certain periods of the year. In most cases, it has been possible to supply water which meets the limit for nitrate by blending the affected groundwater with other waters of a lower nitrate level;

- A few minor areas are affected by higher levels of ammonia (which it is claimed is naturally present) and by potassium;

- high levels of iron (Naples);
• Fluoride - up to 4 mg/l (near to Mount Versuvius);

• Organic chemicals in River Adige (Venito) due to illegal discharges;

• Bacteria in some raw water sources due to sewage from soakaways and cesspools and following breakages of the water mains;

• Problems due to presence of viruses in surface waters noted in some areas;

• Turbidity and colour of distributed waters (southern Italy and especially after heavy rain);

• Aluminium and chloride (Puglia);

• Sulphate (isolated pockets throughout the country).
APPENDIX E

THE EC DRINKING WATER DIRECTIVE IN THE NETHERLANDS
1. WATER RESOURCES IN THE NETHERLANDS

The total volume of water supplied by the public utilities in The Netherlands is around 3000 Ml/d of which about 2400 Ml/d (80%) is for domestic use. The total freshwater inputs are estimated at about 300 000 Ml/d of which around 63% is contributed by the Rhine as it flows into The Netherlands. The Netherlands has a very high population density with a land area of 37 000 km² (15% of the UK) but with a population of 14 million (28% of the UK).

About one-third of the total water supplied is taken from surface water sources, mainly the rivers Rhine and Meuse. Of the remainder the major part is true groundwater. A minor part comes from river bank water which is a mixture of groundwater and river water. Because of the influence of river water on river bank waters they are subject to contamination but often with delays of up to five years. As a result taste and odour can be a problem and simple treatment is not sufficient. The surface water supplies are mainly in the north and west of the country coinciding with the areas of high population density, and the absence of fresh groundwater.

Originally the Rhine was used extensively for drinking water but because of its vulnerability and the detection of trace contaminants it has gradually been replaced with water from the Meuse with extensive reservoirs provided to store Meuse water in the Brabantse Biesbosch and Andelse Maas areas. The remaining users of the Rhine include Amsterdam and North Holland where extensive treatment plus dune infiltration are used. A further source for Amsterdam and North Holland is the IJssel lake but this is fed largely from the
Rhine and is subject to some of the same problems. The total quantities abstracted are around 219 Ml/d from the Rhine (145 for Amsterdam and 74 for North Holland) and 109 Ml/d from the IJssel lake (74 Ml/d for Amsterdam and 35 Ml/d for North Holland). The Meuse is of better quality generally than the Rhine but can be subject to pollution and the quantity available is much less.

Groundwater resources supply areas in the north-east, the east and the south-east which have sandy sub-soils and can be subject to agricultural pollution and sea water intrusion. The limited availability of further groundwater sources mean that some future supplies will have to be taken from surface water. However, the plan for the year 2000 assumes that the proportion of groundwater supplies will remain at 2/3. The contamination of these sources is thus of great concern.

The Dutch government produces a comprehensive structural scheme part of which covers public and industrial water supplies. The suppliers are required to draw up a ten-year plan for water requirements to fit into the structural scheme. Drinking water has a priority call on resources. The ten-year plan is rolled forward at five-year intervals and is jointly drawn up by the suppliers through VEWIN, The Netherlands Waterworks Association. This is a highly influential organisation which also provides representation for the water companies at national and international level. The second ten-year plan was produced in 1984 covering the period up to 1995. The plans are prepared in close collaboration with the Ministry of Housing, Planning and Environment and the Ministry of Transport and Public Works together with provincial authorities.
Surface water quality is the responsibility of the national water authority (Rijkswaterstaat) which is charged with drawing up water quality schemes for the main water courses. The provinces are responsible for drawing up similar schemes for other surface waters. A decree of 3 November 1983 includes quality requirements for drinking water abstraction, bathing, fish and shellfish in line with the EC Directives. The requirements for drinking water abstraction are more stringent for some inorganic and organic substances than the A3 values in the Surface Water Directive. The reason given is that this prevents 'filling up' to the limits in the Directive and provides incentives for improvements in respect to critical parameters.

Water authorities exist in each of the twelve provinces with boards having representatives from the provincial authority, land owners, industry, agriculture and government. Because of the history of flood control in The Netherlands, existing laws on the operation of the polders pre-date other legislation and these are administered by a large number of small bodies (50 in Groningen alone). They have powers which can take precedence over national law and this complicates the machinery for surface water quality control.

2. WATER SUPPLY ARRANGEMENTS IN THE NETHERLANDS

Water supply in The Netherlands is in the hands of a large number of local companies. There are several different forms:

* private limited companies
* foundations
* municipal water companies
* provincial water companies.
This fragmented structure has, however, been subject to some criticism in recent years, with the result that the administrative structure of drinking water supply is now being reorganised. The emphasis of this reorganisation is to create a smaller number of larger companies, with the ultimate aim of reducing the present number of 86 companies to 15-20. Such a reorganisation will inevitably extend over many years and in the medium term it might be expected that the number will be reduced to about 25 by 1995. By this time it is almost certain that all drinking water suppliers will be private limited companies (though with public authorities – provinces and municipalities – as the only shareholders). Within such a fragmented structure, co-ordination of the many companies is essential and this is the responsibility of VEWIN.

3. DRINKING WATER LAW

The management of drinking water supplies in The Netherlands is regulated by the Waterworks Act 1957 (Stb 1957, 150). The quality of drinking water is prescribed by a statutory instrument issued under that Act: the Waterworks Decree of 7 June 1960 (Stb 1960, 345). But this Decree, although laying down a number of standards for drinking water quality, was of insufficient scope to give effect to the Drinking Water Directive’s provisions. A set of amendments was consequently enacted on 2 April 1984 (Stb 1984, 220) and took effect from 1 July 1984 – two years after the formal compliance date. These amendments to the Waterworks Decree lay down quality standards for all the parameters in the Directive. Moreover, the parameters set out in Appendix A to the Decree are divided into four distinct categories:
1. MAC values that must not be exceeded under any circumstances. These include all the Directive's Table D toxic parameters which have MAC values plus total coliforms, faecal coliforms, faecal streptococci and sulphite-reducing Clostridia.

2. Minimum concentrations for total hardness and alkalinity for softened or desalinated water.

3. MAC values that may be deviated from under Article 9(a) and 9(b) of the Directive. These include all remaining substances having MACs in Tables A, B and C of the Directive and there is also a note on aggressivity.

4. MAC values that may be deviated from where it would be unreasonable to require compliance by the drinking water company, taking into account the raw water quality, treatment and distribution of the water. This table includes those parameters in Tables B, C and E of the Directive where MAC's have not been set. For conductivity, chloride, calcium, copper, zinc, suspended solids and boron annual averages may be used.

The MAC values in the amended Decree are largely as in the Directive, although five are more stringent. These are:

- sulphate (150 mg/l)
- sodium (120 mg/l)
- dry residues (1000 mg/l)
- ammonia (0.2 mg/l)
- sulphite-reducing Clostridia (absent in 100 ml)

There are also limits of no total coliforms or faecal coliforms in 300 ml for ex-works samples but for distribution samples the Directive's values are
taken. For sulphate and chloride dispensations may be given to allow values up to the Directive's MACs. Of the nationally imposed MACs the pH limit is tight (7-9.5) as are the limits for conductivity (1250 µS/cm) chloride (150 mg/l), calcium (150 mg/l), boron (1 mg/l) and suspended solids (1 mg/l), albeit on an annual average basis. For copper and zinc the guide levels in the Directive have been made MACs. One surprising inclusion in the regulations is a limit of 1 µg/l for organo-chlorines other than pesticides (parameter 32) but the monitoring requirements do not include a frequency for this parameter. A limit of 1 mg/l has been introduced for substances extractable in chloroform.

Responsibility for drinking water in The Netherlands at State level is held by the Ministry of Housing, Planning and Environment. It was originally combined with the Health Ministry but was separated in 1982. It is now self-contained in relation to setting standards and has its own toxicologists. On special matters it may consult the Health Ministry, as it did for example on nitrite standards.

Responsibility for water quality is exercised through the Public Health and Environmental Hygiene Inspectorate which is regionally located. The Inspectorate, which deals with water, air and other environmental matters, has a Chief Inspector and individual Inspectors for each topic, including one for water. The Inspectors have considerable autonomy in the regions and some public groups believe that they are too independent. It is the Inspector who makes decisions on potability. He has powers to direct the suppliers backed up by the
Minister if necessary. However, the regulations allow the company to appeal to the Minister concerning any instruction from an Inspector.

4. APPLICATION OF THE DRINKING WATER DIRECTIVE

4.1 Responsibility for monitoring

Water suppliers are responsible for sampling and analysis and any supplier having more than 10 000 connections must have an adequate inspection department and laboratory. All sampling programmes must be approved by the Regional Health Inspector. Check sampling and analysis are carried out by RIVM, The Environment Ministry's research institute. RIVM carry out tests once a year on samples from pumping stations and randomly selected points in the distribution system but for a restricted number of parameters, mainly microbiological, turbidity and a few others. The results are reported to the Ministry and to the supplier. Regional health inspectors do not have their own laboratories and therefore rely upon the results from suppliers and RIVM. The law requires suppliers to send a summary of the annual results to the health inspector within six months of the end of the calendar year. The results must be kept for five years. The Environment Ministry is currently developing means of computerising results so that they can be inspected centrally.

4.2 Analytical quality control

Most laboratories in The Netherlands operate internal checking systems by means of standard samples introduced into each batch of real samples. In addition all laboratories belong voluntarily to a KIWA (Netherlands Waterworks Testing and Research Institute) ring test scheme. Standard methods are specified in the regulations and these must be used
unless other methods can be shown to be capable of producing comparable results. All Laboratory Heads also belong to a laboratory committee. Between them the 86 companies operate 25 laboratories. Consideration is currently being given to the certification of all laboratories in The Netherlands and it is anticipated that water laboratories could be certificated within the next ten years. KIWA also operates a system for setting the cost of analysis for specific parameters which all laboratories follow.

4.3
Sampling points

The Regulations specify that samples must be taken from the raw water source from the outlets of pumping stations and in distribution systems. There must be one sampling point in distribution for each 10 000 population. Random or fixed sampling is not prescribed and reference is not specifically made to taps. Although the supplier's responsibility ends at the stop-tap the individual contracts with consumers include right of access. In addition Dutch housing legislation requires that the household fittings should not cause contamination of the water and there is a full testing procedure for fittings. Standards are laid down by the supply companies and right of inspection is included. Some tap sampling is carried out from selected houses and public buildings such as police stations.

In some cases fixed points are sampled in rotation. For example in Groningen 51 points are rotated on a six-week cycle. In North Holland 800 points are sampled four times a year, which is above the requirements of the Regulations. Here again the points are chosen to detect the worst positions in distribution systems, for example points with low
flows or dead ends. The company intends to discuss with the Inspector changing to a scheme where less sampling is carried out in areas where few problems are found to allow more investigative work on problem areas. It is clear that not all sampling regimes are uniform throughout the country and different Inspectors have different views on adequacy.

4.4 Sampling frequency

A table of frequencies is given in the Regulations covering a total of 71 parameters. This is more than included in the Directive because additional parameters such as qualitative taste and odour, individual pesticides, radioactivity and salmonella are listed. Parameters are marked I and II and for class II substances lower frequencies of measurement can be allowed by the Inspector. He can also specify higher frequencies for some parameters or include additional parameters.

Distribution system sampling frequencies are 26, 4 and 2 times per annum depending on the parameter. The frequency must then be multiplied by the number of sampling points (1 per 10 000 population) to obtain the total frequency. Ex-works sampling frequencies include continuous or daily, 52, 13, 4 or 1 times per year for groundwater, and continuous or daily, 52, 13 and 4 times per year for surface water. Bulk supplies must be sampled at ex-works frequencies. These numbers are independent of population. Table 1 gives as an example the frequencies for C1 and C2 parameters for populations of 10 000, compared with the Directive values. The numbers for ex-works and distribution have been added together but raw water sampling has been excluded. It can be seen that the frequencies exceed the Directive requirements except in the
# TABLE 1 - COMPARISON OF SAMPLING FREQUENCIES IN THE NETHERLANDS WITH THOSE SPECIFIED IN THE EC DIRECTIVE

<table>
<thead>
<tr>
<th>Parameter</th>
<th>10,000</th>
<th>Population</th>
<th>50,000</th>
<th>100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EC</td>
<td>Ground</td>
<td>Surface</td>
<td>EC</td>
</tr>
<tr>
<td><strong>G1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taste and odour (Qualitative)</td>
<td>12</td>
<td>26</td>
<td>26</td>
<td>60</td>
</tr>
<tr>
<td>Conductivity</td>
<td>12</td>
<td>39</td>
<td>26+cont* or 391</td>
<td>60</td>
</tr>
<tr>
<td>Residual Chlorine(^{(1)})</td>
<td>12</td>
<td>26+cont* or 391</td>
<td>26+cont* or 391</td>
<td>60</td>
</tr>
<tr>
<td>Total coliforms</td>
<td>24</td>
<td>78</td>
<td>391</td>
<td>120</td>
</tr>
<tr>
<td>Faecal coliforms</td>
<td>24</td>
<td>78</td>
<td>391</td>
<td>120</td>
</tr>
<tr>
<td><strong>G2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taste and odour (Quantitive)</td>
<td>3</td>
<td>4</td>
<td>52</td>
<td>6</td>
</tr>
<tr>
<td>Temperature</td>
<td>3</td>
<td>78</td>
<td>26+cont* or 391</td>
<td>6</td>
</tr>
<tr>
<td>pH(^{(2)})</td>
<td>3</td>
<td>56+cont* or 421</td>
<td>56+cont* or 421</td>
<td>6</td>
</tr>
<tr>
<td>Nitrites</td>
<td>3</td>
<td>6</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Nitrites</td>
<td>3</td>
<td>15</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Ammonia</td>
<td>3</td>
<td>15</td>
<td>54</td>
<td>6</td>
</tr>
<tr>
<td>Total bacterial counts (\text{22}^\circ\text{C} \text{37}^\circ\text{C})</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>

\(^{(1)}\) Where disinfected  \(^{(2)}\) Only where pH correction practised  * continuous or daily
case of quantitative taste and odour for groundwater supplying populations of 50 000 and 100 000 and all cases for total counts at 22 °C and 37 °C. However, it is stated that most suppliers operate in excess of the minimum specified and would therefore comply.

A number of footnotes to the frequency table qualify the frequencies for certain parameters mainly giving the conditions under which it is necessary to monitor for the parameter or allowing monitoring frequency to be reduced or monitoring stopped.

4.5 Action taken when a sample fails to meet the MAC

Under Article 6 of the Waterworks Act water suppliers must inform the regional Regional Health Inspector immediately of any circumstance which might reasonably be expected to form a risk to proper compliance with the Act. Article 63 empowers the Minister of Environment to take any appropriate remedial action necessary to ensure compliance. Any costs incurred can be recovered from the supplier. In practice some differentiation is made between aesthetic and other parameters. Exceedance by category I parameters (Directive table D plus microbiological parameters) must be reported to the Inspector. Special clauses in the regulations instruct the supplier to notify the Inspector if concentrations at the pumping station outlet exceed 5 µg/l for arsenic, 1 µg/l for cadmium, 0.2 µg/l for mercury or 15 µg/l for lead.

A clause was added at a late stage which requires suppliers to notify the health authorities if ex-works aluminium levels exceed 30 µg/l. For
bacteriological samples an exceedance would lead to resampling with a report to the Inspector if the position is confirmed.

In the case of customer complaints the Health Inspector can report these to RIVM who can then investigate. Following a report to the Health Inspector discussions take place between him and the supplier to decide an action plan. Water supply can continue in the meantime provided the Inspector is convinced that there is no health risk. In some cases a warning might be given to consumers, for example where dirty water problems could affect clothing. For occasional exceedances of aesthetic parameters such as iron, reports would not normally be made but the results would appear in the annual returns provided they are not spurious figures due to sampling or analytical errors. The laboratory will often contact the treatment works or pumping station to investigate the reasons for such high values.

Penalties are included in the Regulations. Infringements by water suppliers of the Waterworks Act or the Waterworks Decree are punishable by a maximum of six months imprisonment or a fine of up to NFl 5000. Ultimately it is the director of a water supply company who is responsible for infringements, although there is no case of the penalties being imposed. In one case a director was dismissed for failing to improve a sub-standard water supply. He claimed that his board would not provide adequate funds but his case was compounded by a failure to notify the health inspector.

A more recent case concerns discharges of bentazone into the Rhine from the BASF works. The director informed the Health Inspector that the Directive
limit was being breached but this information did not reach the public for about nine months. This created a storm when it was known and both the Inspector and the supplier were criticised. The Ministry supported the delay on the grounds that the information had to be confirmed and an action plan worked out. Carbon treatment will be installed to remove the pesticide but this will take about 2 years and will cost Amsterdam about £30 m per annum. In the meantime two consumers started proceedings against the supplier but were advised by their counsel not to proceed on the grounds that the case was unlikely to succeed. The defence would be that the Ministry had confirmed that there was no threat to health, that an action programme was in place and that pressure was being put on the discharger (BASF) to modify or stop the discharge.

5. WATER QUALITY PROBLEMS IN THE NETHERLANDS

Although a EUREAU survey produced a list of nearly 30 problem parameters for The Netherlands, this was thought to be exaggerated by the water supply personnel with whom discussions were held. The Ministry stated that there were no formal derogations in place under Article 9 of the Directive but dispensations had been given for about six parameters, notably potassium (for which it was felt the standard should be amended), permanganate value, colour and nitrate. The most problematic parameter at the present time is pesticides.

Pesticides. The topic which is creating much public attention at the moment is the bentazon problem referred to previously. Measures have been taken to reduce the discharge but levels in supply
still exceed the MAC in the Directive. The Netherlands is opposed formally to a change in the standard because this would mean that consumers would be exposed to increased pesticide concentrations and it would weaken the case for control on use. In the meantime advice has been obtained on the likely health effects of the concentrations found and the Ministry has concluded that it is safe to proceed temporarily whilst remedial measures are implemented. North Holland have decided to eliminate the direct supply from the Rhine and use water from the IJssel Lake from the end of this year. North Holland have also found bromacil in a groundwater supply in the southernmost part of its supply area and activated carbon is used to treat this water. Dichloropropane has also been found and aeration is used to treat the affected supplies. Intensive monitoring for eleven individual pesticides by the Groningen Water Supply Company on their single river supply source, the Drentse Aa, has shown that concentrations can exceed the EC limit during the period May - September for atrazine, simazine, MCPA, MCPP and Dinoseb, with some peak concentrations in excess of 1 μg/l. Similar peaks for dichloropropane have been found in the February - June period. Since the supply uses a mixture of surface water and groundwater it is possible to switch to groundwater during problem periods although extended periods of operation in this way can lead to saline intrusion.

Groningen has made extensive studies of pesticides used in their area and 54 have been listed. Groningen laboratories can measure 24 of these at levels equal to or less than 0.1 μg/l and 14 at 1-10 μg/l. In The Netherlands as a whole the
figures are 29 and 14 respectively. As monitoring for pesticides increases it is likely that further contamination will be found elsewhere.

There are already black and grey lists of pesticides which are prohibited or controlled within protection zones. The Ministry would like to see further development of pesticides with reduced persistence. They believe that if degradation can be effected in less than three months water supplies would be protected. Substances which have biodegradation times in excess of this period should not be used. In the meantime retention of the standard and installation of treatment is seen to be the way forward.

Nitrate. Although the existing problem is small - affecting only 0.8% of the supplies - it has been predicted that the limit could be exceeded widely in the future if action were not taken. Controls on fertilisers and farm slurries will operate from 1 October 1988. Slurry storage and redistribution will be necessary although animal numbers will not be reduced. It is expected that the increase in nitrate concentrations will be checked by the year 2000 and in the meantime blending and treatment will be used to comply.

Trihalomethanes (THMs) and other chlorinated organic substances. No limit has been laid down in The Netherlands for THMs but VEWIN have recommended limits for drinking water quality which include 70 μg/l for chloroform. This value can be exceeded at times but there are now moves to eliminate chlorination, this having already taken place in Groningen, The Hague, parts of North Holland and Amsterdam.
The self-imposed limit of 1 μg/l under parameter 32 is clearly exceeded but there is no duty to monitor for this parameter unless measurements for AOX and VOX show this to be necessary. If values in excess of 1 μg/l are found a full sampling schedule has to be implemented if there is any indication that the concentration can reach a value in the supply which is considered harmful for public health reasons. The schedule must be approved by the Public Health Inspector.

Some solvents such as trichlorethylene have been found in drinking water in certain areas and permeation of plastic pipes has been demonstrated.

Taste and odour. Problems can arise in surface waters, such as the Biesbosch reservoirs, due to algal growth and the release of geosmin. Other problems can arise from chlorination of water containing high levels of ammonia, either surface supplies or anaerobic groundwaters subject to contamination from manure spreading.

Lead. There is a small lead problem in a few cities. Suppliers are obliged to carry out standard tests for plumbo solvency based on proportional sampling. Removal of lead pipes is suggested when mains or houses are being renovated. For other supplies action such as raising the pH of the water must be taken where the tests indicate a problem.

Nitrite. There have been a few small problems with nitrite where chloramination is used.

Aluminium. Aluminium is not a general problem in The Netherlands, in fact only two plants are said to use aluminium coagulation. Provided that pH
correction is made after filtration residuals can be controlled. The need to advise the Public Health Inspector when concentrations exceed 30 µg/l leads to careful control of this parameter.

Sodium. Dispensations have been given for sodium in situations where sodium hydroxide is used for pH correction and softening. The need for dispensation is increased because the national limit has been set at 120 mg/l as a maximum but the parameter is included in the table for which derogations can be given.

6. PROTECTION ZONES

A protection zone system is being developed in The Netherlands. Three zones are defined giving 60-day, 10-year and 25-year travel times as the zones extend outwards. There is some evidence that substances used outside the zone can penetrate to water abstracted within. In addition there are cost penalties for water suppliers because they have to compensate farmers on the basis of the cost of maintaining a higher quality of water inside the zone compared with outside. Therefore the suppliers support the concept of a general protection level (for the whole country) which ensures good groundwater quality. This general protection level quality has not been defined completely. Additionally until the protection measures become effective the water suppliers will have to pay for remedial measures.

There is also a feeling that it might be difficult in future to establish new groundwater sources outside the zone. The whole question of groundwater protection is subject to decentralised law which is the responsibility of the provinces.
7. PUBLIC AVAILABILITY OF INFORMATION ON DRINKING WATER QUALITY

There is no formal requirement in law to make available quality data to the public. The requirement is the yearly report to the Public Health Inspector. Nevertheless it is considered important to maintain good relations with the Inspector and with the media and active consumer groups. Only the results of the laboratory analyses carried out to monitor compliance are reported to the Inspector. Results of operational monitoring are not reported but it is expected that action is be taken if exceedances are found. The suppliers try to maintain openness with the media and action groups because they believe that such groups can help to put pressure on polluters to protect water sources. Equally they feel that the public lose interest in water matters if information is not reported. Full details of the quality of consented effluent discharges are available for each province. A summary of water quality is included in many of the companies' annual reports but in some municipalities there is opposition by the politicians on the grounds that it is too technically detailed. At present the Ministry is considering systems for computerising results and will propose a system of reporting to Parliament and the press.

The Ministry of Housing, Planning and Environment has been asked by the European Commission to send information on exceedances to Brussels. The Ministry can supply data on toxic substances fairly readily but other parameters will take much longer.
A consumer survey commissioned by VEWIN showed a fall in confidence concerning water quality during the last year largely it is thought due to the bentazone problem in Amsterdam. However, the support was maintained at a high level.

8. WATER TREATMENT TECHNOLOGY

The Netherlands is one of the most advanced of the Member States in terms of water treatment processes. This arises because of a combination of surface and groundwater contamination problems and a strict attitude towards standards. The general philosophy of combining pressure on prevention of pollution with remedial treatment has led to much innovative work on processes.

Conventionally The Netherlands has always adopted extensive treatment of the surface supplies from the Rhine because of their overall low levels of quality. Extensive work has been carried out in Amsterdam and Rotterdam to develop processes to deal with micropollutants and to avoid formation of potentially hazardous substances during treatment. Collaborative work with KIWA has featured prominently in these developments.

Trihalomethane formation and the creation of other undesirable by-products has led to the restriction or elimination of chlorine as a disinfectant or to the use of advanced organics removal plant, including ozone and carbon prior to final disinfection. Alternative disinfectants have also been explored.

Use of high quality groundwaters in order to avoid treatment and the need for disinfection has been a feature of Dutch practice but the discovery of
organic solvents and pesticides in some of these sources has caused concern and has led to the application of carbon treatment. Dune infiltration has been widely used although it has now become necessary to treat the surface waters more extensively before recharge and to move to relatively cleaner rivers such as the Meuse.

Although it is hoped that controls on nitrogen inputs will prevent nitrate limits being breached, some pilot plant work on denitrification processes is in progress mainly concentrating on sulphur/limestone treatment and combined ion exchange/biological denitrification.
APPENDIX F

THE EC DRINKING WATER DIRECTIVE IN SPAIN
1. WATER RESOURCES IN SPAIN

Mainland Spain has a total land area of just under 500 000 km² (over twice that of the UK) with a population of around 38 million. The total length of the main rivers is estimated at 175 000 km compared with 89 000 for the UK. Ninety-five percent of the population are served by public supplies and the total water supplied is about 11 500 Ml/d, of which approximately 8400 Ml/d (61%) is for domestic use. Total natural water supplies have been estimated as 353 000 Ml/d indicating that about 2.4% and 3.2% of available water is used for domestic and total public supplies respectively. However, this figure conceals very considerable regional variations and does not include irrigation demands which account for a further 20% of available resources.

The bulk of water supplies in Spain are surface derived with 74% taken from rivers or storage reservoirs. It is claimed that Spain has more major storage reservoirs (900) than any other country in Europe and these provide around 40% of total available supplies.

The water supplies in Spain reflect the very considerable differences in topography and climate which divides the country into two main regions - a mountainous north and north-west area having abundant water resources and a dry central plain and southern and south-eastern areas having much less reliable rainfall and not infrequent drought conditions. Rainfall averages 2000 mm in the north-west and 300 mm in the south-east. Fifty-two per cent of the land area drains into the Atlantic Ocean, 11% to the Bay of Biscay and the remaining 37% to the Mediterranean.
Management of rivers and the related construction works is assigned to a series of ten river basin agencies (Confederaciones Hidrograficas). Within the same boundaries water commissions have been established, concerned with the planning of water supplies and sewage disposal, under the Ministry of Public Works, Housing and Town Planning (MOPU).

A new Water Law was promulgated in August 1985 which covers the use of and discharges to surface and groundwaters. This integrates the work of the various agencies and autonomous authorities into a national planning strategy. This law brings together controls on surface and groundwaters which were previously under the separate control of MOPU and the Ministry of Industry (IGME) respectively. Effectively all water resources have become the property of the State, as in many other countries.

The Surface Water Directive (75/440/EEC) has been implemented through an order dated 11 May 1988 issued by MOPU. A separate order from the same ministry covers the directive on frequency of measurement and methods of analysis (79/869/EEC).

The quality of river waters is monitored in each river basin through a network of over 400 sampling locations. The results are collated by MOPU and published annually. Some 38 parameters are measured, of which 23 are used to derive a water quality index which is illustrated three-dimensionally (time, river stretch, index) in the published results. The general position is that many of the rivers are subject to natural and man-made pollution. Industries giving rise to polluting discharges include power stations, steel works, cement works and paper mills. Rivers in the
north are particularly affected. Sewage pollution has also presented problems although major schemes are now in progress to improve this situation.

Generally the pollution is less in rivers flowing into the Atlantic (possibly due to higher dilution) than in those discharging to the Mediterranean. Agricultural pollution occurs in a number of regions but the main problem arises from fertiliser application in the eastern coastal region around Valencia where many groundwaters have high nitrate concentrations due to the cultivation of citrus fruits. It is likely that pesticides will also be found when monitoring is fully implemented.

Mining activities can also create problems in surface and groundwater supplies. In Barcelona, for example, the River Llobregat is used for a major supply but carries on average nearly 900 tonnes of chloride per day from upstream mines giving annual average chloride levels in the period 1980/85 of between 400 and 640 mg/l. A pipeline of total length 124 km is to be built to take the saline discharges to a sea outfall which will discharge into the Mediterranean near Barcelona.

In Valencia nitrate levels in groundwater are affecting provincial supplies but the conurbation uses surface waters which are unaffected by fertilisers. In Madrid nitrate from fertilisers is not a problem because water is taken from large storage reservoirs. However, local agricultural activity includes sheep, cow and pig rearing and the resulting nutrients cause eutrophication leading to algae, taste and odour and elevated levels of manganese, all of which can give problems at the treatment works.
2. WATER SUPPLY ARRANGEMENTS IN SPAIN

Under the Local Regional Act passed at the beginning of this century responsibility for water supplies rests with municipal governments, of which there are about 9000 in Spain. Many villages have populations of less than 5000 inhabitants and this gives problems with infrastructure. Strictly speaking responsibility for water supply rests with the Mayor and his Council who rely upon the local health department for checks on quality. However, the process of decentralisation implemented in the last ten years has created autonomous regions which have health departments and these have some responsibility for water quality. At present it seems that most of the attention of the regional authorities is devoted to the support of provincial suppliers and there has not been a significant impact on major supplies in cities.

As with other countries a number of different types of organisation exist to supply water in Spain. The majority are municipal undertakings or grouped municipalities. Some supplies are in the hands of private companies such as those for Barcelona, Valencia and Alicante. These are operated as normal shareholding companies which make and distribute profits and can either deliver a bulk supply of water to municipalities or supply direct to the consumer. Another form of supplier is an autonomous body run by a board which includes representatives of local and central government. The supplies to Madrid and the region of Murcia are provided by such organisations.

Private companies raise money for their capital works through normal market sources but public bodies raise loans through the official bank, Banco Crédito Local de España.
A Royal Decree was published on 18 June 1982 and lays down in detail the regulations for supplying and monitoring drinking water either directly or for use in the food industry. Although Spain was not a member of the Community at the time it is clear that this legislation was influenced considerably by the Directive. The Decree includes standards under the same groupings as the Directive but with radioactivity added. Of the total parameters which have MAC values in the Directive, five were not included (sodium, potassium, Kjeldahl nitrogen, hydrocarbons and silver) and three have less stringent values (sulphate–400 mg/l, surfactants–1000 μg/l and selenium–20 μg/l). The limit of 50 μg/l for chromium has been set for the hexavalent form rather than total. Two types of limit are included, namely "quality guidelines" and "tolerable levels" corresponding respectively to desirable limits and maximum admissible limits. Most of the quality guidelines correspond with the Directive guideline values.

The limits are held to apply at the entrance to the distribution system. In the monitoring section of the legislation, however, separate limits are laid down for microbiological quality in distribution. These set limits identical to the Directive for total and faecal coliforms but also specify that single samples should not contain more than 10 coliform bacteria per 100 ml and that coliforms should not be present in two consecutive samples.

On the basis of these limits three classes of water have been defined:
* potable water (Aqua potable)
* hygienically permissible water (Aqua sanitariamente permissible)
* non-potable water (Aqua no potable)

The first class meets all the limits in the regulations. The second allows water to be supplied on a temporary basis, with special authorisation from the Permanent Control Commission, where alternative sources are not available, providing that the limits for faecal organisms, toxic substances and radioactivity are met. A limit is placed on total coliforms and faecal streptococci of 10 in 100 mls, with sulphite-reducing Clostridia not exceeding 2 in 20 mls. Faecal coliforms, parasites and pathogens must be absent, although no volume of sample is specified. Water which does not meet the requirements for the previous two classes is regarded as non-potable and must not be distributed or consumed.

The regulations also specify that not less than 100 l/h.d should be supplied. There is a specific requirement for potable water to contain free residual chlorine or combined chlorine or other disinfecting agents at all times. The limits for chlorine depend upon pH and range between 0.2 mg/l and 0.8 mg/l for free chlorine and 1.0 mg/l and 1.8 mg/l for combined.

Other sections of the regulations include broad statements about the proper maintenance of hygienic conditions in treatment plant and supply systems and approval of materials of construction.
A separate section under the authority of the Ministry of Health deals with permissible additives and their allowable concentrations in water treatment. Substances not listed are positively prohibited. Some 54 individual substances are listed in this section grouped into substances for disinfection or oxidation, dechlorination, pH correction and/or mineralisation, fluoridation, coagulation/flocculation and filtration.

At the present time an exercise is in progress led by the Ministry of Health to revise the regulations. Water suppliers are represented on the committee reviewing the legislation together with other government departments. The outcome of the revision is not clear at present but one view was that the technical problems involved in any proposed changes may receive less than adequate attention because the majority of the committee representatives are politicians or administrators. One aim is to bring the regulations more closely into line with the Directive now that Spain is a full member of the Community. The discussions are due to be completed during summer 1988 and the new regulations published later in the year.

The quality of water supplies in Spain is the responsibility at central government level of the Ministry of Health. Surface water quality on the other hand is the responsibility of the Ministry of Public Works. With the move to regional autonomy responsibility for all health matters shifted to the regions. The regulations therefore provide for decisions on potability to rest with Regional Permanent Control Commissions. To date only one region, Valencia, has set up such a commission. In the meantime the regional government assumes the role. It is proposed that the Permanent Control
Commissions will remain responsible under the new regulations. Such an arrangement gives a less-than-direct relationship between Brussels and the competent authorities, rather as in the case of Germany, but the importance of this has yet to be tested. Figure 1 shows the present system of responsibility.

4. APPLICATION OF THE DRINKING WATER DIRECTIVE

4.1 Responsibility for monitoring

The regulations specify that all water suppliers providing potable water for more than 10,000 population must have departments for checking water quality. For populations of less than 50,000 suppliers may have the work carried out under contract or by shared arrangements. For populations less than 10,000 where the supplier does not have monitoring departments, the appropriate health authority (probably regional) must carry out the analysis. Municipal councils have an obligation to supervise and monitor water quality within their districts and must themselves be supervised by the appropriate health authority.

Discussions revealed that the small municipal departments and regional health authorities are ill-equipped with facilities and personnel and the bulk of the work is carried out, at least in larger conurbations, by the water suppliers. Contact is maintained between water suppliers and local officials and a position of trust has been built up. With smaller supplies inspection of individual installations is carried out by the municipal and/or regional authorities. Even the large municipalities have limited facilities for water analysis because their health departments deal with a wide range of items, including food.
Figure 1

Responsible bodies for drinking water in Spain

Central Government

Ministry of Public Works (MOPU)  Ministry of Health

Surface Water Quality  Drinking Water Quality

Regional Autonomous Government

Municipality

Water supplier
Detailed requirements for the keeping of records are contained in the regulations. The results of analysis must be sent to the municipal authority who in turn will forward them to the regional authority. A register of results is maintained by the supplier and this is available to the inspector.

4.2 Analytical quality control

There is no formal system of AQC in Spain. The individual laboratories of the suppliers visited do not have their own system, with the exception of Madrid where there are some central laboratory and inter-laboratory checks. This is clearly something that will develop as the regulations are more closely followed although they do not specify that AQC has to be applied. There is a provision in the regulations for the Ministry of Health and Consumption to specify official methods for sampling and analysis which have to be followed when officially monitoring water quality but these are not listed in the document.

4.3 Sampling points

The regulations specify that sampling points must be provided along the length of all pipes at technically desirable intervals from source through treatment and distribution to the consumers' taps. Although it is stated that the standards laid down for parameters in the main tables apply at the entry to the distribution system, recommendations are also made covering microbiological parameters in distribution. Furthermore the regulations also state that the companies are responsible for complying with the regulations up to the point of delivery to the consumer or user but after that the installer and/or user has responsibility as appropriate. It is stipulated that the sampling
points must be planned to take into account changes in flow, points with higher risk of contamination, points where consumption is low and so on. In every case the points must be chosen to ensure that samples are as representative as possible. The suppliers indicate that the sampling regime has to be approved by the municipal or regional authorities.

In Valencia ex-works samples are taken together with some from distribution sectors including problem points. Samples are taken from public fountains but not at consumers' taps, although complaints from consumers will be followed up with tap and distribution samples to investigate the cause. Barcelona follow a similar procedure and also use public fountains for some samples. The Madrid authorities do not use public fountains because these are owned by the local authority and quality is not representative of the supply. Madrid operate a zone system and have designed special sampling connections which can be flamed for microbiological sampling. All suppliers emphasized the importance attached to the fact that their responsibility ends at the stop tap.

**4.4 Sampling frequency**

For 'minimum analysis' sampling frequencies are specified ex-works and in distribution and are related to population served. Minimum analysis includes the same parameters as specified for 'minimum monitoring' in the Directive but with nitrite and ammonia added. A further classification of analysis is termed 'normal' and this corresponds with 'current monitoring' in the Directive but without total counts at 22° and with permanganate value, faecal streptococci and sulphite-reducing Clostridia added. A further
classification - 'full analysis' - includes all other parameters in the regulations plus all those which may be considered to constitute a health hazard. The frequencies specified are given in Table 1. Ex-works frequencies are in excess of those specified in the Directive. The frequencies for distribution systems are at least equal to those in the Directive except for the microbiological parameters under the minimum and normal analysis classifications for populations greater than 100 000, although for minimum analysis the ex-works samples more than compensate. Also, because of the formula used, the frequency for total bacterial counts at a population of 10 000 would also be one-third of that specified in the Directive.

The maximum interval between samples is also specified for minimum analysis and this varies with population. This is clearly designed to obtain representative spacing of the samples. Provision is also made for specifying extra sampling above the minimum or reduced sampling as determined by the 'appropriate authorities', presumably the municipal or regional health inspectors.

Water suppliers in the three areas consulted stated that their sampling frequencies generally were higher than specified in the regulations. In Valencia four samples are taken per week throughout the network. Sampling frequency is one of the topics still under discussion in the committee studying the revisions to the regulations.

4.5
Actions taken when a sample fails to meet the MAC

The regulations specify that a number of actions are required when the water ceases to be 'potable'. However, because of the definitions of 'potable',
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</table>

Parameters

- Odour
- Taste
- Turbidity
- Nitrites†
- Ammonia†
- Conductivity
- Residual chlorine
- Total coliforms
- Faecal coliforms

Minimum plus
- temperature
- pH, nitrates
- PV*
- plate count 37°
- Faecal streps*
- Sulphite reducing
- clostridia*

Normal plus
all other parameters
in the regulations

* As stated or necessary
† C2 in directive
* not in directive C2
'hygienically permissible' and 'non-potable' used in the regulations, the instructions are not very clear. Suppliers are forbidden to supply non-potable water, i.e., water which does not meet the 'potable' or 'hygienically permissible' criteria. The regulations stipulate that when the water ceases to be potable the health and municipal authorities must be notified so that they may decide on the action to be taken. The suppliers may ask for permission to stop supplies wholly or in part if preventative measures are required and before the results of confirmatory analyses are available. The municipal or health authority is required to advise on the measures to be taken in each case. Suppliers are also obliged to pass on to their consumers the advice from the health authorities on the precautionary measures required to avoid or diminish harm. The regulations provide for sanctions by the health authorities against a supplier found to be responsible due to action, omission or negligence and where it is considered that the circumstances may constitute an offence or transgression against public health. The sanctions are not specified. This provision is without prejudice to placing the matter before the courts.

The regulations would appear to allow supplies to be continued as long as the water is still within the 'hygienically permissible' definition, i.e., as long as exceedance does not include toxic parameters specified, microbiological parameters or radioactivity.

Discussions with the suppliers showed that the action taken depends on the severity of the incident. With pollution incidents involving possible health risks, such as chromium in Barcelona surface water, the municipal health
authority would be informed but it is possible to stop the supplies and use alternative groundwater sources before the response is received from the authority. On the other hand the more trivial exceedances, such as high iron concentrations, do not require action other than resampling or mains flushing and the municipal authorities may ask for explanations retrospectively. The point was made that central, regional and local authorities recognise problems which suppliers have due to quantity and quality difficulties and trust has been built up between them that a responsible approach will be taken. Other difficulties can arise with chlorine residual values at times of high temperature, which necessitates dosing of additional chlorate in distribution, and with manganese levels, which are controlled by treatment.

Dispensations can be given by the responsible authorities. For example problems with nitrate in the Valencia region have required dispensations from the Permanent Commission while alternative sources are explored.

Under the present law consumer associations could bring a case in court when infringements occur.

5. WATER QUALITY PROBLEMS IN SPAIN

Most of the water quality problems occur in the drier areas of Spain and mainly result from naturally occurring substances.

Temperature can exceed the limit due to ambient temperatures and the high dependence on surface waters. Temperatures up to 28-30 °C have been reached.
Chlorides can be high, especially in Andalucia, but this parameter does not have a MAC in the Directive. Spain has adopted a limit of 350 mg/l and this is exceeded in places.

The chloride results from the natural content in some groundwaters from the Keuper, from saline intrusion due to overpumping and from mine discharges, as in Barcelona.

Sulphate. This is a problem parameter in central Spain where concentrations can occur within the range of 260-310 mg/l. The sulphate is largely of natural origin and can therefore be covered by derogations.

Conductivity and Dry Residues. Because of the general mineralisation of surface waters, largely chloride and sulphate, a high proportion of rivers in some regions can have conductivities in excess of 1000 µs/cm. Neither the EC Directive nor the Spanish regulations includes a limit for conductivity, the latter merely stating that it should correspond to the mineralisation. However, the dry residue limit of 1500 mg/l is likely to be exceeded in a number of areas.

Magnesium. This can exceed the limit of 50 mg/l in some areas but is again of natural origin.

Sodium and Potassium. These can both exceed the EC limits but Spain has chosen so far not to include these parameters in the regulations. Derogations may be possible for potassium in view of the absence of health effects and its natural origin but for sodium this could be difficult.
**Ammonia.** This can be a problem in surface supplies due to the discharge of effluents. Chlorination is practised for example in Madrid but this has led to problems with meeting the nitrite limit.

**Nitrate.** As with other Member States the proportion of supplies affected by high nitrate levels is low - around 2%. The main problems arise in the region bordering the Mediterranean where there are extensive areas of citrus fruit. The coastal strip around Valencia and down to Alicante is particularly affected. Groundwaters from shallow wels in sandy soils give levels above 100 mg NO$_3$ /l for about 12% of supplies. The mean level is quoted as 66 mg NO$_3$ /l and spot values as high as 500 mg NO$_3$ /l have been recorded. The major conurbations are not affected but village supplies can give problems. Groundwater can be blended with surface or other low-nitrate water but in some cases this proves too expensive and warnings are given to doctors by the local health authorities that nursing mothers and infants should use bottled mineral water. Local dispensations to exceed the limit can be given by the Permanent Commission in Valencia or other local health authorities elsewhere. In some cases for towns less than 2000 population the municipal authority treats water for one specific fountain using ion exchange or reverse osmosis.

6. PROTECTION ZONES

Protection zones do not exist in Spain since it is considered impossible to constrain the farmers to use less fertiliser. In fact the citrus fruit industry is a large exporter and is important in the national economy. The high proportion of
supplies taken from surface sources which are not affected by nitrate fertilisers mitigates against the development of protection zones.

7. PUBLIC AVAILABILITY OF INFORMATION ON DRINKING WATER QUALITY

There is no formal system for notifying the public of the results of analysis on water supplies. The suppliers respond to specific questions on quality, including complaints. The public and schools and universities are also encouraged to visit the treatment plant. More recently public groups have been putting pressure on the suppliers to release results but there is some reluctance because the public may 'interpret them absolutely'. The suppliers are obliged to send results to the municipal and regional health authorities and to maintain a register of results and incidents. Exceedances must be reported to the inspectors automatically. The new regulations are likely to require such exceedance to be notified to the press as well.

8. WATER TREATMENT TECHNOLOGY

The bulk of supplies taken from surface sources, whether directly from rivers as in Barcelona and Valencia or from storage reservoirs as in Madrid, receive conventional chemical treatment, normally with aluminium as the coagulant. Prechlorination is widely practised for microbiological protection and to help to remove manganese where this is a problem. pH correction and potassium permanganate dosing can also be used for this purpose. Following coagulation vertical flow sedimentation units are used, either of the mechanical mixing type or Degremont pulsators followed by rapid gravity filtration and final chlorination.
Problems can be experienced with taste and odour, either from algal growths in reservoirs as in Madrid, or from components in the river systems, as in Barcelona. Control of trihalomethanes can be a problem with the need to chlorinate heavily (up to 15 mg/l chlorine) to maintain a residual of 0.5 mg/l in supply. The combination of these factors has caused the Barcelona Water Supply Company to install activated carbon filtration in the Saint John plant treating around 3 m$^3$/sec of water from the River Llobregat.

Sand replacement has been used with 40 tonnes of carbon in each filter. Regeneration is carried out on site with a capacity of 7-8 tonnes/day thus requiring one week for each filter for complete regeneration. The regeneration period is of the order of 9 months. Even with this treatment trihalomethanes can give problems. On this plant it is also necessary to monitor chromium and cyanide hourly by manual methods because of the risk of industrial pollution upstream. Future expansion of supplies for Barcelona would have to come from the River Ebro but some 180 km of transfer piping would be required making the water quite expensive.
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