FINAL REPORT

Development of Drinking Water Safety Plans in Scotland

Reference: ENV3/04/03

Date: 31st March 2005

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Acknowledgements

The authors wish to thank all those who gave freely of their time and enthusiasm in the process of carrying out this project. In particular we wish to thank the staff from Scottish Water who gave so much assistance with considerable enthusiasm. Special mention should be made of Marcia Banks, who acted as the liaison person for Scottish Water, and the many staff in the supply areas who broke into busy schedules. We would also like to thank the other members of staff from Scottish Water from all levels, who are to be recommended for their enthusiasm and openness. Thanks are also due to staff from Health Protection Scotland, SEPA and the City of Edinburgh Council. Finally we would like to thank the staff of the Scottish Executive, who have been most helpful with information and assistance.

Cover photograph: Dores source burn adjacent to WTW. Copyright J Littlejohn

Dores catchment from below the WTW. Photograph J Littlejohn.

EXECUTIVE SUMMARY

WHO and the world water industry have considered that the water safety plan (WSP) concept, considering water from source to tap, is the best way to assure drinking water safety and acceptability in the 21st century. United Kingdom Water Research Limited have developed a framework for establishing WSPs in the UK. The concept has been welcomed by quality regulators and the Scottish Executive Drinking Water Quality Division has established a project to investigate WSPs in Scotland based on the UKWIR framework. Three water supplies in Scotland representing small to medium sized systems were chosen to provide suitable examples. Hazards and hazardous circumstances associated with these supplies were assessed and skeleton WSPs prepared. The approaches were also examined in the light of significant initiatives within Scottish Water to develop the necessary systems that would support WSPs but which are also considered to be current best practice. The conclusions from the project are as follows

UKWIR has established a framework for developing WSPs in the UK but Scotland faces significantly different challenges to England and Wales in terms of the types of supply, terrain, previous investment and the maturity of Scottish Water, which is a new organisation.

WSPs provide an excellent means of helping to deliver water that is both safe and acceptable on a continuous basis. The procedures involved build on much of the existing best practice in drinking water supply.

Scottish Water are making significant steps in putting in place the necessary systems on which WSPs are based as part of best practice. A number of these initiatives are at an early stage while some are more advanced, but it is essential that these are seen as working documents, that they are user-friendly and that they are updated in the light of changes and experience.

WSPs will be particularly valuable in supporting small water supplies, some of which are currently experiencing circumstances in which hazards cannot be guaranteed to be eliminated. This is of particular concern with regard to *E. coli* O157, and, potentially, *Camlpylobacter,* which can induce serious consequences over and above gastrointestinal infection and can even kill. This has already been demonstrated in Canada.

There is considerable utility in the use of a generic WSP for small supplies that covers particular types of treatment as long as differences in hazards in the catchment and other specific differences can be taken into account.

WSPs are likely to highlight the issue of de-manning and provide a means of assessing when manpower has reached critical levels for assuring safe supplies. They will however, provide a means of knowledge capture that will aid flexibility and will potentially provide savings by preventing the need for constant reaction to problems after they have occurred.

The resource implications are difficult to assess, since a number of the procedures and actions actually reflect best practice and should arguably have been in place

previously. It is, therefore, difficult to estimate resource implications for Scottish Water with any accuracy. However, a small team of six people, working with the operatives and process control scientists, in addition to the current effort on WSPs, could achieve a great deal within a relatively short time. Resource implications for other stakeholders are dependent on other policy decisions that need to be taken in the light of the benefits in relation to the costs.

WSPs cannot be developed overnight and to have the greatest benefit the process needs to be evolutionary. This process of continuous improvement is consistent with best practice in the water supply industry and with Scottish Waters stated aims.

Contents

1. Introduction

Water supply is a dynamic system and does not usually remain constant. It therefore needs to be considered in this light with the most appropriate approach being proactive rather than reactive. This is reflected in the third edition of the World Health Organisation (WHO) Guidelines for Drinking Water Quality, which contains a number of changes from previous editions of the Guidelines. In particular WHO has proposed a number of ways in which drinking water quality and safety can be assured by taking a more proactive approach to drinking water management. One of the reasons for the change in approach is that for microbial hazards, in particular, the use of indicators provides only a very small snapshot of the quality of the whole supply so ensuring that the barriers are operating efficiently at all times is very important. The failure of an indicator parameter like *E .coli* is a sign that the barriers have been compromised and, therefore, always be taken very seriously. This is based on the development of system specific water safety plans (WSPs) that are based on a system-wide risk assessment and a demonstration that the system is consistently capable of delivering safe water.

During the period of the WHO deliberations a group of water industry professionals, including the European Water Industry (EUREAU), the American Water Works Association Research Foundation (AwwaRF) and the Water Services Association of Australia (WSAA) held a workshop in Bonn with a number of water regulators and water quality specialists to discuss developing a framework for assuring the quality of drinking water in the 21st century. The basis for the discussions was hazard analysis and critical control points (HACCP), a process developed to ensure food and water safety in space and widely adopted by the food industry. This was also the basis for WHO's WSPs. The outcome of the Bonn workshop was a series of principles for water supply that were designed to meet a stated goal "to provide good safe drinking water which has the trust of consumers". The primary principle was that "good drinking water can only be provided through an integrated approach from catchment to consumer tap". In addition good safe drinking water was considered to consist of water supplies, which are reliable in terms of both quality and quantity. It was also considered important that less reliance should be placed on end product monitoring for assuring drinking water safety since results are often received too late to provide adequate time to prevent consumer exposure.

In order to promote this approach, United Kingdom Water Research (UKWIR) funded a project called Managing Microbial and Chemical Risks from Source to Tap. This project laid down a number of approaches and developed a toolbox that was intended to assist water suppliers in developing WSPs. The quality regulators in Scotland and England and Wales were also invited to participate and have accepted the utility of the process in helping to assure drinking water quality and safety by taking a proactive approach to drinking water management.

Subsequent to the completion of phase 1 of the UKWIR project, the Scottish Executive let a contract to examine some of the particular issues that need to be considered in Scotland, to obtain a more in depth practical view of the issues

surrounding the implementation of WSPs in Scotland and to assist Scottish Water in their introduction of WSPs. The aims of the project are;

- To provide information on the practicalities of applying the WSP approach to three different sizes of water supply. The three supplies to be reflective of small, medium and large supplies in Scotland.

- To identify concerns Scottish Water or external stakeholders such as health professionals may have regarding a shift in approach from current compliance monitoring towards Drinking Water Safety Plans.

The objectives of the project were;

- Create three Water Safety Plans for different sizes of water supplies in Scotland. The supplies will be chosen to represent, as far as possible, the range of public water supply systems encountered in Scotland.

- Water Safety Plans to be based on the UKWIR Guidance for Managing Microbial and Chemical Risks from Source to Tap with regard to the necessary interface with the requirement in the Water Framework Directive for Drinking Water Protected Areas and the need to prevent the deterioration of drinking water quality by internal plumbing systems both in domestic properties and large buildings.

- Suggest the most effective way of approaching the task and comment on the completeness and value of the current UKWIR guidance together with recommendations for addressing the deficiencies identified.

- Contact organisations outside Scottish Water (e.g. local authorities, NHS Boards, the Drinking Water Quality Regulator (DWQR) and the Scottish Environmental Protection Agency (SEPA) to determine the requirements for other organisations involved in the production of WSPs.

- Assess the likely costs and resource requirements for other organisations involved in the production of WSPs.

- Identify gaps that exist in current information and systems that need to be filled in order to allow the development of WSPs for public drinking water supplies in Scotland.

- Determine where, if anywhere, there is scope for generic plans or parts of plans.

This report contains the primary outputs of the project.

2. Overview of Water Safety Plans

The basic concept of WSPs is identification of the hazards that can threaten each stage of the water supply process from the catchment to the tap, assess the risks associated with these hazards both in terms of likelihood of occurrence and potential for impact on safety or acceptability, and to put in place procedures that will mitigate the risks. The last requires that appropriate barriers be put in place with operational controls and target criteria to ensure that the barriers are operating properly. In addition, corrective actions are defined that will ensure the process is brought back into line if the process is moving outside of the target criteria. Finally, it is an important component of WSPs that the corrective action taken is verified. Essentially this requires documentation of procedures and recording of actions taken to demonstrate that the appropriate processes and procedures are in place and are carried out satisfactorily. An important part of the process is audit to demonstrate that procedures are indeed carried out according to the WSP and to provide independent assurance that the barriers are operating at their optimum.

To gain the greatest benefit from WSPs, it is important that they be considered over the whole of the drinking water supply process and include aspects such as design and building of drinking water plant and installations, analysis and monitoring and maintenance of equipment and plants. The process covers hazards and threats in the catchment including the changes in risks associated with differing conditions such as following heavy rainfall or seasonal activities. Drinking water treatment and distribution are largely under the control of the water supplier but there is a requirement to consider circumstances in which the risk of a problem that can threaten water quality or quantity may be heightened and such circumstances often involve third parties. The final step involves the water supply in buildings and the impact on water quality. Although the water suppliers have some responsibilities with regard to the water fittings bylaws and water condition with regard to the dissolution of metals from plumbing, there is a significant level of responsibility that lies outside that of the water supplier. The process, therefore, requires the involvement of a range of other stakeholders who have an essential part to play.

It is clear from the above that the process is not about producing dry documents. It is essentially, as indicated, a living process in which the procedures documented need to be used. It is, therefore important that the documents are both accessible and sufficiently user friendly to meet the needs. There is also a significant requirement for training and so the WSP for a supply frequently benefits from being an evolutionary process with a top down approach linked with bottom up practical knowledge capture.

There are two important benefits that can be gained from this process in addition to preventing problems. One is that knowledge within the organisation can be captured and made available very widely and so the organisation is less reliant on the knowledge of particular individuals to operate correctly all of the time. This is particularly important in view of the drive for efficiency, which can result in reducing manpower, and at a time when a significant number of experienced staff are reaching

retirement. The second is that experience from actual problems can also be captured and used to reduce the risks not only in a specific supply but also in other supplies.

However, the process of developing WSPs is not one that requires that all actions be taken at once, nor does it require that an entire WSP be created at once, although the integration of the approach is a vital component. The initial process enables the safety of the supply to be assessed and procedures to be put in place that will ensure that existing barriers and procedures are optimised to minimise the risks to the consumer. The WSP as a living process provides a basis for gradual improvement within the constraints of the available resources. The risk assessment process also allows prioritisation of investment and action to deal with the greatest risks first.

There are significant benefits to regulators, water suppliers and consumers associated with the implementation of WSPs. A number of these are as follows;

Water Companies:
More efficient co-ordination of existing procedures and initiatives providing added return.
Better priority setting for investment.
Better targeting of regulatory monitoring.
Minimises risk of regulatory action.
Minimises risk of losing consumer trust.
Encourages other stakeholders to take increased responsibility.
Clearer identification of responsibility for those outside company control.

Regulators:
Strong basis for demonstrating due diligence defence.
Supports common maintenance framework and DWQR's DOMs process.
Clear risk based targeting and justification of investment in water quality.
Anticipates future regulatory agenda of EC and WHO.
Basis to defend against many additional regulatory parameters.

Customers:
Increased confidence in water supply, particularly from more emotive issues such as trace chemicals.
Increased reliability of the water supply.
Minimised risk of losing confidence in the supply through incidents and more rapid recovery of confidence if an incident occurs.

There are also a number of potential disadvantages that are associated with WSPs. There is a requirement for an extensive recording system and this has to be maintained as current. This in turn has some implications for the resources available and there is a danger that the process is taken over by bureaucracy and ceases to be an essentially practical tool. The increased potential for transparency may also be uncomfortable, at least in the earlier stages and particularly at a time when the political drivers are for instant results. Where water supplies are already of a high standard there are unlikely to be obvious short-term benefits in terms of water quality. WSPs will highlight the problem areas and it is unlikely that investment will be available to cover all of these in the short-term. There is also a danger that the problems will be always the focus and this could give a misleading impression to those not involved in the process.

3. Issues not Addressed in Detail in the UKWIR Project

The UKWIR project 'Managing Microbial and Chemical Risks from Source to Tap' focussed primarily on WSPs from the point of view of the water supplier. Although some mention was made of a number of aspects of WSPs as they are considered in the WHO Guidelines not all were considered in detail or in the context of the UK.

3.1 Health-based targets

While health-based targets are discussed in the UKWIR project, a number of important issues surrounding health-based targets are not considered in detail. The position over health-based targets for chemicals is straightforward because the standards for most chemicals are, in effect, health-based targets. The exceptions are those substances for which standards are set on the basis of acceptability, for which there are no health-based targets. However, for microorganisms the standards are based on indicators, which do not represent health-based targets. Health-based targets for pathogens would be set on the basis of an acceptable risk from specific pathogens and, using quantitative microbial risk assessment (QMRA), the reduction in the numbers of pathogens that a water supply would need to achieve as a consequence of multiple barriers. This approach does not require the actual measurement of pathogens but the determination of whether the supply is theoretically capable of meeting the targets, taking into account the hazards present in the raw water. The approach currently is largely related to the interaction between the catchment and the capability of treatment. While the utility of this approach in designing a new treatment or upgrade is obvious, QMRA is still in its infancy and the decision as to what constitutes an acceptable risk is not a scientifically based one but relates to a wide range of societal factors, including the background rate of disease associated with a particular organism or for overall infection. In developed countries, this largely relates to relatively minor gastrointestinal infections, although some such as *Campylobacter* can have serious sequelae and *Escherichia. coli* O157, which can result in fatal complications in vulnerable individuals, have introduced a more serious dimension for public health. The issue for determining an acceptable risk, which is the foundation for health-based targets is who determines what constitutes an acceptable risk, since acceptable is less of a scientific than societal decision. It is also then important that the body that has determined what is acceptable is trusted by consumers and therefore it needs to be seen as both objective and disinterested.

The issue of health-based targets is one that cannot be discussed without reference to health authorities and is considered in the section in which discussions with other stakeholders are described.

3.2 Mechanisms for determining responsibility for catchment management and water quality in customer premises.

Although the UKWIR project outlines the need for allocation of responsibility, the problems of exactly how negotiations with other stakeholders can be carried out and how issues such as resource requirements can be addressed was outside the scope of

the project. This is a particular issue for Scotland with the extensive agricultural catchments and numerous, small, remote supplies in many parts of the country. Decisions will need to be taken as to the utility of substantial effort in catchment control and how this should be achieved, but there will be significant issues for the cost effectiveness of any initiatives. The implications for policy and resources are discussed in more detail in the section in which discussions with other stakeholders are described. It will be an important component of the way in which WSPs are implemented in Scotland and raises questions about whether there is a need for legislation or whether supporting programmes in which voluntary initiatives are introduced are more appropriate.

The Scottish Executive is already involved in initiatives that should lead to certification of plumbers but there are clear needs for a higher profile for guidance on the responsibilities of customers, beyond the issue of *Legionella*. There is also a need to determine the boundaries of responsibilities and the role of Environmental Health professionals in dealing with the problems of domestic premises and larger buildings. It would appear that supporting programmes in the form of national codes of practice related to the scale of the premises would be a valuable tool in this area.

3.3 Responsibility for independent surveillance

There is a basic requirement within WSPs, as envisaged by WHO, for independent surveillance and audit of the WSPs and their operation. This is part of the process of proving that the system is working as it says it will. There are two possibilities; one is that this is carried out by the quality regulators as part of the existing audit process, which is clearly an important part of the regulatory process. However, there is also room for Scottish Water to employ an independent auditor to examine a selection of supplies for which WSPs have been developed to provide a different point of view. The former is already in place but the second would be considered as an option that Scottish Water would need to consider and decide how much benefit would be gained by such a process. Beyond Scottish Water, the role of audit becomes more complex and relates to the various responsibilities relating to catchment control and water quality in consumer premises. It does seem that consideration as to how this might operate is an essential requirement and probably lies primarily with the Scottish Executive in conjunction with other external stakeholders. Such audit could be through random spot checks or periodic review but would need to take into account the current legislative situation and the costs in relation to the benefit to be obtained from different levels of audit and inspection.

One area that actually falls to Scottish Water is the supervision of contractors and ensuring that they carry out their work according to agreed procedures. This is a particularly difficult area for the Water Company because of the potential resource implications, however adequate supervision is vital and cannot be considered just a luxury. The areas covered would be, for example, delivery and quality of chemicals supplied and mains refurbishment. Both are areas of potential significant vulnerability. While supervision of deliveries and contractor activities on treatment works can usually be more easily achieved with staff responsible for works, refurbishment of distribution systems requires working away from Water Company facilities. The problems that can arise as a consequence of such work are exacerbated by the current approach to capital funding, which means that the level of activity by

the Water Company fluctuates in peaks and troughs. Without a steady work stream, it is very difficult for contractors to keep experienced and trained gangs together with the result that experience is constantly being lost. In addition the cost pressures are such that the most experienced and highest quality contactors may not be able to compete properly. It is, therefore important that in setting the financial constraints quality and water safety need to be included as a key part of the equation.

3.4 Transparency – how and how much.

The UKWIR project emphasises the importance of transparency but does not consider this in any detail since it was considered a matter for individual water companies. However, there are a number of considerations regarding transparency, not least of which is whether it is appropriate for Scottish Water and/or the Executive to be more pro-active in this respect. The introduction of WSPs will provide greater security in the mid to long-term but is unlikely to provide headline improvements in the short term. It does not, therefore, seem to be appropriate to try to engage the wider consumer. Indeed, there is a danger that highlighting the approach at an early stage would be seen as moving the goalposts or that it would be construed that current supplies are not safe. However, there is probably significant benefit of a gradual approach to providing more information to both industrial and domestic consumers through the normal information channels used by both Scottish Water and the Executive and this is something both parties are working towards. There is however, a need to engage more widely with health professionals and this is considered in more detail in the section on external stakeholders.

3.5 Communication between parties

Although the importance of communication is stressed in the UKWIR project, there is no indication as to how this can be achieved and who should take the lead, although there is an implication that this should be the Water Companies. In Scotland, having a single water company potentially makes a difference to the way in which this could operate. It is necessary that there are clear and well documented lines of communication with all of the stakeholders with a degree of formality that ensures continuity. The organisations best placed to take the lead are Scottish Water and the Scottish Executive. Existing contacts between stakeholders at all levels need to be clarified and documented so that any member of a stakeholder organisation is aware of their role and responsibility in the maintenance of drinking water safety. In addition there is a clear need to assess how communications are working on a continual basis and to make positive efforts to ensure that any personnel or organisational changes are taken into account.

4. Specific Issues for Scotland

Although the UKWIR project was intended to provide a tool that could be applied to all water suppliers, there are a number of specific issues applying to Scotland that impact on the circumstances in which WSPs are introduced. These issues do not change any of the principles surrounding WSPs but they do require careful consideration in assessing how Scottish Water, in particular, will be able to introduce and implement WSPs.

4.1 Institutional Issues

Scottish Water is a relatively new organisation formed from three quite different and regionally oriented water authorities with different cultures and, to a significant extent, different problems. These water authorities were, in turn, formed from a large number of local authority water departments that were highly influenced by local political considerations. These political considerations varied significantly over the country and have left a legacy of different water problems, particularly in the Highlands. These problems include significant under-investment in water infrastructure, the legacy of inappropriate materials used for water mains and the adoption of small supplies that in England and Wales would still be private supplies. Currently Scottish Water is in the process of bringing together the different cultures and this in itself is a difficult task that can impact on the introduction of organisation-wide systems. This is not to suggest that the professionalism in each of the regions is not very high, but different systems and work practices exist and, although it is evident that considerable efforts are being made to overcome this, it does introduce significant complications. However, while the rollout of organisation-wide systems of recording and work practice requires considerable effort at all levels, it may also provide an opportunity to counter any perceptions that the system from one region is being forced on other regions by a bottom up flow of practical knowledge that clearly influences the systems being introduced. It is also important that it is recognised that the one size fits all concept only goes so far and there is a need to tailor solutions to specific circumstances.

To achieve all that is needed, WSPs require buy-in from all levels of the organisation, including senior management and the workforce on the ground. It is, therefore, important that staff at all levels have some involvement in the development of WSPs to ensure buy-in and also to ensure that practical and, particularly local considerations are taken into account.

Scotland is also different to England and Wales in having only the single water company but several regulators. There is therefore an even greater need to share information and to ensure good liaison in order to prevent unnecessary duplication of effort between the water company and regulators and to maximise efficiency. WSPs provide a very useful vehicle to do this for drinking water supplies. In particular catchment to tap teams involving several stakeholders provide an excellent forum for exchange of information and liaison at a local level, even if in some areas this may need to cover groups of supplies.

4.2 Water Supplies

Scottish Water has a unique set of issues with regard to public water supplies in the UK with the large number of small and remote supplies, which are frequently located in difficult terrain. This presents a number of problems with regard to investment in improvements, particularly for supplies, many of which have no mains electricity supply, that provide water for very small numbers of consumers. It also presents particular challenges for maintenance and access in the case of emergencies and other problems. These small supplies can benefit significantly from the development of WSPs, which provide a mechanism for risk-based prioritisation of actions needed. WSPs can also help to highlight relatively small changes that can lead to significant benefits in terms of drinking water safety. It is clear that improvement of such supplies will require a long-term strategy, but the long-term development of the Scottish economy will to a significant extent depend on good public water supplies.

In addition to the large number of small supplies, there are many supplies with relatively long distribution systems that cannot be networked. This often results in large numbers of service reservoirs. Such systems provide a significant challenge to distribution operation and management. In addition many of these distribution systems are old and, as indicated above, may not consist of suitable pipe materials.

The challenges faced by Scottish Water mean that expectations of what WSPs can deliver in the short and medium-term need to be managed carefully and, as indicated above, WSPs should be seen as living processes that will develop over time to help deliver the required improvements for assuring drinking water quality and safety.

4.3 Design for Quality

The ability of a water supply to deliver water that is safe and of sufficient quality begins at the design stage. When improving systems it is important to consider what the system needs to achieve and what variations in raw water quality will need to be addressed. In this respect there will be differences between all supplies and in many cases these differences will be significant. It is also important to consider potential combinations of circumstances that will create increased vulnerability of a system to risks, for example rapid changes in raw water quality following rain storms or rapid snow melt combined with loss of power. The potential hazards in the catchment are, therefore, a vital consideration in designing a water supply system.

One of the factors that can result in deterioration in quality is the increase in demand above that which the system can comfortably handle, as opposed to the theoretical design capacity. For distribution systems the key is managing to minimise the residence time of water in the system while providing sufficient capacity for peak demands, potentially including fire fighting, and expansion of the system. In many of the Scottish supplies the potential for networking the distribution system is limited and so there is a difficult balance to be achieved, which requires the recognition of this need by other stakeholders, including local planning authorities. For treatment works the key is to develop designs with both quantity and quality in mind and to take into account the impact on quality that increasing flows to the limit can have.

There are particular issues for small remote supplies that are unmanned and although these will vary, there a number that are generic. These include ensuring hatches are protected from ingress of contaminated surface water, providing sufficient storage that

maintenance operations can be carried out without loss of the supply or by-passing treatment and, where telemetry is available, ensuring alarms are realistic taking into account the ability of staff to access the works in a short time, particularly in adverse weather conditions. Telemetry should be considered a key requirement for remote sites, although it is recognised that installation of telemetry may not be possible at all of the small sites and expanding coverage will take time.

Design also needs to potentially consider future problems that may not be sufficiently recognised at present and for which there is no current regulatory strategy. In Scotland this primarily means microbial contaminants. The microbial contaminant, which has been the focus of activity, has been *Cryptosporidium* but *E. coli* O157, which is capable of being a killer, is a significant hazard in Scotland. Already deaths have occurred in Canada in a public water supply and the situation in parts of Scotland is a concern. Outbreaks associated with private supplies could have been in public supplies if the timing had been different. It is, therefore, important to plan to meet these problems and there needs to be appropriate financial and regulatory recognition that this is an important requirement.

4.4 Water Quantity

Contrary to common belief and media presentation, Scotland has many supplies that are short of water and require drinking water to be brought in by tanker during dry periods, at significant cost. This can lead to a number of potential hazards and increased risks. Many of the small supplies consist of stream sources that are draining the hillside and are very vulnerable to the impact of dry spells, which can result in a significant fall in the quantity of water available in a relatively short time. This has two implications, one is the need to provide water by tanker with the potential hazards that can arise from breaking the water supply chain, not least of which is the need to intermittently fill storage and to connect into the system through a potentially vulnerable point. There is also a significant risk of large changes of raw water quality when rain does fall following a dry spell. These can be quite sudden and have implications for a number of processes, including filtration and chlorination.
In addition there is an increasing pressure of development in a number of areas of both the Borders and the Highlands. Where there remain limitations on alternative supplies this may lead to increased demand and subsequently to pressure on the ability of existing treatment to cope. The regulatory control of water abstraction for drinking water lies with SEPA, whose primary responsibility is for the environment. However, it is important that SEPA takes into account not only the quantity, but also the potential for significant impacts on the quality and safety of drinking water, when considering the balance between environmental concerns and water supply.

4.5 Access and Communication

In contrast to England and Wales, many of the supplies in Scotland are remote and access can be quite difficult, particularly in adverse weather conditions. In addition many only have access to limited electricity supplies and electronic communication can be difficult due to the terrain. As a consequence, the frequency of visits to unmanned works may be limited and the response to problems with the works or following rain events may not be rapid. It is important that such issues are taken into account in designing and modifying works. Where telemetry allows the installation of

alarms it is essential that these are carefully set in order not to require unnecessary visits, and to give some indication of the cause of the problem and the urgency of the response required. In many cases operatives are responsible for several works and some assistance in setting priorities in visits and for carrying out checks would be an important part of a WSP.

Even where treatment works are not remote, the catchment and intakes may not be easily accessible. Under these circumstances routine inspections are much more onerous and so problems not giving rise to obvious and immediate water quality or treatment problems may not be found as quickly as might be desirable.

4.6 Training

Training is an essential component of WSPs. This is even more important under circumstances of de-manning, which has been a significant part of meeting the efficiency targets given to Scottish Water. Periods of de-manning unavoidably cause a feeling of uncertainty in the workforce. Training plans for each operative are an important part of the WSP and are an important part of the process of gaining and maintaining staff buy-in to WSPs and the principles behind WSPs. They also help maintain a high level of commitment to Scottish Water's objectives and policies. Training can take a wide range of different forms but where operatives are often working on their own in remote areas, takes on an even greater importance. Scottish Water also faces the problem that there is a conflict between the resources available on the ground for maintaining the supply and the time required for training. One means of reinforcing training is for more experienced staff to be closely involved in the training process. It is also important that staff have at least a broad overview of the water supply chain and the types of problems that can arise. This, in turn, means that they are in a position to be able to provide information to a more experienced individual where they encounter a problem, or potential problem, as the workforce on the ground are the eyes and ears of the organisation on a daily basis. Training is also an important part of the process of bridging the gap between management aims and staff perceptions, which is one of the most difficult problems facing rapidly changing organisations.

4.7 Documentation and Recording

Documentation and recording are a key part of WSPs, providing the basis for the correct procedures to be followed at all times and providing a reference point for all staff members involved in drinking water supply. The way in which documentation is established needs to consider accessibility and ease of use, both in terms of being able to access and use the information in the field and also in terms of recording. In field situations in particular, this can be a difficult task to achieve and, with the large number of small remote supplies, is more of a challenge in Scotland than in England and Wales. Ease of recording encourages operatives to faithfully record what they have done and to note any particular points that may be of value in the overall assessment of a supply.

Documentation for WSPs is a potentially vital tool in capturing knowledge during periods of change, particularly reorganisation and demanning. In this way knowledge

regarding specific supplies is not lost to the organisation. Without recording knowledge in the WSPs, there is a potentially significant cost to the organisation in terms of both time and in terms of increased risks of problems with the supply at all stages. Where there are small, unmanned works, it is also important to have adequate and accessible documentation where operatives who are not especially familiar with a works may need to attend in order to carry out routine maintenance or to deal with problems, for example during sickness or holiday periods.

5. Other Stakeholders

5.1 The Scottish Environmental Protection Agency (SEPA)

SEPA are the regulators for environmental quality in Scotland and have responsibility for raw water quality and quantity. In particular they have extensive powers regarding pollution control, especially releases and discharges. Their responsibilities regarding diffuse pollution are less clear. JKF met with Colin Bayes, Director of Environmental Protection and Improvement and Martin Marsden, Water Unit Manager. Currently SEPA have a role in the development of drinking water protection areas, which will include sources for private supplies. These will prevent deterioration of drinking water sources. However, at present there are no proactive preventative programmes specifically aimed at drinking water. There are programmes and initiatives to encourage farmers to handle and use pesticides more safely and to control discharges of slurry. These campaigns will have a benefit for drinking water supplies and would come under the heading of supporting programmes. There is no systematic approach for picking up incidents but staff in the field are alert to signs of incidents and SEPA have telephone numbers that can be used by the public to report incidents and unusual occurrences. This operates through the SEPA Communication Centre. Road transport and fire services also report accidents to SEPA. It would be valuable for Scottish Water to talk to SEPA to ensure that existing links by which the Water Company is informed of relevant incidents and problems by SEPA staff are up to date and working efficiently.

One of the major points is that SEPA staff are able to identify potential pollution sources and circumstances, e.g. leaking drums near water or field drains. It is important that such identified threats are dealt with promptly, either by SEPA or their agents, which could include Scottish Water, where appropriate.

Currently there is only limited action on diffuse pollution in catchments except in relation to bathing water. The Water Framework Directive, article 7, requires that the degree of risk to drinking water sources providing more than 10 m^3 per day as an average, or serving more than 50 persons and bodies of water intended for such use in the future, be identified. What will be required and what will emerge from this is somewhat uncertain but the risk assessments carried out by Scottish Water as part of the development of WSPs could make a valuable contribution to this process.

It is probable that more effort on diffuse pollution will be directed at priority catchments, which would be associated with major drinking water supplies. In order to cover all catchments it would require the passing of legislation on diffuse pollution and a significant increase in resources, estimated at an additional 20 people. This is a matter for discussion between the Scottish Executive and SEPA but the benefits for drinking water would appear to be limited. There is, however, a potential for combined initiatives in a wider range of catchments to provide information on good practice for a range of potentially polluting activities.

SEPA are involved in catchment planning and would like to be able to link into a number of other policy areas. This is potentially a much more efficient way of dealing with planning issues. The development of catchment maps will also be of benefit in developing WSPs. Scottish Water also have such maps and there is currently

significant collaboration, particularly on GIS. However, there may be potential for even greater collaboration between SEPA and Scottish Water to maximise the resources available. SEPA are also involved as a statutory consultee in the planning process and have an important role to play in providing warnings about issues regarding water resources. The issue of abstraction licences is an important one and Scottish Water might be placed in an impossible position between SEPA's desire to conserve water resources and the pressure of planning and increased water use.

There are resource implications for SEPA if a decision is taken that responsibilities for diffuse pollution should be extended. There are also potential resource implications, albeit much smaller, regarding local liaison with Scottish Water staff but there are also potential savings that could counterbalance this. Much of this liaison exists but there is a need to ensure that it is properly documented and maintained even where there are changes in personnel or organisational structures.

5.2 Health Authorities

The primary focal point for environmental health in Scotland is Health Protection Scotland and the primary contact is Dr Colin Ramsay, based at the former Scottish Centre for Infection and Environmental Health in Glasgow. Dr Ramsay is familiar with the concept of WSPs, having been one of the delegates at the final task group for the third edition of the WHO Guidelines for Drinking Water Quality.

JKF met with Dr Ramsay on the 2nd February 2005 to discuss the issues for public health professionals. The Consultants in Public Health Medicine (CPHMs) are the regional focal points for dealing with exceedences of the standards in relation to public health impact. They are particularly interested in those exceedences involving microbiological parameters. In general, WSPs would be seen as a benefit because they are a means of providing more data to determine whether an apparent outbreak of gastrointestinal disease in a community is likely to be associated with the water supply. Not all CPHMs are required to do much with drinking water related issues and Dr Ramsay has just formed a group of CPHMs who will have a particular brief for drinking water and they will provide a focal point for any discussions and a sounding board for a wider public health opinion on issues surrounding WSPs.

In discussions with Dr Ramsey, we particularly identified the issue of health-based targets and their utility, or otherwise, in Scotland. The current system of indicators for microbiological contamination and regulations for *Cryptosporidium* are not closely tied to health-based targets for microbiology. Dr Ramsey identified a danger that if the targets showed that a number of supplies could already easily meet the health-based targets there may be financial pressures to reduce current standard of treatment or to reduce the importance of water quality. This is one of the potential issues surrounding the use of health-based targets for microbiology as proposed by WHO. It is quite possible to establish WSPs and to obtain significant benefits without resorting to health-based targets. The converse is that if supplies are shown to not be capable of meeting the theoretical targets, there may be a distortion of priorities if they are perceived, inappropriately, as not being safe.

Scotland is starting to make progress with reducing problems with pathogen contamination e.g. Loch Lomond and *Cryptosporidium*. Dr Ramsay considered that it

would be inappropriate to reduce the pressure for improvement at this time, as it would send the wrong message. The issue of what is an acceptable risk is also difficult and would be likely to prove contentious. USEPA use a value of 1 infection per 10,000 population per year while WHO suggest a risk of 1 in 1000 population per year for non-fatal watery diarrhoea. While this has been less of a problem to date, the emergence of *E. coli* O157 as a waterborne contaminant, particularly for medium and small rural supplies, has changed the picture since this is a potentially fatal pathogen. *E. coli* O157 is a significant concern to the public health community.

Dr Ramsay considered that emergencies are already quite well covered for microbiology. Health-based targets are not particularly helpful in this respect, although WSPs are more generally of considerable value. In particular, they provide useful additional information in the event of an emergency and are a good argument for due diligence by the Water Company.

While there is a continuing need to be open with the public on drinking water quality it must be clear that there is no lowering of standards and that WSPs do not provide a route by which standards could be lowered. The objective remains as zero pathogens in drinking water.

WSPs will also provide increased confidence for public health authorities regarding the need for intervention on a particular supply or in a particular area. They also provide an opportunity to improve the confidence of the CPHMs and other public health figures in the water supply and the process of providing safe water. They may also provide an opportunity for consultation with the public health community and a focus for stakeholder involvement.

5.3 Local Authorities

Although local authorities have potential responsibilities and powers associated with public water supplies, contact with one of the senior EHOs for Edinburgh indicated that the workload is such that they are primarily concerned with private supplies. Stewart Graham, who is head of public health for Edinburgh outlined their activities with regard to public water supplies. This is primarily focussed on the consumer end of the supply with checks on all new-build properties for lead, and offering free lead tests and advice on request. They have a significant problem with lead rising mains to tenement properties in Edinburgh with a significant number of bursts that impact on the availability of water. Clearly replacement of lead rising mains with modern materials and with individual supplies to tenements would stop the bursts, eliminate much of the lead problem and enable the fitting of water meters where this is desired, or considered appropriate.

When complaints are received about water quality, particularly colour or taste, these are passed on to Scottish Water, since they could be an indicator of a problem in distribution. However, if there is any allegation of illness a sample is taken for analysis as well as Scottish Water being informed of the problem. There is, therefore, a significant involvement for local authorities with regard to consumer premises. Should there be a requirement to extend this involvement significantly, there would be resource implications but the scale of such resource implications on a Scotland –wide basis is uncertain. The extent to which other local authorities are involved with public

drinking water supply issues, even in consumer's properties and larger buildings, is likely to vary depending on a range of factors, including the nature of the properties and the density of properties and numbers of larger buildings.

6. Water Safety Plans

6.1 Introduction

The four key components of the WSP are catchment, treatment, distribution and consumer premises. These are not separate but are closely interlinked because each impacts on the next stage.

Catchment evaluation considers the nature of the catchment and the activities in the catchment that can impact on water quality. This also includes water quantity, since quantity and quality are frequently closely linked. The catchment assessment may not need to be extremely detailed but even in apparently simple catchments there are questions that can be asked. For example in a catchment with a relatively low density of animals the questions are do the animals congregate close to water sources and are there specific activities that could result in an increased risk of contamination at specific times of the year, such as lambing or dipping. Are there intensive cattle units and are any water sources at risk from slurry; if they are fed on silage is there a risk that silage liquor will enter water sources? For a number of smaller supplies there are questions such as whether dead animals, domestic or wild, can fall into the supply. The natural behaviour of the source is also an important feature, e.g. will heavy rainfall change water quality, including microbiological quality, or will dry periods result in oxidation of peat and result in an increase in colour and/or THMs in subsequent years. This means taking a broad look at the catchment and using local knowledge to inform the hazard and risk assessment.

Treatment can include the point from the intake, through raw water storage, if it is present, and through the treatment train. The requirements here range from design through to the operation of the works under all conditions. Basic questions need to be asked, e.g. is the works capable of dealing with the hazards in the catchment at all times, even under periods of stress such as after heavy rainfall or in times of high demand? In addition there is a need to consider each of the processes to determine whether they are operating at their optimum at all times and how this can be monitored in real time in order to ensure and prove that this is so. It also includes assessment of all materials and chemicals used and the practices associated with them with fresh eyes in order to ensure that documented practices are in place to prevent any problems and that procedures are in place to ensure that the document practices are not only adhered to but can be shown to have been followed.

Distribution is perhaps the most complicated of the four components but the first step is having detailed and accurate plans of the system, including flows. The plan covers the materials used in distribution and the condition of the assets. It also covers service and storage reservoirs, their condition and potential short-circuiting, including whether they are vulnerable to contamination. In some areas problems such as access of animals to reservoir roofs have lead to significant microbiological contamination of treated water. The plan should cover operating procedures and issues such as surge minimisation and parts of the distribution system that could be vulnerable to bursts or ingress, for example when a sudden high demand is exerted. Refurbishment and the use of contractors are also important issues and require not only clearly documented procedures but also means of ensuring and demonstrating these procedures are

adhered to. Consumer complaints procedures are also important since these may be the first indication of a wider problem in the system.

Customer premises are largely outside the responsibility of Scottish Water. However, consumer complaints can be an indication of problems introduced by the consumer and Scottish Water will be the first point of contact. In addition Scottish Water do have responsibilities regarding water bylaws enforcement. However, there are significant issues for a range of other stakeholders including a consumer education strategy for good practice, probably in conjunction with Scottish Water, training and certification of plumbers and the development of national advice on maintaining water quality in domestic premises. The management of water quality in larger buildings and public buildings is already receiving attention but a national code of practice on management of water quality in buildings would seem to be of significant benefit in providing a good starting point for all stakeholders.

Throughout the WSP there is also a need to consider emergency procedures and contingency plans, and contacts and liaison with external stakeholders such as public health authorities, SEPA and significant users who could have an impact such as Fire Brigades.

Evaluations of three supplies have been carried out with the preparation of three outline WSPs. It must be emphasised that these evaluations were not comprehensive given the time available and the information gleaned was not necessarily verified with more senior staff. It is also recognised that Scottish Water are in the process of establishing training and the processes that would contribute to the development of WSPs, and that the current situation is likely to change. The three supplies provide a snapshot of the situation in Scotland but comments are necessarily limited in view of the wide range of supplies to be found in Scotland. In particular, none of the three supplies suffers from problems with high trihalomethanes levels, which are a problem in some parts of Scotland. Never the less, the narratives below and the draft WSPs and worksheets presented in the appendices do provide a basis for looking at the utility of WSPs in Scotland and provide some suggestions that might assist Scottish Water with their programme.

Copies of the site – specific water safety plans have not been included for security reasons

7. Scottish Water Initiatives

In many cases Scottish Water has already begun the process of putting in place the systems and procedures that will be an essential part of the framework for WSPs. There is also a clear recognition of the value of the WSP approach at board level and considerable enthusiasm for what WSPs can provide within the constraints of funding and price control. A steering group has been put in place and a number of the initiatives in developing the tools that are required are at an important stage in their development. There is a considerable way to go before a comprehensive WSP network is available but it must be recognised that good WSPs cannot be developed overnight and that the change from a basically reactive mode of operating to a much more proactive mode will need to be developed gradually. However, it is important that the systems are seen as a support at all levels of the company and that everybody

understands their importance and value. WSPs should not be delivered down the line as yet another management requirement; they require buy in and adoption from the front-line operatives upward and need a significant input from the operatives to be effective and realistic. Scottish Water initiatives that are in preparation cover treatment, distribution, emergency response plans and risk evaluation and these are discussed individually below. They also include important initiatives such as an improved information handling system and improved GIS. A comprehensive asset inventory has been developed, which, with records of asset condition and linked to maintenance schedules, will be an important step towards the proactive management of supplies.

The management structure of Scottish Water also places quality and regulation, along with laboratory services, out of the operational line, which provides a means of separating the water quality/regulatory function from the pressures inevitably experienced by the operational managers.

Treatment Operation and Maintenance System (TOMS)

TOMS is still under development but a number of parts of the strategy and planning procedure documentation are available. These cover the broad requirements of a number of areas of the process including catchment management and borehole protection as part of the consideration of hazards from raw water and the catchment. At present there is no coverage of industrial hazards. The layout of the TOMS process seems to be excellent and will clearly build as more documentation is developed. In particular, the general procedures and policies will be translated into documentation for specific supplies. It is also important that the documentation for the local level is easily accessible and sufficiently user friendly to meet the needs of local operatives. It will be important to establish clear procedures for mothballed supplies and their reintroduction during times of water shortage. Such procedures should also cover any distribution pipes that are not normally in use. They should also include procedures for permanent decommissioning to ensure that there is no leakage or accidental reintroduction into supply.

The Mannofield Works Operating Manual is an example of a more complete manual for a specific works, although the version available to us was not the final version. This is a large document and presumably the version available on the intranet will allow easy access to the various sections. This type of comprehensive document can be added to and modified as appropriate and can link in to local instructions that are associated with particular pieces of equipment. Much is centred round the *Crytosporidium* Direction but of course this will generally be of significant benefit for other microbial hazards and water quality in general. Linked with the risk assessment project discussed below, this has the potential to be a significant contribution to the development of WSPs in Scottish Water.

Distribution Operation and Management System (DOMS)

The DOMS documentation and recording system is at a more advanced stage than TOMS. This has built in the integrated network management system (INMS) that was developed in East of Scotland Water. The documentation is extensive and covers a wide range of procedures, including design, hygiene and bylaws inspections. It is

anticipated that more detailed procedures will be developed for a number of procedures, one of which will hopefully cover a more detailed procedure for supervision and audit of contactors, particularly those carrying out potentially high risk procedures such as mains renovation. As with TOMS it is anticipated that more user-friendly versions will be available on the intranet that will be easily searchable and accessible by the workforce.

In the Water Supply Hygiene Listing there is a list of gastrointestinal pathogens and the requirement that staff should not have access to clean water systems if they are suffering from, or suspected to be suffering from these diseases. This list helps to create a state of awareness but more important are clear and unambiguous procedures for on-site working that would prevent actions that could possibly result in significant contamination, such as resulted in the Croydon typhoid outbreak. Failure to adhere to such procedures would lead to instant dismissal. Such procedures would also be required for contractors working on distribution systems.

Waterborne Hazard Plan

The Scottish Waterborne Hazard Plan has been developed in conjunction with the NHS Scotland and is a fairly comprehensive document. It was assembled by a Steering Group in July 2003 and subsequently reviewed and revised in September 2004. It is available from wavelength (the Scottish Water Intranet site). It has been presented to employees following a major training plan during 2003/2004. The SWHP is a 24 page document that details a framework for a coordinated response by Scottish Water in the event of an actual or potential waterborne hazard in a public water supply. It describes the initiation of an Incident Management Team (IMT), the composition of the team and the management of an incident. It does not deal with outbreaks. The main document is supported by a series of nine Annexes, which deal with the identification of a waterborne hazard, the communications relating to an identified hazard and PCVs for a range of chemical and microbiological standards. There are also 24 Appendices, which deal with specific chemical and microbiological problems and hazardous circumstances such as a treatment failure. There is also a section on treatment by-pass and the supplying of chlorinated raw water for small supplies. It is not clear that these procedures are actually adhered to and in view of the high risk Scottish Water may need to ensure that the proper procedures are followed and properly documented. The microbiological sections deal only with bacteriological failures, *Cryptosporidium* , *Salmonella*, *Campylobacter* and *E. coli* O157. The appropriate sections do not have references to standard methods. In due course the microbiological section could be expanded to include other pathogens known to cause waterborne disease. This is particularly important in relation to individuals who are carriers with no symptoms.

The chemicals sections cover a range of common contaminants, although the information in some, e.g. lead, PAH, is not entirely up to date. There is an error in the section on iron in which the SMRV is given as 2000 g/L instead of 2000 µg/L, although the WHO value of 2000 µg/L is mentioned. New chemicals can be added as required.

GIS

Scottish Water has an extensive GIS system, which provides an important tool for recording assets and, potentially, hazards and is an essential part of the base information for the development and operation of WSPs. It is an important part of detailed mapping and recording and keeping records up to date, which has aided in the comprehensive recording of assets (Elipse). This record is particularly helpful where there are many small supplies with dispersed assets, particularly abandoned supplies and mothballed systems. It is anticipated that there will also be procedures regarding such assets should there be a requirement to bring them back into use since this can have a significant detrimental impact on water quality unless proper steps are taken to ensure that the system is prepared and commissioned.

Risk Assessment

Risk assessment is one of the key stages in determining the likelihood of hazards reaching the consumer or of hazardous events occurring. There is a need in a company like Scottish Water for a more refined system of risk assessment in order to distinguish between many risks that would otherwise have a similar risk ranking, which is unhelpful for prioritisation. The risk assessment project being developed by Scottish Water is very impressive and will certainly be of significant value because it is not just a tick-box system and has a number of stages that require thought and careful consideration. The system also involves local knowledge and the process involves local operatives. The risk seminar held at Manse Street a short-time before our visits clearly had an impact on the thinking of the local operatives. This has an additional benefit in helping to engage the workforce at all levels and increases the sense of ownership. It was otherwise apparent that there is a gap between management intentions and workforce perceptions. Such initiatives can provide one of the means of bridging that gap and are of benefit to both management and the workforce, particularly as WSPs should not be perceived as purely another management initiative but a key process in helping staff to deliver a safe and high quality product.

Complaints Procedures

The complaints monitoring procedure in Scottish Water has much to recommend it. Customer complaints are handled through the Call Centre who, when necessary pass the complaint through to the Networks Services Inspector via the “Promise” complaints handling system. More complex complaints or failures indicative of a system problem are also passed on by the Network Service Inspectors to the Drinking Water and Compliance Section. The staff of the Customer Centre have a number of questions that are used to gain more information about the problem in order to inform the Networks Service Inspector and to assist in deciding which range of sample bottles will be required.

Although customer call centres are often seen as remote and limited, every effort is being made to provide a high level of training. This includes sending customer centre staff out with Networks Service Inspectors dealing with distribution and customer complaints to gain first hand experience wherever possible. This policy is clearly within the spirit of WSPs where buy in at all levels and appropriate training are both vital. The response to complaints can always be improved but the procedures for a rapid response at this point seem to be in place. It is then important that scientific and

operational staff are able to pick up on the complaints where appropriate and to ensure that these are resolved satisfactorily, especially where complaints could be an indicator of a wider problem.

Discussion

Scottish Water is in the process of putting in place the mechanisms for establishing WSPs. The area that is not well covered to date is that of auditing and record keeping, which provides a significant benefit in establishing that systems are working to their optimum and for demonstrating due diligence. The processes are still in development in many cases and will take time. However, this is to be expected and rushing through the development of WSPs and the managements systems around them would be neither efficient nor appropriate. Some initiatives, such as the risk assessment project are very interesting and may well provide an important basis for communicating the concepts around WSPs while providing an important means of involving staff at all levels. Currently there appears to be still a significant compartmentalisation and there is a need to more clearly link TOMS and DOMS for specific supplies.

There is now probably a need for more active coordination with WSPs in mind so that activities can be efficiently directed to reduce potential overlap and unnecessary effort. The formation of the Drinking Water Safety Plans Strategy Team is, therefore, timely. Much of the change needed for WSPs is being introduced as a matter of course in adopting the most up to date approaches to water supply management and the proactive nature of WSPs sits well with this.

There will be a need to ensure that procedures are fully understood and properly adhered to. There is also a need to modify procedures in the light of experience. There is already a considerable amount of data collected by Scottish Water regarding the safety and quality of water supplied. This is a valuable resource that has required significant investment to collect. It is, therefore, important that there is a system in place by which data is examined and appropriate action is taken to use the information generated from the data. Examination of the data needs to go beyond exception reporting and consideration of meeting the standards.

There is also a need for a rapid response to any indications of microbiological problems. This is particularly true for *E.coli* for which any occurrence on treated water is a concern, in view of the small volumes sampled and frequency of sampling in relation to the overall amount of water supplied. Unlike chemical contaminants, except in emergency, the problem with microbial contamination is acute and plugs of contaminated water in supply are potentially serious. The time between sampling and operational staff being informed needs to be as short as possible.

8. Resources

The additional resources that will be needed are difficult to judge with any accuracy. Scottish Water is already in the process of developing much of the documentation and systems that will be required to develop WSPs. Indeed WSPs are a means of ensuring good practice in drinking water supply and the work of WHO and the Bonn workshops show that they are essential for assuring drinking water safety. In this respect they should be considered as a basic tool in water supply rather than a regulatory mechanism. The involvement of staff as part of their normal work is also beginning to happen as the organisation moves forward with its strategy for increasing efficiency. Much of the resource will also be necessary as part of the knowledge capture requirement to reduce reliance on particular individual's experience and the loss of that experience through retirement and demanning. This is also a prerequisite for increased flexibility of working. However, as the systems become established and the process becomes one of maintenance and audit then this should ultimately lead to savings in time spent responding to problems and emergencies. The process will also identify where rationalisation is possible and potentially lead to a reduction in the requirement for such short-term fixes as tankering water during dry spells.

It is notable that for small supplies, such as Dores, the project team were able to capture information and prepare an outline water safety plan in 2 to 3 days. It is probable that for many such supplies the basics in terms of information gathering could be achieved within a day, after allowing for travelling time and possibly some additional time if more detailed catchment inspection is required. Individuals closely involved in the process and working with local staff would rapidly become more experienced and become more efficient. Taking into account the increased time involved in some of the medium to large supplies it might be estimated that a team of about 6 persons, working with the existing staff would be a necessary increased resource over that being committed to the process at present would be required. Such a team would work closely with staff carrying out existing initiatives and would work with local staff on the ground.

Perhaps the greatest resource requirement is not directly associated with WSPs but arises from the identification of manpower needs to run water supplies safely. The primary issue is the pressure for de-manning and whether this will reach a point at which public health is put at risk. WSPs will help to identify at which point de-manning will cut into the operational capability of Scottish Water and can provide a public health argument for supporting the submission on price determination.

Resources for other stakeholders are discussed above but the key questions primarily relate to SEPA, in relation to catchment management including diffuse pollution control and the benefits that would be gained from this in relation to the potentially significant costs. However, there are potential trade-offs in other areas if there is increased cooperation between Scottish Water and SEPA.

There is also a potential resource implication for local authorities if there is an increased requirement for them to have a greater involvement in water quality in buildings. However, at present there appears to be little need for additional resources in relation to their current programmes.

1. Overall Conclusions

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1. Water Safety Plans are considered by WHO and a significant proportion of the world water industry, including regulators to be the best way forward to assuring drinking water quality in the 21st century. UKWIR has established a framework for developing WSPs in the UK but Scotland faces significantly different challenges to England and Wales in terms of the types of supply, terrain, previous investment and the maturity of Scottish Water, which is a new organisation.

2. WSPs are an excellent means of identifying problems and potential problems before they actually cause an actual threat to public health or a deterioration in consumer acceptability.

3. WSPs will be particularly valuable in supporting small water supplies, some of which are currently experiencing circumstances in which hazards cannot be guaranteed to be eliminated. This is of particular concern with regard to *E. coli* O157, and, potentially, *Campylobacter*, which can induce serious consequences over and above gastrointestinal infection and can even kill. This has already been demonstrated in Canada.

1. WSPs provide an excellent means of helping to deliver water that is both safe and acceptable on a continuous basis. The procedures involved build on much of the existing best practice in drinking water supply.

5. Scottish Water are making significant steps in putting in place the necessary systems on which WSPs are based as part of best practice. A number of these initiatives are at an early stage while some are more advanced, but it is essential that these be seen as working documents, that they are user-friendly and that they are updated in the light of changes and experience.

6. There is considerable utility in the use of a generic WSP for small supplies that covers particular types of treatment as long as differences in hazards in the catchment and other specific differences can be taken into account.

7. WSPs are likely to highlight the issue of de-manning and provide a means of assessing when manpower has reached critical levels for assuring safe supplies. They will however, provide a means of knowledge capture that will aid flexibility and will potentially provide savings by preventing the need for constant reaction to problems after they have occurred.

8. The resource implications are difficult to assess, since a number of the procedures and actions actually reflect best practice and should arguably have been in place previously. It is, therefore, difficult to estimate resource implications for Scottish Water with any accuracy. Resource implications for other stakeholders are dependent on other policy decisions that need to be taken in the light of the benefits in relation to the costs.

Comment: Worth stating estimated figure (£1.5m) here?

9 WSPs cannot be developed overnight and to have the greatest benefit the process needs to be evolutionary. This process of continuous improvement is consistent with best practice in the water supply industry and with Scottish Waters stated aims.

2. Recommendations

1. Scottish Water has begun the process of developing WSPs but it is recommended that this process be expedited, particularly in relation to small supplies.

2. In the assessment of charges and financing of water supply in Scotland it is recommended that drinking water quality be given a significantly higher priority.

3. It is recommended that WSPs be used in the integration of planning and investment in drinking water supplies in Scotland, including determination of the viability of supplies and prioritisation for improvement.

4. The consideration of drinking water should be given a much higher priority in regional development and there should be an overall strategy for drinking water supplies for which WSPs will assist greatly in determining the viability of existing supplies and the hazards and risks that must be taken into account.

5. Regional development has significant implications for drinking water supplies and it is recommended that the impact on quality and safety, as well as quantity, of increasing demand be taken into account by water and environmental regulators and planning authorities.

6. It is recommended that the way in which generic approaches to developing WSPs for small supplies be more closely examined and illustrated with an appropriate range of specific examples.

7. It is recommended that WSPs be used to improve the approach to catchment management and management of drinking water in buildings by identifying and engaging other stakeholders with responsibilities in these areas.

8. Scottish Water is making excellent progress in developing the necessary systems to introduce WSPs on a company-wide basis. It is recommended that there is greater integration of systems and that the systems be developed with a high degree of user friendliness.

9. It is recommended that consideration of safety and viability of small water supplies be given a higher priority and, where necessary, simple changes made to improve these supplies.