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THE POSSIBLE ADOPTION OF A DIRECT FEED SUPPLY TO DOMESTIC PROPERTIES IN THE UNITED KINGDOM (TMU 9008)

Final report to the Department of the Environment

DoE 3136

AUGUST 1992

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Author: M Hitchmough

Contract Manager: M Hitchmough

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WRc Swindon, Frankland Road, Blagrove, Swindon, Wiltshire SN5 8YF.
Telephone: (0793) 511711.

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PREFACE

The aim of the project was to investigate, through a review of available information, the problems associated with the inclusion into the U.K. water distribution network of new properties adopting the direct feed method of domestic water supply favoured in continental Europe. This is in contrast to the current United Kingdom system of supply which utilises domestic storage.

In this report the expression 'direct feed' is to be taken as referring to water delivered at all domestic taps either directly from the distribution main or via a pressure reducing valve.

SUMMARY

The current method of water supply in the United Kingdom employs storage within domestic property boundaries. This method of supply is unique in Europe. The majority of properties in continental Europe are served by a direct feed method.

The reasons given for the adopted UK water supply method are:

(i) Domestic storage gives provision against supply interruptions.

(ii) A storage cistern gives an air gap which protects against backflow.

(iii) Storage reduces peak demands in water supply.

(iv) Storage reduces the strain on domestic plumbing.

The main reason offered for the conversion to a direct feed method of supply, as favoured in continental Europe, is that this method reduces the risk of microbiological contamination of water supplies.

It is assessed in this report that domestic storage is significant only in the provision against supply interruption. This advantage of the current UK supply system should be weighed against the consideration of microbiological safety when determining a preferred method of supply.

1. INTRODUCTION

There are two general methods of domestic water supply in the U.K. which incorporate storage to different extents. The methods are referred to, in some literature, as the North of England and South of England supply systems.

The North of England system features a direct supply to the cold water outlets in a house with only the hot water system supplied via a storage cistern. A direct supply is fed to all WC's, though in the majority of cases these are fitted with flush cisterns, which will allow one flush if the water supply is temporarily ceased. The South of England system has a direct feed from the distribution main to the kitchen tap but all other outlets, including WC's, are served from storage within the premises. In practice, despite the nomenclature, there is no real division across the country north and south of which a supply would unquestionably fit either of these supply descriptions.

The European plumbing system is based on a direct supply from the water main to each cold water outlet in a premises and, via in-line or point of use heating, to each hot water source in the house.

2. SUMMARY OF PREVIOUS WORK

In November 1978 the Water Research Centre produced a technical report, (TR94, Field, 1978), which reviewed the effects of domestic water storage on water demand patterns. The report outlined the following reasons for the adoption of a stored approach:

(i) Stored water on the property gives provision against supply interruption.

(ii) The air gap created by the presence of a storage cistern provides protection against backflow.

(iii) The use of storage reduces the impact of peak demands on the distribution network.

(iv) Storage reduces the stress on plumbing from mains pressure water.

Items (i), (iii) and (iv) are considered in this report.

The issue of backflow, (item (ii)), is beyond the scope of the study and problems associated with the prevention of contamination of the mains supply are currently under separate investigation.

2.1 Outline of UK domestic water supply systems

A brief survey was conducted to assess the predominance of the supply strategies in various regions (Personal Communications, 1992). The companies questioned were chosen as being representative of different regions of the U.K..

North East Water reported that the most common system of supply is that which fits the description of the North of England system. Chester Waterworks Company report that more water is supplied in this way than via the South of England system, though the terminology for the supply strategies is no longer commonly used or understood. South West Water believe that the South of England system predominates in their area. Essex Water estimate that the division is about equal between the two supply methods with the so-called South of England system more likely in new properties. This is an attempt to meet the requirements of the Water Act 1991, s.66 1 & 2, which states that a cistern should be capable of holding sufficient water such that a 24 hour supply could be provided from storage. This applies to any property where water is required to be drawn off at a level less than 10.5 m below the service reservoir, or tank, from which a supply of water is being provided.

In Cambridge Water Company's supply area, properties are served either by the South of England system or by a hybrid system. The hybrid system has all cold water outlets at ground floor level fed directly, with the entire hot water supply and cold water to the upper floors fed via storage.

2.2 A review of the results and conclusions of TR 94

The assessment of the effects on peak demands of eliminating domestic storage from the system were carried out based upon flow measurements into supply areas in which domestic storage existed. It was assumed that demand or usage patterns would not be affected by a change in plumbing system. The flow rates for a supply system without storage were derived theoretically from the gathered data.

The study concluded that the effect of introducing a fully pressurised plumbing system, i.e. a direct feed system, would not significantly change the requirements for main sizing or reservoir capacity. In support of this conclusion there is no notable change in mains sizing between areas adopting the North or South of England approach. Continental street mains are of a similar size to those in the UK. However, the minimum diameter for distribution mains in Europe is generally 150mm compared with a minimum of 100mm in the UK.

The study found that the effect of storage removal on peak demands were pronounced for an individual property but less so for groups of properties. Storage was considered to have little or no effect on peak demand for a supply area in excess of 400 properties, (1000 people).

It was noted however, that diverse peak demands, i.e. intermittent peaks of short duration, could be reduced by up to 20% where storage is present. To put this into context it should be noted that an increase in pipe diameter from 100 mm to 150 mm will roughly double the carrying capacity of the pipe. This factor is of particular importance when design flows are considered.

The merit of having stored water as a protection against supply interruption was questioned as this volume is much reduced in the North of England plumbing system without there being any suggestion that this system is inferior.

It is worth noting that repair times currently achievable by water companies are much improved when a supply is interrupted and water supplies can be redirected within the distribution network during repair work. The current approach of the water companies is to initiate repair work immediately it becomes necessary, further reducing the delay in reconnecting supplies.

The report concluded that it was not feasible to use a direct feed system where a low or variable supply pressure exists. Discussions with water companies (Personal Communications, 1992) have supported an argument that the ability of a North of England supply system to be successful in meeting minimum pressure requirements is due to the topography of the North of England which is generally higher and more contoured than land in the South.

The suggestion that storage reduces the stress on plumbing from mains pressure water, thus allowing the use of cheaper fittings, is not a valid argument. Plumbing fittings before and after storage are commonly designed to meet the same standards. The noise associated with water being fed through pipes at mains pressure is considered less than the more prolonged noise which can be associated with a cistern filling.

In the South of England supply system, the mains supply is protected from backflow by air gaps. Unvented systems require mechanical devices to protect against backflow. The issue is not addressed in this report. The current validity of the conclusions of TR94 are discussed further in the remainder of this report.

3. UNITED KINGDOM WATER USAGE ASSESSMENT

In order to understand more fully the requirements of a water supply and distribution method an assessment of current and future water usage was attempted. The investigation concentrated on the regions identified in section 2.1 as having an identifiable water supply strategy.

In 1977 and again in 1985 South West Water conducted a water usage survey (Hall et al, 1988). The findings of the survey were that the average daily domestic water use per head of population rose from 113.4 litres in 1977 to 131.6 litres in 1985, an increase of 16%. A review of companies' annual reports (Annual Reports, 1978-1991), shows that the trend towards increased water usage is not confined to the South West. Table 1 indicates the change in demand since 1977 for four water companies based on figures for total water supply. The figures also include non domestic supply and wasted supply hence the higher values of per capita usage compared with the survey in the South West.

Table 1 - The change over the last 13 years in total water supply in four U.K. water company regions

Water Company	Total daily water supply per capita		Percentage increase since 1977
	1977 (litres)	1990 (litres)	
Cambridge	230	291	26
Chester	234	250	7
Essex	260	296	14
Newcastle and Gateshead	286	324	13

From the data in table 1 it is clear that per capita water usage is increasing. Further data, (Waterfacts, 1985-1991), show that water usage in the U.K. has increased by over 60% since 1961. The rate of increase has reduced from 17% in the five years from 1965 to 1970, to around 5% for each of the five year periods since 1975.

Using data from company reports, (Annual Reports, 1978-1991), the total increase in average daily supply varies between 11% and 40% for the four companies reviewed. This reflects, in addition to the increase in per capita water use, an increase in the population of each region.

As the volumes quoted in the table refer to overall water supplied, not just domestic usage, it would be wrong to be too unequivocal when making comparisons between the favoured methods of supply. However the figures do indicate a particularly high per capita water consumption for Newcastle, where the North of England plumbing system predominates. Also noteworthy is the rate of increase in water usage in the Cambridge area. It could be suggested that the increase is related to the recent adoption of a supply philosophy incorporating more water supplied by direct feed. However, it is just as likely that the high volume of water supplied is due to the amount of waste through leakage in the system.

Despite the potential conclusions of the above data, there is no evidence that water usage is greater in countries where direct feed is the favoured method. The reasons for this are discussed later in the report.

It is forecast that by the year 2011 the per capita demand for domestic water usage, (based upon data from South West Water), will have increased by 25% over the 1985 figure.

Increased usage is an important factor to be considered when reviewing the likely effects of dispensing with domestic storage in new water supply systems. Increased use will both reduce the significance of any stored volume and increase the size of demand peaks.

The increase in overall demand means that the proportion of a daily supply available from stored water is reduced and the ability of a household to retain enough water in storage to last 24 hours is an increasing impossibility, given the limitation on the potential size of any storage vessel. Conversely, an increase in demand peaks could be seen, on a local scale, as increasing the importance of a stored volume, in order to reduce flow demands in small mains and service pipes.

3.1 Design flow considerations

The Continental supply system, which seldom employs domestic storage, requires more thorough investigation of local demand peaks to be

successful. A supply without storage requires any demand for water to be met immediately and there is no safety margin of a stored volume. (As reported in section 2, storage can reduce diverse peak demands by up to 20%). Therefore, if storage is to be eliminated from domestic water supply, it is important that design flows for small mains and service pipes are properly understood.

A general method of forecasting supply region demand is to multiply extrapolated usage by 1.1 to allow for leakage loss. A further assumption is that the largest consumption month will be 1.3 times average demand (Novais-Barbosa, 1988). The second assumption is partly validated by figures from various water companies (Annual Reports. 1978-1991), where the range of the peak to the normal demand is from 1.11 up to 1.33. European forecasts based on expected flows, (Coe, 1978), can overestimate demand by as much as 15% for a direct feed supply where storage was previously used.

More important, in relation to domestic water storage, is an understanding of typical peak flows in small mains and service pipes. This would require field investigations beyond the scope of this project.

3.2 Elements of water demand

A simple analysis of the breakdown of water usage does provide an insight into the possible effects of removing storage from the reticulation.

Figures from a South West Water survey in 1985 (Hall, 1989), gave the following results.

Activity	% of Daily Use
Drinking and cooking	4
Laundry	14
External usage	7
Cleaning	11
Toilets	25
Personal Hygiene	31
Other usage	9

The combined activities of drinking and cooking, laundry and external usage account for 25% of daily usage. The water for all these activities is commonly supplied by direct feed. A proportion of the water use attributed to cleaning, personal hygiene and other usage will also be supplied by direct feed. Therefore even in areas where domestic storage is favoured a significant percentage of the daily water usage (>25%) is supplied directly.

3.3 Effects of metering on water usage

Where a metering program is combined with a modified charging scheme for domestic water, there is an increased tendency for a householder to repair leaks within the property boundary. For example, the replacement of a washer on a constantly dripping tap can result in the saving of between 6 and 30 gallons of water every 24 hours. The top end of this range is the equivalent of an average per capita daily water usage.

In countries where metering is a more recent development of water supply systems, the resulting reduction in domestic water consumption has ranged from 12% (in Holland) to 50% (in France and Switzerland). In Belgium, where all water is supplied at mains pressure through meters, a 25% reduction in domestic demand has been recorded since meters were installed. The water suppliers in Belgium make a surcharge on water over a certain 'necessary' volume consumed by a household. In a pilot scheme for metering in the U.K. a reduction in water consumption of around 10% was recorded.

In countries such as Hungary, Austria, Italy and Portugal it is claimed that metering reduces peak demands and encourages water conservation.

4. THE EFFECT ON DOMESTIC APPLIANCES OF CONVERTING TO A DIRECT FEED SUPPLY SYSTEM

Point of use devices for water softening or chemical removal are designed to operate at mains pressure; point of entry devices are similarly designed. A change to a direct feed supply will not affect the operation of such equipment.

Appliances such as dishwashers and automatic washing machines are commonly plumbed to the domestic supply and usually operate at mains pressure.

A problem exists with showers which mix hot and cold supplies. For correct operation the flow rate from both hot and cold water sources must be matched. In a North of England system this entails the added expense of either reducing the pressure of the cold water input or increasing the pressure from the stored hot water supply. A similar situation exists for washing machines and dishwashers. Pressure reducing valves are currently successfully used in the U.K. as a solution to the problem.

5. PROBLEMS ASSOCIATED WITH GENERATING HOT WATER FROM A DIRECT FEED SUPPLY

On the Continent domestic hot water is often generated without a storage stage. In some cases this is achieved by 'district heating' systems whereby water is heated outside the property and is supplied to the premises at mains pressure. The consumer is charged for the amount of water used. In other cases in-line heaters take mains pressure water and heat it either at the point of supply or at a point of entry to serve all the hot water outlets.

In the U.K. point of use heaters are becoming more common. The provision of 'instant' hot water is seen as being a more useful and less wasteful method of hot water generation than maintaining a hot water cistern. Manufacturers of in-line heating devices would prefer water to be supplied at a pressure in

excess of the current minimum. They would like to see the U.K. fall into line with the rest of continental Europe and provide generally higher pressure supplies. Water companies are resisting requests to increase minimum target supply pressures because to do so would involve disproportionately high expenditure in order to bring small areas up from the current minimum, when the majority of areas are already supplied at a significantly higher pressure. Direct hot water systems have been developed which will operate at lower pressures but these are likely to be more expensive.

Supplying hot water directly, without storage, would create additional difficulties in the U.K. as the energy demands associated cannot be adequately met by the electricity grid. The only suitable heating source for instantaneous hot water is gas.

An additional problem is created by U.K. water industry byelaws. Expansion of heated water in the Continental system is accommodated by expansion relief valves allowing the water to run to waste. The U.K. water industry byelaws require the expanded water to be accommodated within the system by expansion vessels or by other means.

A further problem of providing hot water at mains pressure is that the materials used for manufacture of the heating unit would have to be more pressure resistant. Copper, commonly used as a material for boilers, is unlikely to be strong enough and a conversion to steel heating units would be necessary.

6. THE EFFECT ON LEAKAGE OF A DIRECT FEED SUPPLY STRATEGY

It is expected that an increase in water supply pressures will exacerbate leakage problems in the distribution system. It has been shown that high supply pressures increase leakage, especially from old or badly maintained pipework. Leaks at higher pressures are inevitably more costly in terms of wasted water. The philosophy adopted in the U.K. is that pressures should be kept to a minimum in order to reduce chances of failure whilst fulfilling minimum supply pressure requirements. Any increase in pressure would add cost to rehabilitation programmes.

However, there is not obvious need to increase water supply pressures in distribution in order to supply water by direct feed. The only increase in pressure would be experienced within the property boundary where fittings would be subject to mains pressure rather than the potentially lower pressure of water delivered via a storage tank.

It is expected that leakage within a property would be quickly stopped.

7. THE EFFECTS ON WATER QUALITY OF DOMESTIC STORAGE

The inclusion of storage in a distribution system can mean that the quality of water arriving at a tap may not match the water quality delivered by the water company. Byelaws require that contamination of water by contact with a storage cistern material should not occur. However, it is possible for both biological contamination and metal leaching to occur during storage. For this reason alone it can be argued that it is of benefit for a consumer to have water delivered by a direct feed method.

It is universally accepted that the microbiological quality of a water supply is the most important aspect when the safety of a supply is considered. Residual disinfectant almost guarantees that in the U.K. the water arriving from a distribution main meets the requirements of the water quality act. However, if a storage stage exists the risk of microbiological contamination of a supply is increased and this risk increases further with the length of time of storage. The residual disinfectant will decay with time and the rate of decay will increase with increasing temperature, change in pH and light infiltration. It is also true that residual disinfectant will be destroyed rapidly by the presence of metal ions, particularly iron, in the water.

Storage cisterns are required to be protected from extremes of temperature by the U.K. water supply byelaws. The World Health Organisation reports that the growth of nuisance organisms is enhanced in warm water and it is recommended that a cold water supply should not exceed a temperature of 20°C, though the actual requirement is non-specific with regard to temperature. It is known that water temperatures exceeding 20°C can promote growth and multiplication of

micro-organisms including Legionella bacterium (ECS internal document). The Health and Safety at Work Act 1974 recommends avoidance of stagnation and water temperatures that would favour micro-organism growth to minimise the risk of exposure to Legionella. This view is supported in a recently released Health and Safety Guidance document (HSE, 1991).

In fulfilling the requirements of byelaw 30, precautions against infestation by larger animals, such as insects, are usually successful. The presence of filters and covers cannot ensure against microbiological contamination.

Water which has been treated by a point of use device or, more critically, by a point of entry unit, can be rendered biologically unsafe, as the action of removing any metal contamination or water hardness can also remove the residual disinfection of the water. Manufacturers of these devices recommend that treated water is used immediately or kept refrigerated. If point of entry treated water goes to storage it can result in an increased health risk.

Diet studies have shown that domestic water consumption is not solely from the kitchen cold tap (Hopkin et al, 1980), the only tap in U.K. properties which is always served directly from the distribution main. This means that water taken from storage is frequently used for consumption. Survey results indicate that hot water outlets in domestic properties are frequently used for drawing drinking or cooking water (7% of volume drawn (Hopkin et al, 1980). These facts show that at a domestic property where water is stored in a cistern the occupants may be exposed to a health risk.

Despite the potential problems associated with stored water at a domestic property, there are very few records which suggest that health problems have resulted.

8. THE CONTINENTAL VIEW

A survey of international water prices by National Utility Services Limited in August 1990, showed that in the majority of European nations water prices are higher than those charged in the U.K.. For example prices per cubic metre in Belgium are 25% higher, in France 35% higher and in Germany 80% higher. This cost difference must be considered when reviewing Continental supply systems.

A questionnaire gathering data on Continental reticulation was circulated to contacts in eight countries (Appendix A). The questionnaire was designed to gather data on the difficulties of operating a direct feed system, with emphasis on demand management, metering and maintenance of reasonable supply pressures, as well as gathering data on water usage and pipe sizing.

8.1 Continental reticulation

Mains sizing, as suggested in section 2, is not greatly affected by the type of supply operated. Distribution mains in Germany, Italy, Holland and Sweden are all in the same size range as those in the U.K.. The minimum main size in the U.K. of 100 mm is also used in Sweden. Other European countries favour a minimum diameter of 150 mm for distribution mains.

Typically the water pressures and design flows in the water distribution networks of other countries are greater than those experienced in the U.K. leading to a generally higher delivery pressure. In Germany 4 bar is the average delivered pressure. If pressures exceed 6 bar, valves to reduce pressure are employed. If the pressure falls to less than 1.5 bar, the pressure is boosted. Regulations in Germany insist on a minimum pressure of 2.2 bar at the property plus 0.35 bar per floor.

In France the regulated minimum pressure of supply at the property is 2.5 bar with an additional 0.5 bar per floor.

In Italy mains pressures are between 6 and 10 bar, leading to supply pressures of 4 to 6 bar, although the minimum requirement is a pressure

of 1 bar on the highest floor supplied at peak flow. In Holland, for high rise buildings, the responsibility is on the property owner to install local boosting for ensuring a reasonable supply pressure.

Around 25%, by volume, of the total daily water demand is held as a reserve within the distribution network in Holland and this is fairly typical for most of Europe. In Germany the percentage is slightly higher (30%) and in Italy and Sweden the amount of stored water varies around a 25% average.

8.2 Cost of providing water at a reasonable pressure

It is assessed, by companies in Holland, Sweden, Italy and Germany, that the energy requirements and the provision of booster stations and larger pipes to maintain reasonable water supply pressures inevitably increase the costs of water provision.

9. THE CURRENT CONTINENTAL APPROACH TO WATER SUPPLY

The view of the Belgian water industry is very clear. Domestic storage is considered to be 'uneconomic, unnecessary and unhygienic'. All water in Belgium is provided by direct feed.

Other European nations are less forthright but still tend towards completely direct fed water supply networks. In Denmark all cold water is direct fed and cisterns are not permitted. In Holland cisterns are rare and are banned in new properties.

In Spain the water supply is direct feed for both hot and cold water and the supply is normally metered. Cisterns are discouraged as a health risk and are rarely seen.

In Italy, where the preferred supply strategy has been direct feed since 1974, cisterns are still fitted where the supply is unreliable. Storage is particularly common in Rome. Cisterns are still permitted in Germany.

Sweden supplies water with no storage phase, and uses pressure reducing valves where mains are under exceptional pressures. In Sweden the use of cisterns is rejected on grounds of 'purity, pressure and economics'.

In European countries considered in this report, other than the U.K., all new properties will have their water supply metered.

10. HOW PERCEIVED PROBLEMS WITH DIRECT FEED WATER SUPPLY ARE MET ON THE CONTINENT

Approaches to the problem of supply interruptions during maintenance and repair vary across Europe. In Germany, whenever possible, temporary pipelines are installed to supply the affected areas. When this is not possible tankers are used to provide water. In Italy, Holland and Sweden, the network design limits areas affected by supply interruptions. The use of temporary by-pass pipes further limit inconvenience to the consumer. Continental water companies claim to restore interrupted supplies within 24 hours of any fault occurring. The effects of supply interruptions due to essential maintenance are reduced in Holland by carrying out this work at low demand periods.

The problem of variable water pressures in areas of low topography is not acknowledged in Germany or Sweden. The distributed pressures are high and the use of pressure reducing valves ensures a safe pressure to properties. In Holland the onus is on property owners to ensure adequate pressures in high rise buildings. In Italy various methods to maintain pressure are used and in some areas these include the use of storage cisterns.

11. DISCUSSION

The effects on the distribution network of relinquishing the requirement for storage for domestic water supply to new properties would not be significant, except at the individual supply level. The increase in per capita water usage has reduced the proportion of water which is currently stored and hence the effect of storage on reticulation. As the number of water using appliances

which are fed directly from the distribution main increases, the significance of any stored volume becomes much reduced.

Microbiological data indicate that at a domestic property where water is stored in a cistern, the occupants may be exposed to a health risk. The attitude of other European nations is to eliminate storage within domestic properties in order to preserve the water quality.

Provision of hot water at mains pressure is possible using current heating technology and would prove no more difficult to include than the provision of a direct feed cold water supply. However, safety requirements would necessitate professional installation and maintenance of the heating units. The added problem of the introduction of peaks in energy supply needs further assessment.

Data from European countries, where direct feed is the normal supply method, have provided more evidence as to the effects of relinquishing the requirement for storage in new properties in the U.K.. The primary reasons for using storage within the premises stated in the Technical Report TR94 do not prevent direct feed systems being successful in continental Europe.

Direct comparison between water usage in the U.K. and in other European countries employing a direct feed supply system is not really valid as the continental European system generally involves domestic metering. Water usage in areas of the U.K. where a substantial proportion of the water is fed directly from the distribution main, but where metering is generally absent, may be significantly higher, (about 10%), than the water usage in areas where storage is used. Continental European data strongly suggest a major reduction in consumption when metering is established.

The adoption of a direct feed system of cold water supply to new properties in the U.K. could not be argued against on the grounds of provision of suitable pressures or suitability of current domestic pipework. The current reticulation and stored reserves in the U.K. distribution system appear to be generally sufficient to properly operate a direct feed system.

12. CONCLUSION

Of the factors assessed in this report only two are demonstrably significant when considering the differences between water supplies with or without domestic storage.

A supply system that includes storage gives a reserve against potential supply interruption which does not exist in a direct feed system. A direct feed system of supply, on the other hand, avoids the risks associated with microbiological contamination within the property boundary which might occur where a stored supply exists.

These two issues must be central to any discussion of the merits of the two supply methods.

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APPENDIX A

QUESTIONNAIRE ON DIRECT SUPPLY WATER DISTRIBUTION

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QUESTIONNAIRE ON DIRECT SUPPLY WATER DISTRIBUTION

The following questionnaire was sent to WRc contacts in Europe to assess the current views held on water supply systems.

1. For a typical water supply area serving approximately 50,000 people and a second area serving approximately 2,000 people could you please provide;

   (a) An estimate of the volume of water supplied to the area,

   (b) The ratio of the peak water demand to the normal water demand level,

   (c) The typical size of the water mains serving the area,

   (d) The typical water pressures and design flows in the water distribution network of the area,

   (e) An assessment of how the actual values of water usage and peak demands compare with the theoretical values used in planning.

2. How are the following problems overcome;

   (a) Supply interruption during maintenance,

   (b) Variable water pressures in areas of low topography ?

3. As a percentage of the daily demand, what amount of water storage is held within a distribution network ?

4. Where domestic metering is employed:

   (a) Was the metering designed to assist in water distribution planning or to encourage water conservation by the householder?

(b) In general terms what effect on domestic water usage did metering actually have ?

5. How are acceptable supply pressures generated in a direct supply domestic water distribution system ?

6. What influence does the generation of a reasonable supply pressure have on the cost of supplying water ?

APPENDIX B

COMPARATIVE DATA FROM EUROPEAN CONTACTS

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Table B.1 - Comparison of United Kingdom Water Supply Data with those of other European Nations

Country	Estimated annual volume (1000 m^3) supplied to given population areas		Estimate of the ratio of peak to average demand for a supply area of 25,000 people.*
	50,000 people	2,000 people	
U.K.	**6,000**	**230**	**1.60 : 1**
Germany	3,250 γ	123 γ	1.50 : 1
Holland	3,200 γ	130 γ	2.00 : 1
Italy	6,000	140	1.45 : 1
Sweden	6,000	210	1.60 : 1

* For smaller populations the peak to average ratio is increased.
γ Volumes do not include industrial use, wastage or municipal use.

Table B.2 - Estimated percentage of supplied water which is unaccounted for in the system for a selection of European Nations

Country	Estimated Wasteage	Country	Estimated Wasteage
Austria	10-20 %	Italy Ψ	20 %
Belgium *	20 %	Norway	25 %
Denmark *	< 10 %	Portugal	15 %
Finland	15 %	Spain *	10-20 %
France	15-20 %	Sweden *	12 %
Germany Ψ	< 12 %	Switzerland	14 %
Holland *	12 %	UK β	25 %
Hungary	10 %		

* All domestic water outlets supplied by direct feed.
Ψ Majority of domestic water outlets supplied by direct feed.
β Majority of domestic water outlets supplied via storage.

NB. The figures quoted in Table B.2 cannot be attributed to leakage alone as they may include water used in fire fighting and in council operations. The values could be misleading as some countries regard major bursts, or known leaks, as accounted for water. This water is not included in their estimates of percentage waste.

ACKNOWLEDGEMENTS

Information on continental European water supplies was freely provided by WRc contacts in Europe. The actual contributing organisations cannot be identified as some of the data provided may be commercially sensitive.