



*guardians of drinking water quality*

## **GUIDANCE**

**ON THE**

**WATER SUPPLY (WATER QUALITY) REGULATIONS 2000  
(ENGLAND) incorporating the  
WATER SUPPLY (WATER QUALITY) REGULATIONS 2000  
(AMENDMENT) REGULATIONS 2007**

**AND THE**

**WATER SUPPLY (WATER QUALITY) REGULATIONS 2001  
(WALES) incorporating the  
WATER SUPPLY (WATER QUALITY) REGULATIONS 2001  
(AMENDMENT) REGULATIONS 2007**

**3<sup>rd</sup> Edition – October 2008**

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## INTRODUCTION

1 This document provides guidance on the implementation of the Water Supply (Water Quality) Regulations 2000 (Amendment) Regulations 2007 (SI 2734) which apply to water undertakers<sup>1</sup> and licensees whose areas of supply are wholly or mainly in England and the Water Supply (Water Quality) Regulations 2001 (Amendment) Regulations 2007 (SI 3374 (W 299)) which apply to water undertakers and licensees whose areas of supply are wholly or mainly in Wales. Unless otherwise specified, reference within this document to "the Regulations" means the Water Supply (Water Quality) Regulations 2000 and the Water Supply (Water Quality) Regulations 2001 as amended with effect from 22 December 2007. In line with common practice, water undertakers and licensees are referred to as water companies throughout this Guidance.

2 The Drinking Water Inspectorate (DWI) exercises the powers and duties of the Secretary of State for Environment, Food and Rural Affairs and Welsh Ministers. When there are references to DWI in the Guidance they mean on behalf of the Secretary of State and Welsh Ministers. References to the Secretary of State also include reference to Welsh Ministers.

3 The first edition of this Guidance came into effect in line with the coming into force of various regulations between 1 January 2001 and 1 January 2004. The second edition of the Guidance replaced the first edition on 18 May 2005. Some of the regulations have ceased to have effect (transitional arrangements which have date expired) whilst a few have been revoked and replaced with new regulations. However the majority remain in force unchanged or with minor changes.

4 This third edition of Guidance replaces the second edition on 1 October 2008. It does not purport to offer any authoritative interpretation of the Regulations. It is recognised that it may contain omissions and that some of the advice contained herein will need to be modified or updated in light of experience gained with implementing the Amendment Regulations or as and when further guidance on interpretation of the Drinking Water Directive is published by the European Commission. The Guidance is consistent with advice issued by DWI Information Letters up to and including 31 December 2007. However aspects may be updated or superseded by more recently issued letters so water companies would be wise to always check the DWI website for Information Letters issued after this Guidance Document. Comments are welcome on all aspects of the Guidance. The master copy of the Guidance document has been placed on the Drinking Water Inspectorate website (<http://www.dwi.gov.uk>) and only that version will receive any periodic updates. It is the intention to review the Guidance on a rolling basis as and when the need arises. Water companies will be notified of any changes to the Guidance by e-mail.

### **Regulatory Framework, legal instruments and other relevant documents**

5 The following legal instruments and associated documents provide the regulatory framework for the quality of drinking water supplies in England and Wales. Copies of all these documents are available on the Inspectorate's website.

- Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption (European Drinking Water Directive) – sets standards for drinking water quality to apply in all member states, implemented in England and Wales through the drinking water regulations cited below.

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<sup>1</sup> For the purposes of this Guidance document "Undertakers" also includes Inset Appointees.

- The Water Industry Act 1991 (the Act) – the primary legislation which enables Regulations to be made and contains the duties of water companies and the powers used by DWI.
- The Water Act 2003 – primary legislation which, *inter alia*, designates the post of Chief Inspector of Drinking Water, gives greater autonomy to the DWI and contains amended provisions in respect of fluoridation

### **Drinking Water Regulations applying to England**

- The Water Supply (Water Quality) Regulations 2000 (SI 2000/3184)
- The Water Supply (Water Quality) (Amendment) Regulations 2001 (SI 2001/2885)
- The Water Supply (Water Quality)(Amendment) Regulations 2002 (SI 2002/2469)
- The Water Supply (Water Quality)(Amendment) Regulations 2005 (SI 2005/2035)
- The Water Supply (Water Quality)(Amendment) Regulations 2007 (SI 2007/2734)

### **Drinking Water Regulations applying to Wales**

- The Water Supply (Water Quality) Regulations 2001 (SI 2001/3991)
- The Water Supply (Water Quality) Regulations 2001 (Amendment) Regulations 2007 (SI 2007/3374)

### **Other legal instruments applying to England & Wales**

- The Water Suppliers (Information) Direction 2004<sup>2</sup> – made under the Act, specifies the format and timing of water companies' provision of information to DWI.
- The Drinking Water (Undertakings) (England and Wales) Regulations 2000 (SI 2000/1297) – relates to legally binding water quality improvement programmes to meet drinking water standards
- The General Food Regulations 2004 (SI 2004 / 3279) as amended.
- Council Directive 98/34/EC The Technical Standards and Regulations Directive - requires Member States to notify all new technical regulations when they are at the draft stage
- Security and Emergency Measures (Water and Sewerage Undertakers) Direction 1998
- The Security and Emergency Measures (insert name of company) (Licensed Water Suppliers) Direction (insert year) – this is a pro forma for a named licensee

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<sup>2</sup> Lawyers are currently drafting the Water Suppliers (Information) Direction 2008 which will replace the 2004 Direction in due course.

- The Security and Emergency Measures (Water Undertakers) Direction 2006 – this updates the 1998 Direction in light of Water Act 2003 and provisions for licensees

### Other relevant documents

6 There are a wide range of other useful documents on the science and practice of drinking water quality regulation from research reports through to industry best practice documents. All of these may be of assistance to water companies. DWI makes many of these available through its website either directly or by a link to another website where the document can be obtained. For example:

- The Water Supply (Water Quality) (England and Wales) Regulations 2000 SI No.3184(Unofficial Consolidated version 2007) available on the DWI website ([www.dwi.gov.uk/regs/si3184/consolidated2007by2734.pdf](http://www.dwi.gov.uk/regs/si3184/consolidated2007by2734.pdf)). *This consolidated version is provided for information only and has no legal status.*
- Government's response to the consultation on the amendment of the Water Supply (Water Quality) Regulations 2000 held between 29 December 2006 and 31 March 2007. *This document updates Government's policy on drinking water quality.*

### Definition of health authority

7 Earlier editions of the guidance contained a definition of the term "health authority" in the context of both England and Wales. This advice is no longer required because the regulations no longer use the term health authority. Instead the regulations cite the Health Protection Agency (in England) and National Public Health Service (for Wales). The person(s) who water companies are expected to notify and communicate with in the context of the regulations are Consultant(s) in Communicable Disease (CCDC) based at the relevant Local Health Protection Unit(s) of either the Health Protection Agency in England or the National Public Health Service in Wales.

8 Water companies are expected to keep their contact arrangements with CCDCs under continual review, particularly in respect of 24 hour (out of hours) contact details. Water companies are advised that the regulations intend that their point of contact is the CCDC(s) at the local Health Protection Unit(s) of the HPA. Whilst it is for the HPA to have in place arrangements to inform other parts of the health service water companies are free to make local arrangements to communicate with other person(s) within the health service however DWI advises caution about such local arrangements because experience has shown that multiple points of contact can result in misunderstandings and poor communications. In the context of discussing matters relating to drinking water quality it should be kept in mind that the nature of these communications will involve the exchange and interpretation of technical information. Therefore these communications are most effective when they are conducted between professionals - a CCDC and a senior public health or water quality scientist (for the water company). If a water company is concerned about the public health communications during any notified event they should seek assistance from DWI. Companies should bear in mind that the role of DWI in any event which threatens to become an emergency is as the appointed technical advisor to the Secretary of State.

**PART I - GENERAL**  
**Regulation 2 - Interpretation**

**Definitions – Reg 2(1)**

**1 Meaning of relevant metabolites.**

1.1. The Regulations set the following standards for pesticides and related products:

• aldrin	0.03 µg/ l
• dieldrin	0.03 µg/ l
• heptachlor	0.03 µg/ l
• heptachlor epoxide	0.03 µg/ l
• other pesticides	0.10 µg/ l
• total pesticides	0.50 µg/ l

1.2 Pesticides and related products are defined as any organic insecticide, herbicide, fungicide, nematocide, acaricide, algicide, rodenticide, slimicide, molluscicide and any product related to any of these including any growth regulator, and their *relevant* metabolites, degradation and reaction products. *Relevant* should be taken to mean any metabolites, degradation and reaction products that have similar pesticidal properties to their parent pesticides. No guidance has yet been issued by the European Commission but until it is, DWI considers that, in respect of drinking water, there is no evidence at the present time that any pesticide metabolites, degradation or reaction products are active pesticides or represent a risk to health and therefore no additional monitoring is required. This Guidance document will be updated in the light of EC guidance on the definition and interpretation of related products and relevant metabolites, degradation and reaction products as it may apply to the EC Drinking Water Directive.

1.3 The standard for other pesticides applies to each individual pesticide, also including any *relevant* metabolite, degradation and reaction product. Total pesticides means the sum of the detected concentrations of the individual pesticides and any *relevant* metabolites, degradation and reaction products *detected and quantified* in the samples taken on a particular sampling occasion from a sampling point. This definition recognises that more than one sample may be taken on a particular sampling occasion from a sampling point to enable all the pesticides of interest to be determined.

**2 Meaning of Disinfection**

2.1 The regulations define disinfection as a process of water treatment to remove or render harmless to human health every pathogenic micro-organism and pathogenic parasite that would otherwise be present in the water and disinfected shall be construed accordingly.

2.2. Disinfection, as defined, relates to the arrangements and equipment a water company has in place to treat raw water before it is supplied. These disinfection arrangements may be a single process of inactivation (such as chlorination, ultraviolet radiation, ozonation) or a single process of removal (such as membrane or other equivalent filtration technology) or it may be achieved through a combination of two or more removal or inactivation processes (such as filtration followed by UV and

chlorination). It is important therefore that the technical performance characteristics of the disinfection arrangements used by the water company at each of its water treatment works is known in relation to the ability of the process or combined processes (when operated in the manner intended) to remove or inactivate pathogens, and that these performance characteristics are validated in advance. Performance characteristics of disinfections arrangements should be validated<sup>3</sup> against the removal and/or inactivation of pathogens. The validation of performance characteristics of disinfection arrangements shall not be defined in terms of removal or inactivation of indicator organisms such as coliforms or *E.coli* or Enterococci. These indicator organisms, as defined in the regulations are not pathogens. Indicator organisms are however appropriate for use in the verification<sup>2</sup> of disinfection arrangements.

- 2.3 The technical performance of disinfection arrangements should target the widest possible range of pathogens – viruses, bacteria, parasites and toxic algae – that are likely to occur in the source(s) of water being abstracted for water supply purposes and are recognised by the Health Protection Agency as potential agents of waterborne disease. It is expected that a water company will have in place a disinfection policy which is informed by sound science and by knowledge of the occurrence of pathogens in water sources in England and Wales. The disinfection policy will cover the design, maintenance and operation of all relevant components of its treatment works.

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<sup>3</sup> The terms **validation** and **verification** are defined in Chapter 4 of the WHO Guidelines for Drinking-water Quality 3<sup>rd</sup> Edition ([http://www.who.int/water\\_sanitation\\_health/dwg/guidelines/en/index.html](http://www.who.int/water_sanitation_health/dwg/guidelines/en/index.html))

## **PART II – WATER SUPPLY ZONES**

### **Regulation 3 - Identification of water supply zones**

#### **Delineation and designation of Water Supply Zones**

- 2.1 Regulation 3 came into force on 1 June 2003. Regulation 3(1) requires water companies to pre-designate the names and areas of the supply zones within its supply area for the forthcoming calendar year. Regulation 3(2) specifies that the water supply zone should not supply more than 100,000 people. Regulation 3(3) requires that the designation of the water supply zone should not change through the year. With effect from 22 December 2007 regulation 3 (2A) comes into effect which requires that water quality within a supply zone should be approximately uniform.
- 2.2 In the last quarter of each calendar year, water companies should review the designation of their water supply zones to ensure that the delineation remains appropriate and assess revised estimated populations. The population estimates for water supply zones should relate to permanent residents only. During the review, water companies should identify any water supply zone where the revised estimate of resident population supplied exceeds 100,000. Regulation 3(2) and (3) provide that the delineation of such zones should be revised to produce zones with a population below 100,000 in the following year. In general the number of changes to the designation of water supply zones should be kept to a minimum.
- 2.3 A consistent approach is needed in the delineation of water supply zones. Water companies should therefore first identify which areas are supplied from single sources. A source could be the outlet of a water treatment works, a pumping station, a blending point, a service reservoir or a meter point on a bulk supply of treated water provided by another water company. A discrete area supplied from a single source should always be recorded as a single water supply zone unless it supplies more than 100,000 people. In such circumstances the area should be subdivided into water supply zones each with a population of less than 100,000.
- 2.4 Regulation 3 (2A) defines a supply zone in terms of its water quality which is required to be approximately uniform. This requirement will be met if a zone is served only by a single source as set out above. However the Inspectorate recognises that the actual supply arrangements may be more complicated and the following paragraphs are intended to assist in the interpretation of this requirement.
- 2.5 Any discrete area of supply should be sub-divided into separate supply zones if there are or could be significant differences in water quality within the area. To ensure that water quality is approximately uniform, the sources of water, if more than one, should be of a similar nature and receive the same treatment. This requirement will be met if each supply zone is served by an individual service reservoir or water tower, pumping or booster station or distinguished as a discrete pressure zone or by other appropriate features of the distribution system.
- 2.6 In areas where the potential for variations in water quality are complex or where the water supplied may be from a number of potential sources via transfer mains, the water supply zone should be delineated by reference to convenient features of the distribution system and geography.
- 2.7 Many water companies have delineated their supply areas into district metered areas which under normal operation have a single supply inlet. In such circumstances water

supply zones should consist of related district metered areas, which are supplied from common sources.

- 2.8 It is recognised that water companies have to take temporary operational actions to maintain water supplies that may involve the introduction of water from sources not designated for that supply zone. Such temporary measures should not influence the annual designation of water supply zones. If permanent changes have to be made to the sources that supply a zone, or to the delineation of that zone, the designation of the zone can only be changed for the next calendar year.
- 2.9 Where water companies provide a concessionary (free) supply of water this is usually to a single dwelling or a small number of co-located dwellings. The Inspectorate has issued guidance to companies to the effect that all these supplies, wherever they are located geographically, should be grouped together in a single water supply zone on the basis that such supplies have similar characteristics (surface water or springs with minimal or no treatment).
- 2.10 Some companies have designated a number of water supply zones which are very small (population <5000). These usually serve a discrete rural community. Water companies are encouraged to use new paragraph 2A during 2008 to review small water supply zones with a view to combining them together into a larger water supply zone. A typical case might be where there are several small ground water sources each serving a separate village but all drawing water from the same stable aquifer and all being subject to the same type of water treatment. Another situation maybe a set of zones each served by a different treated water reservoir but all receiving water from the same large treatment works. If the designation of small zones is changed then companies must specify and keep a record of the relationship between the previous zone designations and the new ones.

### **3 PART III - WHOLESOMENESS**

- 3.1 Part III (regulation 4) defines wholesomeness in respect of water supplied by water companies for cooking, drinking, food preparation and washing, and to premises for food production purposes. In particular, regulation 4 provides that water is wholesome if it contains concentrations or values in respect of various properties, elements, organisms and substances that do not contravene the prescribed maximum, and in some cases, minimum concentrations or value (PCV). Some of the PCVs are specified in regulation 4 but most are included in Tables A and B in Schedule 1 of the Regulations. Attention is drawn to Regulation 4(2)(a) which covers the situation where water supplied contains micro-organisms, parasites and substances for which no standard has been set. Companies also reminded of their obligations under Regulation 10 with respect of further sampling arrangements.

#### **Regulation 4(3) - Definition of consumer's tap**

##### **Definition of consumer's tap**

- 3.2 The Regulations implement Drinking Water Directive 98/83/EC on the quality of water intended for human consumption. The Directive's standards must be complied with, in the case of water supplied from a distribution network, at the point within premises or an establishment, at which it emerges from the taps that are normally used for human consumption. Water companies are not responsible for any deterioration in water quality that may arise as a result of the domestic distribution system (with the exception of plumbing metals copper and lead where specific regulations apply).
- 3.3 Regulation 4(3) states that the standards for wholesomeness are to be complied with at the consumer's tap except in the case of water supplied from a tanker or by means of bottles or containers. Paragraph 3 has been amended to define the point of compliance for bottles and containers as the point at which water first emerges from any bottle or container. The definition of the point of compliance relates only to bottles or containers which have been stored by the water company at a temporary local public distribution point, it does not relate to stocks of bottles or containers which are under the control and management of the producer, the company or any specialist supplier. The regulations do not specify monitoring requirements for water supplied by means of bottled or containers. However water companies are reminded of their duties under the Water Industry Act to supply water that is wholesome and fit for human consumption. DWI consider that as a fundamental aspect of due diligence water companies should develop appropriate quality control procedures for supplies provided in bottles and containers. These arrangements should cover the entire supply chain and include consideration of the risks posed by unattended distribution points. The Inspectorate encourages companies to work together with their suppliers to identify and document best practice and to promote its adoption across England & Wales. DWI considers that companies are under a duty to secure that such quality control arrangements are in place and carry out audits of their effectiveness
- Part IV of the Regulations requires monitoring at sampling points and other points to establish whether the water supplied meets the standards for wholesomeness. A sampling point is defined in regulation 2 as being a consumer's tap that is selected for monitoring purposes. From 1 January 2005, all water companies were advised to select from all premises and establishments (including public buildings) within their area of supply in their random compliance monitoring programmes for water supply zones.
- 3.4 The consumer's tap is not defined in the Regulations. Water companies should assume that the consumers' taps to be used for monitoring to determine compliance

with the standards are those taps that are normally used for drinking, cooking, food preparation or other domestic purposes. In a domestic property this tap is normally the kitchen cold water tap that is used for drinking and food preparation purposes irrespective of whether any upstream devices such as softeners or filters are present. Garden taps should not be used for regulatory samples. In non-domestic properties (including public buildings) the sampler should seek to determine from the occupier or owner which tap is normally used for drinking and food preparation (or supply to the public in the case of public buildings) and should sample from that tap. Where more than one appropriate tap is available in a building, the sampler will need to record accurately which tap was sampled. Since it is known that upstream devices and/or the nature of the tap can influence the quality of water, it is good practice for these details to be recorded by the sampler at the time of sampling to assist the interpretation of any adverse results obtained from analysis of the sample in the laboratory. Alternatively, if prior to collection of the sample, the sampler becomes aware that an upstream device is present or there are unusual fittings on the tap which cannot be removed to facilitate tap cleansing, then they can select another nearby property to be sampled for compliance purposes. However, in these circumstances, samples must still be taken from the original property and arrangements made for appropriate advice to be given to the owner/occupier, including, as appropriate, a water fittings inspection. Companies must document their protocols and keep records of every non-compliance sample generated in this way.

- 3.5 It has long been established practice to “disinfect” the sample tap before sampling for microbiological parameters. Indeed, cleansing of the cold water tap is recommended prior to sampling for bacteriological parameters by the Microbiology of Drinking Water Supplies 2002. It should be noted that “disinfecting” of taps is a generic term to describe a process of cleansing the tap which involves the application of chlorine based solution as a spray or in the form of a proprietary wipe to the outlet followed by running the tap to waste. Companies are advised that the act of flushing to draw off standing water is a very important part of the cleansing protocol and this must be emphasised to samplers in their training. As many domestic taps are made from plastics the application of heat to the tap is no longer used. Until such time as any more specific advice is provided through a revision of the Drinking Water Directive companies may continue to follow best practice as set out in the Microbiology of Drinking Water Supplies 2002.
- 3.6 The Directive requirement for water in public buildings is for it to meet the quality requirements irrespective of whether or not any non-compliance is due to the domestic distribution system or the maintenance thereof. It is for this reason that in previous versions of this guidance the Drinking Water Inspectorate advised that taps in public buildings should not be cleansed prior to sampling for microbiological parameters. This advice was intended to indicate only that samplers should not apply chlorine sprays and wipes (i.e. they should not carry out an act of maintenance). If a tap in a public building is situated over a sink or basin such that a user can flush the tap to waste prior to drawing off water for drinking, then the sampler should also run the tap to waste before microbiological samples are collected.

## **Regulation 4(4) - Sampling on transfer from a water treatment works**

### **Water treatment works**

- 3.7 Regulation 4(4) defines the criteria for wholesomeness on transfer from a water treatment works. Regulation 13(1) requires water companies to ensure that samples for *E. coli*, coliform bacteria, colony counts, residual disinfectant, turbidity and nitrite are taken at the required frequency from the point at which water leaves each treatment works.
- 3.8 The sampling point should be located so as to provide a representative sample of the water flowing into distribution. The sample point must be downstream of all treatment processes including blending and any storage in final water storage reservoirs at the treatment works.
- 3.9 Where the treatment stream within a works divides in such a way that a single final water compliance point will not be representative of all water leaving the works (i.e. there are different treatment streams which leave the works through different outlet mains), then more than one sampling point will be required. Where there is a possibility of differences in water quality within different outlet mains leaving the treatment works then separate sampling points are required for each different final water. Although on the same site, each treatment train is regarded as a separate water treatment works for the purposes of the Regulations.
- 3.10 All treatment works outlets should be fitted with metal sampling taps of a hygienic design which do not have attachments or inserts and which are made from materials complying with BS6920. Water should be supplied to the sampling tap through a sample line of a suitable material, which if plastic, complies with BS6920. Sample lines should be kept as short as possible and the number of take-offs from the sample line should be kept to a minimum.
- 3.11 Water companies may receive inputs of treated water from neighbouring water companies termed as “bulk supplies”. Such supplies should not be monitored within the compliance sampling programme as water leaving a treatment works (as this will be undertaken by the water company which operates the treatment works). It would be prudent to undertake water quality monitoring of such supplies at the point of transfer on an operational basis. The bulk supply input point may be an appropriate location for authorised supply point monitoring if this monitoring option is being used by the water company receiving the bulk supply. Further advice on supply point monitoring for bulk supplies is given below at paragraph 4.41.

## **Regulation 4(5) - Sampling on transfer from a service reservoir**

### **Service reservoir**

- 3.12 Regulation 4(5) defines the criteria for wholesomeness on transfer from a service reservoir. Regulation 14 requires water companies to ensure that a sample is taken for bacteriological analysis and determination of residual disinfectant in each week the reservoir is in use. Water Companies should be confident that samples taken are representative of the water from each service reservoir.

- 3.13 The Regulations define a service reservoir as any structure in which a reserve of treated water is contained and stored for the purposes of meeting a variable demand for the supply of water. The definition specifically excludes any structure at a water treatment works such as final water storage reservoirs. Sampling points at water treatment works should be located so as to provide a representative sample of the water flowing into distribution and this should be downstream of any final water storage reservoirs at the treatment works.
- 3.14 The definition includes any temporary structures such as static tanks or tankers that are connected to the distribution system and are being used as service reservoirs. Accordingly, water from these structures should be sampled every week they are in use.
- 3.15 Break pressure tanks should not be designated as service reservoirs unless they are designed to provide strategic water storage. There is always a risk of ingress where the system is vented and companies may be wise to conduct operational monitoring at break pressure tanks that do not provide strategic storage. Some water companies have water retaining structures which are solely connected to further service reservoirs and do not supply consumers directly via distribution mains. If such water retaining structures contain strategic reserves of water they should be classified as service reservoirs and sampled within the compliance sampling programme.
- 3.16 Where a service reservoir has more than one compartment with its own water inlet and outlet and the compartments are not connected hydraulically to any other compartments, then each compartment should be regarded as a single service reservoir. Sampling is required at the outlet main of each compartment unless the individual outlets subsequently combine into a single common outlet main.
- 3.17 Where a service reservoir has more than one compartment but the compartments are hydraulically connected then the connected compartments may collectively be regarded as a single service reservoir and be sampled accordingly.
- 3.18 Where a service reservoir has a single common inlet and outlet main, the water company must have arrangements to ensure that samples are taken only when the main is acting as an outlet and the water quality is therefore representative of water that has been stored within the service reservoir. Where this is not practicable alternative representative sampling arrangements can be made.
- 3.19 All service reservoir outlets should be fitted with metal sampling taps of a hygienic design which do not have attachments or inserts and which are made from materials complying with BS6920. Water should be supplied to the sampling tap through a sample line of a suitable material, which if plastic, complies with BS6920. Sample lines should be kept as short as possible and the number of take-offs from the sample line should be kept to a minimum.

#### **Other sampling arrangements at water treatment works and service reservoirs**

- 3.20 It is not possible for this Guidance to describe all the possible arrangements for the siting of regulatory sampling points at water treatment works and service reservoirs. Where water companies are unsure about the number or siting of regulatory sampling points they should submit details of their proposals to DWI for approval.

## PART IV – MONITORING OF WATER SUPPLIES

### Regulation 6(1) - Monitoring: numbers of samples

- 4.1 Regulation 6(1) states that water companies shall take and analyse not less than the number of samples specified within the provisions of Part IV. A water company may programme and report more than the minimum number specified for any parameter to ensure that the minimum sampling and analysis requirement is met.
- 4.2 It is recognised that water companies will wish to carry out some additional sampling to provide additional information on the quality of water supplies. Water companies may prefer to manage such monitoring within a separate non-compliance sampling programme with individual samples identified by a separate sample purpose code.
- 4.3 Water companies may carry out sampling for both compliance and non-compliance purposes on the same sampling occasion provided that the samples taken are identified by separate unique sample numbers or other auditable process (with the appropriate sample reason).
- 4.4 If water companies wish to carry out additional sampling within the regulatory monitoring programme they should not programme significantly above the numbers specified for selected parameters in order to influence compliance statistics.

### Regulation 6(2) - check and audit monitoring

- 4.5 Regulation 6(2), with reference to Table 1 of Schedule 3, sets out the criteria under which parameters should be monitored at check or audit frequency. These are:
  - (i) Parameters not listed in the Table 1 must be monitored at audit frequency;
  - (ii) Parameters listed in the Table 1 and with conditions specified in column 3 of the Table must be monitored at audit frequency, unless the conditions are met when they must be monitored at check frequency; and
  - (iii) Parameters listed in Table 1 that have no conditions specified must be monitored at check frequency.

The relevant frequencies are specified in Table 2 for water supply zones and Table 3 for supply points.

- 4.6 In practice this means that there are six parameters which can **either** be monitored at check monitoring frequency **or** at audit monitoring frequency, depending on the following circumstances:
  - (i) aluminium and iron are to be monitored at the lower audit monitoring frequency unless they are used as a flocculent or coagulant or the water originates from, or is influenced by surface waters, in which case the higher check monitoring frequency applies. The frequencies are specified in Table 2 of Schedule 3;
  - (ii) manganese is to be monitored at the lower audit monitoring frequency unless the water originates from or is influenced by surface waters, in which case the higher check monitoring frequency applies. The frequencies are specified in Table 2 of Schedule 3;

- (iii) *Clostridium perfringens* is a Schedule 2 indicator parameter which should be monitored at treatment works or supply points at the audit monitoring frequency unless the water originates from or is influenced by surface waters, in which case the higher check monitoring frequency applies. Since 1 January 2004 some companies have chosen to monitor for *Clostridium perfringens* at consumer's taps. DWI does not consider this approach to be consistent with the primary role of *Clostridium perfringens* as an indicator of remote or historic faecal contamination which has its greatest use as an indicator of the adequacy of the operation of water treatment. Accordingly companies are advised not to include this parameter in water supply zone compliance monitoring. Where a company has chosen for reasons of practicality (i.e. to avoid the need to take multiple samples each day from a large water treatment works) to monitor *Clostridium perfringens* at consumers taps then it is imperative that their response to an unsatisfactory result includes a comprehensive investigation into the efficacy and performance of the treatment process of the supplying works. It should be noted that testing in zones for *Clostridium perfringens* has merits as an investigational tool and should continue to be used when following up failures for *E.coli* or Enterococci at service reservoirs and consumer's taps.
  
- (iv) nitrite and nitrate are to be monitored in water supply zones at the lower audit monitoring frequency unless chloramination is practised at the water treatment works, when the higher check monitoring frequency applies in the water supply zones. The frequencies are specified in Table 2 of Schedule 3. **In addition** there is a requirement to monitor for nitrite at the water treatment works, against the 0.1 mg/l standard. Nitrite is to be monitored at the water treatment works at the lower monitoring frequency (item 4 of Table 3) unless chloramination is practised, in which case the higher monitoring frequency specified at item 16 in Table 3 applies; and
  
- (v) water companies should consider undertaking additional operational monitoring at groundwater sources which have significant natural concentrations of iron and/or manganese.

### Monitoring for pesticides – monitoring strategy

- 4.7 It is not practical or necessary to monitor for every pesticide that is used within the catchment of a water source. The Drinking Water Directive recognises this by noting that only those pesticides which are likely to be present in a given supply need to be monitored. The advice that follows assumes that water companies use the option of sampling for pesticides at supply points, normally water treatment works, instead of in water supply zones.
  
- 4.8 To effectively implement the requirement of the Drinking Water Directive, each water company is required to develop a monitoring strategy for pesticides at each treatment works based on the likely risk of particular pesticides being present in the water source or sources from which water is abstracted for treatment at that treatment works. In developing a monitoring strategy water companies are expected to:
  - (i) assess as far as is practicable which pesticides are used in significant amounts within the catchment area of each water source;

- (ii) assess as far as is practicable on the basis of the properties and method of use of these pesticides, and local catchment knowledge, whether any of these pesticides are likely to reach each water source in the catchment area;
  - (iii) take into account the results of any monitoring for pesticides in water sources within the catchment area carried out by the Environment Agency;
  - (iv) take into account the results of any operational monitoring of water sources or water supplies for pesticides carried out previously by the water company; and
  - (vi) take into account the results of the compliance monitoring of water supplies for pesticides carried out under the provisions of the Water Supply (Water Quality) Regulations 1989 (1989 Regulations).
- 4.9 On the basis of that strategy, the water leaving each treatment works (or supply point) should be monitored at the frequency specified in Table 3 of Schedule 3 of the Regulations for each of the pesticides identified as likely to reach a water source from which water is abstracted to that treatment works. Where a treatment works has a treatment process installed to remove pesticides or reduce the concentration of pesticides, the water company must include in its monitoring strategy for that treatment works those pesticides for which the treatment process has been installed.
- 4.10 Aldrin, dieldrin, heptachlor and heptachlor epoxide must be included in the monitoring strategy for each treatment works unless the water company has received a waiver from the Inspectorate. DWI recognises that these pesticides have not had approved use for many years and that a monitoring programme for these pesticides may not be necessary. However they can be persistent in the environment and occasional detections in drinking water have occurred. Companies should consider the appropriateness of a monitoring programme as part of their overall risk assessment of the supply system under Regulation 27. If water companies are of the opinion that there is convincing evidence that these pesticides are not detectable in the water supplied from the treatment works they may apply for a waiver. To apply for a waiver they should submit a reasoned case, backed up with whatever data are available. Normally this should include a minimum of three years' data from the most recent period when monitoring was conducted. The data must have a limit of detection well below the new standard. The frequency of monitoring should be at least that specified in the Regulations. Where appropriate, water companies can supplement regulatory data with relevant operational data or by data from other organisations such as the Environment Agency. Further details are given in [Information letter 8/2003](#). Any application for a waiver should be submitted to DWI in sufficient time to allow determination prior to the commencement of any proposed revised monitoring programme.
- 4.11 If at any time a water company has any reasonable grounds for believing that a pesticide not included in its monitoring strategy for a particular works could be present at a concentration in excess of the standard, it must include that pesticide in its monitoring strategy for that works as soon as practical. It may also be appropriate and advisable for the water company to carry out operational monitoring for that pesticide in the water source or sources from which water is abstracted to the treatment works in order to provide additional information about the behaviour of the pesticide.
- 4.12 Towards the end of each calendar year, each water company should review its monitoring strategy for each treatment works using the guidance above. A particular

pesticide may be omitted from the monitoring strategy if it has not been detected at significant concentrations in the water supplied from the works in the previous three calendar years compliance monitoring under the 1989 regulations or the new Regulations. At works where a pesticide removal treatment process has been installed, any pesticide that has been found above the standard in that source can only be omitted from the monitoring strategy for that treatment works if the water company can show, from at least three years' operational monitoring of the water source or sources from which the water is abstracted, that the pesticide is no longer detected at significant concentrations in the water source or sources.

- 4.13 It is recognised that particular analytical methods for pesticides enable a suite of pesticides of similar chemical structure or properties to be determined. Water companies may continue to monitor all the pesticides in the suite even if a particular pesticide could be omitted because it had not been detected in the previous three years.
- 4.14 The standards for pesticides apply at consumers' taps. However, regulation 8(1) allows water companies to monitor compliance with those standards by taking samples for pesticides from supply points because the results of the analysis of such samples are unlikely to differ in any material respect from the results of the analysis of samples taken from consumers' taps. Should water companies choose to monitor at customer taps in water supply zones, then they should develop their strategies based on the source or sources that supply particular zones and the considerations given above. Sampling frequencies for zones are given in Schedule 3 Table 2. Water companies receiving small bulk supplies from other companies may use the originating company's pesticide monitoring data for that supply.
- 4.15. The regulations have been amended to require companies to carry out a comprehensive risk assessment (new Regulation 27). It is expected that companies monitoring strategy for pesticides will be reviewed, particularly for any new and emerging pesticides and related products, and kept up to date in future as part of the Regulation 27 Risk Assessment process. Similarly companies will need to ensure that compliance monitoring for pesticides is developed and adjusted in light of the regulatory raw water monitoring programme established under new Regulation 16A.

#### **Regulation 6(3) - Monitoring : Sampling - tankers**

- 4.16 Regulation 4(3) defines the point of compliance as the consumer's tap or in the case of water supplied by tanker, the point at which the water emerges from the tanker. This regulation has been amended to define the point of compliance for bottles and containers as the point at which water first emerges from any bottle or container collected from a local distribution point. Regulation 6(3) requires water companies to take samples from water tankers in specified circumstances. Within England and Wales water is not normally distributed by tanker except on occasion for short term supplies associated with operational work or emergency provisions. The regulations do not specify monitoring requirements for water supplied by means of bottles or containers. .
- 4.17 Regulation 6(3) does not apply to the use of tankers to fill service reservoirs. Water companies should follow good operational practice for filling tankers and transporting water to service reservoirs and weekly regulatory monitoring must continue at the service reservoir being supplied by tanker.

- 4.18 For the purposes of these Regulations water tankers are considered as any mobile water tank used to provide water supplies to consumers on a temporary basis and includes water bowsers. Water tankers should only be filled with wholesome water from a known source.
- 4.19 The Regulations require monitoring for *E coli*, hydrogen ion and conductivity from each tanker that has been providing water for longer than 48 hours. Any tanker that has been providing water continuously for more than 96 hours must be sampled and analysed for full microbiological and chemical analysis. Further samples for full microbiological and chemical analysis must be taken after every additional 48 hours of use of the tanker. Provided tankers are collected or emptied before a 48 hour period has elapsed there is no monitoring requirement. A tanker should only be filled and re-filled with wholesome water.
- 4.20 In order to demonstrate that they have complied with these requirements water companies should keep detailed records of the deployment of each tanker. These records should include the material of the construction of the tanker or a reference that allows this to be determined, its cleaning, the source of the water used to fill it, the time of filling, the time of emptying, the time of refilling and the source of the water used to refill it. Not only will these records allow companies to demonstrate they have complied with the 48 hour and 96 hour sampling requirements specified in the Regulations, they will also provide valuable information necessary for the investigation of any failures that may occur.

#### **Regulation 6(6) - Monitoring : copper, lead and nickel monitoring**

- 4.21 The Regulations require sampling of water supplies at the consumer's tap for copper, lead and nickel at the audit frequency specified in Table 2 of Schedule 3. Samples for these parameters must always be taken at consumers' taps. The sampling point should be selected from the random sampling programme and the sample should be the first one litre of water drawn from the tap without flushing.

#### **Regulation 6(7) - Monitoring : Radioactivity monitoring**

- 4.22 The Regulations require sampling of water supplies for the determination of radioactivity. Sampling is to be undertaken at audit frequency specified in Table 2 or Table 3 of Schedule 3. Analysis is required for tritium as an individual radionuclide, which is effectively a screening parameter for the presence of contamination by artificial radionuclides. Monitoring for total indicative dose (TID) is routinely achieved by analysis for gross alpha and gross beta activities although it is calculated from the activities of individual radionuclides using the summation formula in the EC guidance document (see Appendix 4A ). Calculation of TID is only required if the screening values for gross alpha, gross beta or tritium are exceeded. In many water supplies the gross beta activity is primarily due to the presence of potassium-40, a naturally occurring radioactive isotope of potassium. As potassium-40 is specifically excluded from the calculation of total indicative dose, it may be helpful to monitor for potassium alongside any monitoring for gross alpha and gross beta activity. [Note: For each mg/l of potassium, the beta activity due to potassium-40 is 0.03026Bq/l]. Appendix 4A contains the current advice from the European Commission. The paragraphs below and Appendix 4 contain guidance on how this advice should be implemented in England and Wales.

## **Routine monitoring for TID (in practice gross alpha and gross beta activity)**

- 4.23 DWI recognises that water companies will require further advice on monitoring for radioactivity. Regulation 6(7) permits DWI to notify water companies that monitoring for radiological parameters is not required where they are satisfied that the water supply is well below the specification for the relevant parameters. DWI will inform water companies by Notice where it has been satisfied that there is sufficient information to establish that water supplies meet these criteria and there is therefore no need for audit monitoring. Unless a company has received a Notice under regulation 6(7) in respect of TID it must continue to monitor at its supply points (or in its zones) for gross alpha and gross beta at the relevant audit frequency. Notices are currently time limited (5 years). Applications for renewal should be accompanied by an appropriate risk assessment and verification data to show that a notice is still appropriate.
- 4.24 Appendix 4 contains a flowchart which deals with two key issues:
- (i) the need for statutory monitoring for total indicative dose; and
  - (ii) how to respond to results for gross alpha and beta activity.

The flowchart attempts to deal with a variety of circumstances but does not attempt to specify the form of any more detailed analysis. This must be judged on a case by case basis. The flow chart does not apply to monitoring for tritium.

- 4.25 Companies that consider they have met the requirements of Appendix 4 and have sufficient information to demonstrate that total indicative dose is well below the specification may apply for a Notice under regulation 6(7). Details of how to apply are given in [Information letter 1/2005](#).

## **Monitoring for tritium**

- 4.26 Monitoring of drinking water for tritium shall be necessary where a source of tritium is present within the catchment and it cannot be shown on the basis of other surveillance programmes or investigations that the level of tritium is well below its parametric indicator value 100 Bq/l. Where monitoring for tritium is required, it must be carried out at the audit frequency.
- 4.27 Tritium was included in the Drinking Water Directive on the basis that it provides an indication of other, potentially more harmful, artificial radionuclides discharged into the environment. In the UK such discharges are subject to stringent controls and even where authorised discharges of artificial alpha and beta emitters occurs within the water catchment the concentrations of tritium are low and routinely below 10 Bq/l.
- 4.28 In these circumstances monitoring of tritium in drinking water would be a check on on-going discharges of radioactivity to the environment. Environmental sampling programmes already exist tailored to sample close to the source of discharges. Elevated concentrations of tritium have also been associated with landfill leachates where the tritium probably derives from the disposal of gaseous tritium lighting devices and is not an indicator of other artificial radionuclides. In these cases elevated gross beta activity has also been detected in the water, probably due to the presence of particulates and natural potassium-40. The relationship between tritium and landfill sites is best investigated by research projects rather than routine monitoring.

- 4.29 It is not considered necessary for water companies to carry out routine monitoring for tritium in drinking water sources unless there is evidence of elevated beta activity or water companies have reason to believe it may be significantly present. However unless a company has received a notice under regulation 6(7) in respect of tritium it must continue to monitor at its supply points (or in its zones) at the relevant audit frequency. Companies that consider they have sufficient information to demonstrate that tritium is well below the specification may apply for a Notice under regulation 6(7). Details of how to apply are given in [Information letter 1/2005](#). Notices are currently time limited (5 years). Applications for renewal should be accompanied by an appropriate risk assessment and verification data to show that a notice is still appropriate.

## **Regulation 7 - Sampling point – random selection**

### **Random selection of sampling points**

- 4.30 Regulation 7 requires all sampling points to be selected at random except in relation to those parameters where monitoring from supply points has been authorised. Water companies are expected to use a sampling programme that selects sample points at random from a comprehensive list of its consumers, including public buildings.
- 4.31 Water companies' methods should ensure random selection from a customer list to produce an individual target address or a sampling location such as a designated street or a designated postcode. If a sample cannot be obtained from the target sample address a neighbouring property should be chosen and appropriate records amended accordingly. A check should always be made to ensure that any alternative address is within the target water supply zone, especially when properties are close to the water supply zone boundaries.
- 4.32 DWI expects water companies to be able to obtain samples from randomly selected sample points in most circumstances. In exceptional circumstances water companies may apply to DWI to use an alternative method of selection for sample points. An example of such circumstances is concessionary water supplies.
- 4.33 DWI is aware that some water companies have concerns regarding the security of samplers in some specific locations. Where a water company considers that these concerns prevent the implementation of sampling by random selection of sample points it should provide DWI with evidence of the risk e.g. a letter from the police or local authority and information on its alternative method for selecting appropriate samples. DWI will indicate whether or not the alternative method is acceptable.

## **Regulation 8 - Authorisation of supply points**

- 4.34 The Drinking Water Directive permits the use of monitoring at supply points for parameters provided it can be demonstrated that there would be "no adverse change to the measured value" for the parameter between the supply point and the consumers' taps. Under regulation 8(1) the Secretary of State automatically authorises the use of certain supply points for certain parameters. Under regulation 8(2) the Secretary of State has discretion to authorise supply points for other parameters, subject to certain criteria.
- 4.35 At any supply point, water companies should ensure that sample points are fitted with metal sampling taps of a hygienic design which do not have attachments or inserts

and which are made from materials complying with BS6920. They should be fitted in such a way as to ensure that the sample is representative of the water in the main.

- 4.36 When treatment works or service reservoirs are used as supply points they must be coded as supply points in the data returns for applicable parameters, see [Information Letter 2/2005](#) .

#### **Regulation 8(1) Automatically authorised supply points**

- 4.37 Regulation 8(1) authorises the use of supply points for monitoring the following parameters:

*Clostridium perfringens*; conductivity; benzene; boron; bromate; cyanide; 1,2dichloroethane; fluoride; mercury; pesticides and related parameters; trichloroethene and trichloroethane; tetrachloromethane; chloride; sulphate; total organic carbon; tritium; gross alpha and gross beta.

The regulations have been amended to remove nitrite from this list. However water companies should have been following previous DWI guidance not to use supply point monitoring for nitrite in place of sampling in zones against the 0.5mg/l standard. Companies should continue to monitor at treatment works against the 0.1mg/l standard.

- 4.38 Supply points authorised in the context of regulation 8(1) may be:

- treatment works
- service reservoirs (prior to supply to customers)
- blending points

- 4.39 A blending point means a point at which treated waters, originating from two or more sources, are combined under controlled conditions. In practice, blending is normally accomplished by the controlled mixing of treated waters in service reservoirs and specific sections of trunk main. The position of any sample tap at a blending point, used as a supply point, should be carefully selected to ensure that adequate mixing has taken place prior to the sample tap.

- 4.40 For any supply point used under regulation 8(1) the company should be satisfied that there is no subsequent significant change in the value or concentration of the parameters between the supply point and consumer's taps. New Regulation 1A prohibits the use of supply points where a combined licensee introduces water into the water supply zone unless the water quality within the water supply zone remains approximately uniform. DWI expects combined licensees to obtain and make available sufficient data to allow the water company (in advance of any introduction of water) to determine whether existing supply point monitoring can continue. DWI must be notified as soon as possible and applications for authorisations in these circumstances should follow the general approach which is already in place in respect for authorisations under Regulation 8 (2).

- 4.41 Companies should apply the relevant monitoring frequencies in Table 3 of Schedule 3 and should remain on supply point monitoring for a full calendar year.

- 4.42 The Regulations make no reference to the provision of a bulk supply of water from one water company to another, though this is common practice. For parameters specified at paragraph 4.36 above and subject to prior approval of the Inspectorate, companies receiving a bulk supply may use data gathered by the supplying company

from its supply point in place of supply zone data. Further details along with information on how to apply for such arrangements are detailed in [Information letter 18/2003](#) . If such arrangements are put in place for bulk supplies that are used on an intermittent basis the two companies will have to ensure procedures are in place to guarantee the supply is sampled when the bulk supply is in use. Companies are also reminded of the need for appropriate arrangements to ensure clear communication in the event of sampling or analysis problems, the appropriate transfer of data.

### **Regulation 8(2) - Authorisation of parameters for supply point monitoring**

- 4.43 Regulation 8(2) allows DWI to authorise sampling from supply points instead of sampling points (consumers' taps) for parameters other than those specified in Regulation 8(1). In this instance a supply point may be any of the types of point specified under regulation 8(1) or any other point.
- 4.44 Such authorisation will only be granted when DWI is satisfied that the results of the analysis of samples taken from the supply point are "unlikely to differ in any material respect" for a particular parameter from the results that would be produced from the analysis of samples taken from sampling points. Where DWI authorises particular parameters to be monitored at supply points, the sampling frequency should be that applying to audit monitoring in Table 3 of Schedule 3. Companies should remain on supply point monitoring for a full calendar year unless the supply point authorisation is revoked or modified.
4. 45 In respect of the following parameters, it is unlikely that authorisation to sample from supply points will be given because the results may "differ in a material respect":
- (i) *E.coli*, coliform bacteria and colony counts, as these are likely to change in concentration through the distribution system;
  - (ii) lead, copper, nickel and chromium because these metals can be present from contact of the water supplied with plumbing materials;
  - (iii) iron, manganese and aluminium because these metals can be present in water leaving treatment works and picked up from deposits in the distribution system;
  - (iv) polycyclic aromatic hydrocarbons and benzo(a)pyrene because these substances can be present from contact of the water supplied with coal tar pitch linings within the distribution system;
  - (v) colour, taste, odour and turbidity because these characteristics of the water supply can be affected by the condition of the distribution system and consumers' plumbing systems;
  - (vi) hydrogen ion because this can change as the water passes through the distribution system and by treatment equipment within consumers' premises;
  - (vii) sodium because this can increase when sodium hypochlorite is added during distribution and when treatment equipment is used within consumers' premises;
  - (viii) ammonium and nitrite because these concentrations are likely to change as the water passes through the distribution system due to microbiological

reactions and when chloramination is practised (see comment at paragraph 4.36 above on nitrite);

- (ix) nitrate should be sampled at the same time and place as nitrite because of the need to calculate the nitrate / nitrite formula; and
  - (x) trihalomethanes when the water supply originates from or is influenced by surface water as the concentrations leaving the treatment works are likely to vary significantly as the water passes through the distribution system. Groundwaters are influenced by surface waters when water quality changes occur as a result of rainfall or changes in river flows.
- 4.46 Authorisation to sample from supply points could be considered in the following circumstances because the results may not differ in “any material respect”:
- (i) for antimony, arsenic, cadmium and selenium when the water company can demonstrate for a particular supply or supplies that these metals have not been detected at significant concentrations in samples taken from consumers’ taps for at least two years; and
  - (ii) for trihalomethanes when the water supply zones are supplied with water that originates solely from groundwater and the water company can demonstrate that the concentrations at consumers’ taps have been an average of 30 µg/l or less for at least two years and not exceeded 50 µg/l in that time.
- 4.47 The regulations do not specify a supply point audit frequency for the parameters listed in paragraph 4.45. In the case where a supply point authorisation is granted for any of the parameters listed in paragraph 4.45 above, companies will be expected to adopt the relevant supply point audit frequency specified for other parameters that is items 9-25 in Table 3 Schedule 3.
- 4.48 The granting of an authorisation under regulation 8(2) requires a written application from the water company. Details of how to apply are given in [Information letter 9/2003](#) .

### **Regulation 9(1) - Monitoring: numbers of samples**

- 4.49 Regulation 9(1) requires companies to take the standard number of samples from its sampling points (consumers’ taps) or, where appropriate, supply points for analysis for the parameters listed in Tables 2 and 3 of Schedule 3. The Inspectorate recognises that this is a complex new sampling regime. The following examples are intended to illustrate the process for two of the more complicated parameters, nitrite and nitrate. These cover the audit and check monitoring requirements outlined above at paragraph 4.5 and 4.6. The output includes the monitoring for nitrite required at treatment works under regulation 13.

#### **Example A**

A water treatment works, which practises chloramination, has an annual average output of 25,000 m<sup>3</sup>/d and supplies three water supply zones with populations of WSZ1 25,000, WSZ2 35,000, and WSZ3 65,000.

#### **Monitoring required at WTW**

Nitrite (against standard of 0.1mg/l) – 365 samples per annum (standard frequency)

Check monitoring required in water supply zones

Nitrite (against standard of 0.5mg/l) and nitrate (against standard of 50 mg/l)

WSZ1 – 24 samples per annum (at standard frequency)

WSZ2 – 36 samples per annum (at standard frequency)

WSZ3 – 52 samples per annum (at standard frequency)

**Example B**

A water treatment works, which does not practise chloramination, has an annual average output of 10,000 m<sup>3</sup>/d and supplies two water supply zones with populations of WSZ1 4,000 and WSZ2 56,000.

Audit monitoring required at WTW

Nitrite (against standard of 0.1mg/l) – 8 samples per annum

Audit monitoring required in water supply zones

Nitrite (against standard of 0.5mg/l) and nitrate (against standard of 50 mg/l)

WSZ1 – 4 samples per annum

WSZ2 – 8 samples per annum

**Regulation 9(2) - Numbers of samples - reduced frequency**

**Reduced frequency**

- 4.50 Regulation 9(2) allows a water company to take a reduced number of samples for those parameters that are subject to check monitoring provided specified conditions are met.
- 4.51 One of the conditions is that the water company is of the opinion that the quality of water supplied by it to a water supply zone is unlikely to deteriorate. In future the DWI expects that the new regulation 27 risk assessments will form the basis of a water company's assessment of whether a reduced frequency can be applied. The risk assessment will have addressed all the points of consideration set out in existing guidance, which has been retained below unchanged until such point in time as risk assessments have been completed by companies and assessed by DWI and experience in their use gained.

Water company judgements on reduced frequency must be based on an assessment of whether there;

- (i) has been any change in the activities within the catchment or the condition of the catchment which is likely to have an adverse effect on the quality of the raw water;
  - (ii) is any evidence of a general deterioration in the quality of the raw water, or the water supplied from the treatment works
  - (iii) is any evidence of a general deterioration in the quality of water as it passed through the distribution system to consumers' properties.
- 4.52 Another of the conditions is that the results of the analysis of samples in each of two successive years (or the results of the last 12 samples where less than this number has been taken in two years) show no significant variation and, except for colony counts and pH value, the concentration or value is significantly lower than the

prescribed concentration or value. The following paragraphs give guidance on specific parameters.

- (i) For aluminium, ammonium, colour, conductivity, iron, manganese, nitrate, nitrite and turbidity, a significant variation is when any result deviates from the arithmetic mean concentration or value, in either of the two years, (or in the results of the last 12 samples where less than this number has been taken in two years) by more than 20% of the prescribed concentration or value. For these parameters significantly lower is when all the values in each year (or in the results of the last 12 samples where less than this number has been taken in two years) are below 50% of the prescribed concentration or value.
- (ii) For taste and odour a reduced frequency can only be applied when all the results in the previous two years (or in the results of the last 12 samples where less than this number has been taken in two years) have been 1 dilution number.
- (iii) For *Clostridium perfringens* (including spores) a reduced frequency can only be applied when the organism has not been detected in any of the samples taken in the two years (or in the results of the last 12 samples where less than this number has been taken in two years).
- (iv) For colony counts, no significant variation and no abnormal change is when all the results obtained in the two years (or in the results of the last 12 samples where less than this number has been taken in two years) are within plus or minus one order of magnitude of the mean for that zone. In cases where the mean value is less than 2/ml, individual results up to 20/ml can be taken as indicating no significant variation and no abnormal change.
- (v) For the hydrogen ion parameter, no significant variation is when all the results for pH value in the two years (or in the results of the last 12 samples where less than this number has been taken in two years) are within a spread of 1 pH unit. A reduced frequency cannot be applied when any of these result is below a pH value of 6.5 or above a pH value of 9.5.

#### **Regulation 9(4) - Numbers of samples – regular intervals**

##### **Regular intervals**

- 4.53 Regulation 9(4) requires samples to be taken at regular intervals. Regular sampling means that there is a suitable spread of samples to detect possible variation in water quality. Variation could occur on long term (seasonal) or more short term (within a week or day due to operational changes) basis. The requirement for regular sampling does not mean that the sampling occasions have to be spread at exactly equal intervals.
- 4.54 For water supply zones the most common sample frequencies are 12, 24 and 36 per annum. Samples should generally be taken at one, two or three times per month. It is important that there is a good spread between the sampling events. For sampling frequencies of 52 and 76 per annum samples should be taken once and sometimes twice a week to meet the targets. Ideally the day within each week that the sample is taken should be randomised. However it is recognised that it may not be practicable to fully randomise the day of sampling. Where the sources of supply or operation of a works, service reservoir or zone are known to vary significantly over the period of a

week, the sampling programme should be managed to ensure some variation in the day of the week in which the sample is taken.

- 4.55 If a water company fails to take or analyse a sample, through no fault of its own, e.g. a broken sample bottle, it will be expected to reschedule a further sample as soon as possible. The resample should be taken well in advance of the next programmed sample. The Inspectorate considers that only in exceptional circumstances will it not be possible to resample in advance of the next programmed sample. Each case will be reviewed on its merits. Since the Regulations require the frequencies to be met on an annual basis rescheduling does not constitute a shortfall. Provided the resampling is prompt, occasional occurrences of this type will not be regarded as a failure to meet the regularity requirement.
- 4.56 The requirement for regularity does not apply to raw water monitoring carried out under regulation 16A.

### Summary

- 4.57 A summary of the sampling requirements for each parameter is given in the Table in Appendix 7.

## PART V – MONITORING – ADDITIONAL PROVISIONS

- 5 Regulation 12** - has been amended by the addition of Regulation 12 (2) which imposes a duty of sampling on combined licensees.

### Regulation 13 - Sampling at treatment works

- 5.1 Regulation 13(1) requires water companies to ensure that samples for *E coli*, coliform bacteria, colony counts, residual disinfectant, turbidity and nitrite are taken at the required frequency from the point at which water leaves each treatment works. The frequencies are set out in Table 3 of Schedule 3. All six parameters should be monitored at the flow related frequencies set out against items 1 to 6. In the event of chloramination not being practiced, the frequency for nitrite should be that specified against item 16 rather than against item 4.
- 5.2 Regulation 13(2) provides for a reduced frequency of sampling for the colony counts parameter when there has been no significant increase in the counts in each of two successive years. Colony counts, particularly for surface water derived supplies, are likely to vary seasonally because of changes in quality and temperature. A significant increase should be regarded as a count which is more than one order of magnitude greater than that normally expected for the time of year the sample was taken for the works in question (for low values the advice at paragraph 4.51(iv) above can be applied to works).
- 5.3 Regulation 13(4) provides for a reduced number of samples for the coliform bacteria parameter and the *E.coli* parameter only when the water company is of the opinion:
- (a) that there is no foreseeable risk that the supply will exceed the maximum concentration for the parameter; or
  - (b) that the treatment works is at all times designed, maintained and operated in a way that fully complies with new Regulation 26 and , in the event of a failure of the treatment processes, water that has not been adequately treated and disinfected cannot enter the supply.

- 5.4 In respect of 5.3 (a), a water company would be expected to take into account all relevant factors identified through its Regulation 27 risk assessment which will have included the factors in earlier editions of this guidance which are repeated below for convenience:
- (i) risk factors and activities in the catchment from which the water source is drawn;
  - (ii) the concentrations of the parameter in the raw water;
  - (iii) the nature and capability of the treatment processes at the works; and
  - (iv) the concentration of the parameter in the water leaving the treatment works over the previous two years.
- 5.5 In respect of 5.34 (b), this requirement would be met when:
- (i) a treatment works automatically shuts down almost immediately after a disinfection failure is detected through appropriate alarms; or
  - (ii) procedures are in place for a treatment works to be manually shut down almost immediately after an appropriate alarm warning of a failure of adequate treatment and disinfection.
- 5.6 It is unlikely that a reduced frequency could be applied to only one of the coliform bacteria or *E.coli* parameters.
- 5.7 Regulations 13(2) and 13(4) deal with the adoption of reduced frequency monitoring. Where there is a failure to meet the PCV or an exceedence of an indicator parameter value occurs at a treatment works where reduced frequency monitoring has been adopted, sampling should be increased to the standard frequency on a pro rata basis for the remainder of that year and the two following calendar years.
- 5.8 Sampling frequencies are normally based on the volume of water supplied in m<sup>3</sup>/day. Sampling frequencies should be based on the average daily output from the works during the previous calendar year except where it is known that the current year's average daily output will be significantly different from the previous year's average daily output. Where there is more than one outlet at a works requiring separate sampling points (as explained in paragraph 3.9), the sampling frequency should be determined separately for each sampling point based on the average daily output at each point.
- 5.9 Normally water companies would be expected to establish prior to the start of the calendar year, their annual sampling frequency for each works based on the previous year's average daily output from the works or the anticipated average daily output for the current year. Water companies with treatment works whose output may vary considerably at different times of the year for extended periods should consider adjusting the frequencies in accordance with the average daily output for those periods.
- 5.10 Regulation 13(5) requires samples to be taken at regular intervals. For water treatment works sampling frequencies may range from 2 to 2,190 per annum. A

sample frequency of 365 per annum requires a sample to be taken on each calendar day of the year (and should include February 29 in each leap year). For sample frequencies in excess of 365 per annum, samples should be taken over as large a daily span as is possible. They do not have to be spread at exactly equal intervals but should be broadly spread to be representative of any potential changes in water quality during the day. There must be a mechanism to pre-determine the time of sampling

- 5.11 For works on daily sampling, if a water company fails to take or analyse a sample through no fault of its own e.g. a dropped sample bottle, it will be expected to reschedule a further sample for the same day if possible or the following day. On the following day the resample should be taken at a significant time interval before or after the sample programmed for that day. Since the Regulations require the frequencies to be met on an annual basis rescheduling does not constitute a shortfall. Provided the resampling is as described above an occasional occurrence will not be regarded as a failure to meet the regularity requirement.
- 5.12 For sampling purposes a treatment works is considered to be in service on every day (midnight to midnight) that any treated water is supplied from the works.

#### **Monitoring : Analysis using monitors**

- 5.13 Regulation 16(3) extends the scope of the term “laboratory” to a person who may undertake analysis at the time when and place at which the samples are taken. This allows the potential use of results from continuous water quality monitors for certain parameters e.g. turbidity, conductivity and residual disinfectant. This section has been included here because it is envisaged that the most likely use of such monitors will be at treatment works.
- 5.14 In general, on-line monitors at water treatment works or service reservoirs may be used for regulatory analysis provided it can be shown that the particular monitor is:
- (i) Capable of providing fit for purpose data (as defined in the Regulation 16 or this Guidance);
  - (ii) sited to ensure that results are representative of the water being supplied;
  - (iii) maintained and operated to a demonstrably high standard at all times;
  - (iv) calibrated in a way that is valid, appropriate and traceable;
  - (v) subject to reliable quality checks at an appropriate frequency;
  - (vi) the date and time of each compliance reading is specified in advance of the start of the compliance year;
  - (vii) there is a traceable means of demonstrating that the recorded reading is the true reading of the instrument at that time; and
  - (viii) there are robust and effective means for sampling and analysis whenever the monitor is out of service or performing unreliably.
- 5.15 Existing monitors for total chlorine, free chlorine, turbidity and conductivity may be demonstrated as meeting requirements (i) and (ii) above by comparing results of analysis using the current regulatory method with the instrument readings at the times of sampling. Provided the difference between the means is not greater than 10% of the result or 5% of the PCV, whichever is the greater, and the 95% confidence interval for the difference of an individual pair of results (difference between paired instrument result and compliance method result) is not greater than 20% of the result or 10% of the PCV, whichever is the greater, the results will be acceptable. Not fewer than 20 pairs of results covering at least one year should be

used for the comparison. Only installations which satisfy these requirements may be used.

- 5.16 Quality control checks should take the form of comparisons of instrument readings with results obtained using the compliance method at a frequency of 1 check for every 10 compliance results reported. For high frequency measurements, fewer checks may be carried out (up to 1 in 50) provided the suitability of the selected frequency can be demonstrated. A separate difference type control chart must be set up for each monitor, with standard rules for interpretation of the chart and action in the event of evidence of loss of control.
- 5.17 Fully documented and controlled procedures and records, to the standards required in laboratories, are required to demonstrate compliance with the other requirements. These records must be sufficient to satisfy the requirements of regulation 16(4).
- 5.18 Companies wishing to use monitors for other parameters, or new types of monitors for any parameter, must demonstrate that the monitor is capable of achieving all the performance requirements set out in the Regulations or, for chlorine and total organic carbon this Guidance (see paragraph A8.6), before demonstrating that all the other requirements are met. Only once this has been done can the monitor be used for compliance purposes.
- 5.19 Monitors, installations, staff, procedures, records, results and all other relevant data will be subject to audit by the Inspectorate.

#### **Regulation 14 – sampling at service reservoirs**

- 5.20 Regulation 14 requires water companies to take a sample from every reservoir every week it is in use. These samples must be analysed for coliform bacteria, *E. coli*, colony counts and residual disinfectant.
- 5.21 Ideally the day within each week that the sample is taken should be randomised. However it is recognised that it may not be practicable to fully randomise the day of sampling and in such cases the sampling programme should be managed to ensure some variation in the day of the week in which the sample is taken.
- 5.22 If a water company fails to take or analyse a sample through no fault of its own e.g. a broken sample bottle, it will be expected to reschedule a further sample for the same week. In exceptional circumstances, if a sample cannot be programmed the same week the Inspectorate may take a lenient view of the shortfall, provided the resample is scheduled for the following week on a day separate from and not consecutive to the day of the sample programmed for that week.

#### **Regulation 15 – sampling new sources**

- 5.23 Regulation 15 outlines the sampling requirement for:
  - (i) sources that have not been used since 1 Jan 2004; and
  - (ii) sources that have not been used for a period of six months.

Those in category (i) must be sampled before they are put into supply and those in category (ii) must be sampled as soon as practicable after the source is put into supply. However companies should consider how new Regulations 16A, 26, 27, 28 might change their approach to sampling of sources as set out in Regulation 15.

- 5.24 The sampling for a category 5.23(i) source must include all the parameters in Schedules 1 and 2 of the Regulations and any other element, substance or organism likely to make the supply unwholesome. The sampling for category 5.23(ii) sources must include the parameters in Table A of Schedule 1, conductivity, hydrogen ion and turbidity and any other parameter that the company considers is likely to have changed since the supply was last used.
- 5.25 There is no Regulation 15 requirement to sample sources which have been out of supply for less than six months when they are first used again. However companies would be prudent to conduct some monitoring for key parameters prior to introducing such sources, dependent on the time since the source was last in use. All such sources must be included within the new Regulation 27 risk assessment for the treatment works and associated supply system. The risk assessment should inform the selection of monitoring parameters. Companies should make sure that the parameters in their Regulation 16A monitoring programme are appropriate for when intermittent sources are in use, as well as at other times.
- 5.26 Sources that have not been used for over six months but have been used since 1 January 2004 must be subject to limited monitoring after return to supply. The scope of the monitoring required should be informed by the new Regulation 27 risk assessment for the treatment works and the associated supply system. Depending on the circumstances, the risk assessment may require revision, although companies should have ensured that each risk assessment, when first prepared, recognises the hazards potentially involved with the bringing back on line of all existing standby or emergency sources. Companies should make sure that the parameters in their Regulation 16A monitoring programme are appropriate for when standby sources are in use, as well as at other times.
- 5.27 Regulation 15 has always required entirely new sources or those not used since 1 January 2004 to be subjected to full monitoring prior to introduction into supply. However Regulation 15 has been strengthened and under these circumstances the source cannot be used until a Regulation 27 assessment has been carried out and three months have elapsed from receipt by the DWI of a Regulation 28 risk assessment report. The Inspectorate expects water companies to follow these requirements to the letter but for new sources that were planned to come on line after 22 December 2007 but before 1 October 2008, as a result of an AMP4 improvement scheme, it is sufficient for a company to notify DWI of the circumstances confirming that a provisional risk assessment has been carried out and no adverse results have been obtained from full Regulation 15 monitoring. The DWI will take a pragmatic view regarding the three month period before commissioning of any such source up to 1 October 2008. However, DWI expects that companies will have prioritised risk assessments for treatment works subject to an AMP4 scheme involving new sources and it is expected that these Regulation 28 reports will be submitted as soon as practicable and not delayed until 1 October 2008. As a matter of good practice it is expected that the scheme design for developing new sources would be informed by relevant historic data between 1 September 1989 and 1 January 2004 (under the 1989 Regulations) as well as contemporaneous data. Companies will need to review and if needs be adjust their new Regulation 16A monitoring programme when they introduce a new source.

## **Regulation 16 - Collection of samples**

- 5.28 Regulation 16 specifies the minimum quality requirements for the taking, handling, storage and analysis of samples taken for the regulatory monitoring of water supplies. These requirements are set out in regulations 16(2) and 16(5). Regulation 16(4) sets out the requirement for the retention of records to demonstrate that the sampling, transport, storage and analysis of each sample complied with the requirements. Other paragraphs cover definitions and the procedure for authorising the use of alternative methods for microbiological analysis.

### **Regulation 16(2)**

- 5.30 Sub paragraphs 16 (2) (a) and 16 (2) (b) require that the sample is representative of the quality of the water being sampled at the time of sampling and that the sample is not contaminated when being taken. Sub paragraph 16 (2) (c) specifies that samples must be kept in conditions that will ensure that the sample does not deteriorate in any significant way between sampling and the commencement of analysis.
- 5.31 Water companies, or their sampling contractor, should produce a comprehensive sampling manual setting out the procedures and precautions to be adopted for each parameter or group of parameters. Guidance on all aspects of sampling can be found in the BS EN ISO 5667 series of Standards.

#### **Sampling Manual for microbiological parameters**

- 5.32 As a minimum, the sampling manual should include relevant information on the types of sample bottle, the preparation of sample bottles, the sampling procedures and the transportation of samples. Details of recommended sampling procedures are given in 'The Microbiology of Drinking Water 2002 Part 2' and BS EN ISO 19458.

#### **Sampling Manual for all other parameters**

- 5.33 The nature of parameters varies widely, and a range of sample containers, cleaning regimes, and methods of sample preservation and storage will be required. For example, mercury is highly volatile even at low temperatures, and requires the addition of preservative at the time of sampling. Polycyclic aromatic hydrocarbons react with chlorine and are light-sensitive and require the immediate destruction of chlorine and storage in the dark. Other parameters are volatile or subject to biological degradation and require immediate refrigeration.
- 5.34 As a minimum the sampling manual should specify:
- (i) the types of bottles or containers, their closures and the purposes for which they are to be used;
  - (ii) where relevant, the cleaning procedure and shelf life for bottles, containers and closures used for each parameter, including the amount and type of preservative to be added;
  - (iii) the sampling procedure for each parameter, including the type of sample to be collected (e.g. first draw, flushed, stagnation) and the procedure for collecting samples for different parameters;
  - (iv) the order of sampling; and

- (v) the conditions of storage and transport of samples and the maximum time that can elapse before analysis should commence, for each parameter.

5.35 Further general information on sampling procedures is given in 'General Principles of Sampling and Accuracy of Analytical Results' in the series 'Methods for the Examination of Water and Associated Materials' published by the Standing Committee of Analysts. Detailed information for individual parameters or groups of parameters is given in the individual booklets in the same series.

### **Training of samplers**

5.36 In order to carry out sampling correctly it is essential that all samplers are fully trained and competent before they are allowed to work unsupervised. The water company or its sampling contractor should produce a comprehensive sampler training programme to cover all aspects of sampling.

5.37 Once trained, all samplers' performance should be monitored and subject to regular audit. Monitoring and audit procedures and criteria for satisfactory performance and policy on retraining should be documented.

5.38 A training record should be produced for each sampler detailing the training given, with dates and assessment of competence, results of any audits, any retraining or further training given and any re-assessment of competence.

5.39 Sub-paragraph (d) requires that all samples are analysed as soon as possible after they have been taken, by and under the supervision of a competent person using suitable equipment.

### **Regulation 16 – Analysis of samples**

5.40 Detailed advice on this part of the Regulations is given in Appendix 1.

### **Part VA – DRINKING WATER PROTECTED AREAS**

5.41 New Regulation 16A concerns the collection and analysis of samples of raw water used by water companies for Regulation 4 (1) purposes primarily to provide information to inform Regulation 27 risk assessments but also to contribute to the body of information identified as being necessary for every member state to collect in support the objectives of the Water Framework Directive (in particular data for parameters set out in Annex X).

5.42 Regulation 16A (1) requires water companies to identify every abstraction point from which water is drawn for Regulation 4(1) purposes. As part of each Regulation 27 risk assessment DWI expects companies to document every licensed abstraction point irrespective of whether a source is used continuously, intermittently or as standby and emergency sources. However for the purpose of collecting Regulation 16A(2) samples of raw water, companies may use a sample point located at the treatment works end of any pipe or set of pipes conveying water from the abstraction point(s) (usually such a sample point is known as the combined inlet to the works). If a single combined inlet sample point is not located so as to be representative of all the water that may enter the treatment works then the company will need to use more than one sample point. These may be located either at the individual abstraction point(s) or at the treatment works end of each pipe conveying

water from an abstraction point to the treatment works. Every sample point must have a unique reference number and its relationship to licensed abstraction points and the aquifer or the body of surface water must be recorded. When selecting sample points, companies must ensure that they are located upstream of any treatment intended to modify water quality in respect of any parameter, substance, micro-organism or parasite. Treatment in this context includes blending where this is undertaken deliberately to modify the quality of water e.g. blending of high nitrate water with water from a low nitrate source, it also includes dosing to adjust the concentration of fluoride or alter the pH.

- 5.43 Regulation 16A (3) and (4) give DWI the power to specify the number of raw water samples to be taken and the nature of the analysis to be carried out and to change these requirements. DWI will form a view as to the need for such notices after assessment of companies Regulation 28 risk assessment reports and the raw water monitoring data submitted by companies in 2009 (covering samples collected in 2008). However, this general position does not preclude DWI from issuing such a notice sooner as a consequence of audit findings or an assessment of a notified event. Regulation 16A (5) sets minimum frequencies for surface water which derive from the Water Framework Directive but in practice it is expected that companies will exceed these frequencies when considering what sampling frequency is necessary to demonstrate compliance with new Regulation 26 and to support Regulation 27 risk assessments. DWI, through WaterUK are running a pilot project on the collation and submission of raw water monitoring data in 2008. Guidance on raw water monitoring and related data provision will be developed further in consultation with companies and the Environment Agency during 2008.

## **PART VI – INVESTIGATIONS, AUTHORISATION OF DEPARTURES & REMEDIAL ACTION**

### **Regulation 17 - Investigations: Schedule 1 parameters**

- 6.1 A summary of the investigations for Schedule 1 parameters is given in Appendix 2. Note that where the DWI decides that the exceedence is trivial or unlikely to recur then no further action is necessary.
- 6.2 Regulation 17(1) requires a water company that has reason to believe that the water supplied fails, or is likely to fail, to meet the standards of wholesomeness specified in regulation 4 and Schedule 1, to investigate the cause of that failure or likely failure. Similarly regulation 17(3) requires a water company to investigate the cause of any failure or likely failure to meet the concentration or value required in an authorisation. Regulation 17(2) sets out the actions that an water company is required to take, including establishing the case and extent of the failure, the Schedule 1 parameter(s) that have not met (or are unlikely to meet) the regulations and whether the failure is related to the domestic distribution system (see 6.5 below).
- 6.3 The definition of a failure is clear. It is when the analysis of a sample taken as required by the Regulations exceeds a concentration or value specified for the parameters in Schedule 1 of the Regulations. However, the terms of “likely to fail” or “likely failure” are not defined in the Regulations.
- 6.4 A water company may have reason to believe that the water supplied is likely to fail in the following circumstances:

- (i) there is evidence from the analysis of samples taken as required by the Regulations that the trend in the concentration or value of a particular parameter is generally and steadily increasing (or decreasing) towards the prescribed concentration or value and if that trend continues the water is likely to fail to meet the prescribed concentration or value in the future, say within five years. Such evidence may be available for the nitrate parameter for example;
- (ii) no regulatory samples are in breach of the prescribed concentration or value for a particular parameter but there is evidence from the analysis of non-regulatory samples such as operational control samples or samples taken in response to incidents or consumer complaints that the prescribed concentration or value has been breached;
- (iii) no regulatory samples have exceeded the prescribed concentration or value for a particular parameter but there is evidence from the analysis of non-regulatory samples such as operational control samples or samples taken in response to incidents or consumer complaints that the concentration or value is generally and steadily increasing (or decreasing) towards the prescribed concentration or value, and if that trend continues the water will fail to meet the prescribed concentration or value in the future, say within 5 years.

#### **Regulation 17(2)(c) - Failures attributable to the domestic distribution system**

6.5 Regulation 17(2)(c) requires water companies to investigate whether a failure to achieve the prescribed concentration or value may be attributable to the domestic distribution system or its maintenance or neither.

6.6 Bacteriological parameters may be influenced by the condition of the domestic distribution system and particularly the design and hygienic status of the consumer's tap. Where a failure to achieve the prescribed concentration for Enterococci and *E coli* occurs the water company should investigate the cause by taking further samples which may include:

- the original sample point
- alternative consumer taps (only taps directly connected to the supply main) at the same property and at adjacent or nearby properties
- sampling from related points upstream and downstream in the distribution main
- checks on performance of the treatment works and samples from any service reservoir

6.7 Additional information may be obtained by:

- review of the outcome of analyses from other samples that may have been taken from related water supply areas at a similar time to the original sample
- taking a sample prior to and after disinfection of the consumer tap
- taking a swab sample from the surfaces of the tap that come in contact with the water supply

- 6.8 The outcome of the further analysis provides important information on the likelihood that the failure to achieve the prescribed concentration is attributable to the domestic distribution system. There is a strong indication that the failure is attributable to the domestic distribution system in any of the following circumstances:
- (i) the failure to meet the prescribed concentration recurs at the original consumer's sample tap but all other samples meet the relevant prescribed concentrations;
  - (ii) the failure to meet the prescribed concentration recurs in a sample taken before disinfection of the original consumer's sample tap but a sample taken following disinfection meets the relevant prescribed concentrations and all other samples meet the relevant prescribed concentrations;
  - (iii) the failure to meet the prescribed concentration does not recur at the original consumer's sample tap but Enterococci or *E coli* are recovered from a swab sample taken from the surfaces of the tap and all other samples meet the prescribed concentrations; or
  - (iv) the failure can be shown to be attributable to an upstream device e.g. softener, filter or point of use treatment device or from some other unit connected to the domestic plumbing e.g. washing machine or dishwasher. Note: There must be evidence as to causation that is more than the mere existence of such devices.
- 6.9 Where water companies can demonstrate that failures to meet the prescribed concentrations were likely to be attributable to the domestic distribution system then the individual results on the public record should be qualified by appropriate comments.
- 6.10 The standards for taste and for odour have been adjusted to bring them into line with those in the Drinking Water Directive. These are descriptive mandatory national standards and consequently, when detected, either qualitatively or quantitatively, any detection of taste or odour must be investigated to establish whether the finding is abnormal, relative to previous results from the zone, taking into account seasonal variations. Use of the Standing Committee of Analyst's dilution number methods continues to be recommended as part of the investigation to characterise the intensity. Consumers expect their water to exhibit no objectionable taste and odour. Judgements about acceptability will require the company to have regard to its records of consumer contacts about taste or odour reported for the zone as a whole. However company investigations of both compliance samples and consumer complaints should be guided initially by the description of the taste and odour and the likely contribution of the domestic plumbing at the property from where the sample was taken, as well as the likelihood of a problem stemming from contamination of the supply pipe or being due to a wider problem, such as backflow or back-siphonage from neighbouring properties. [Information letter 9/2007](#) gives guidance on the reporting of taste and odour results.
- 6.11 Failures to achieve the prescribed concentration for copper, lead and nickel at the consumer's tap are commonly associated with the domestic distribution system as the water interacts with copper or lead pipes (or solders) and both metal and plastic

fittings may release nickel<sup>4</sup>. Failure for copper or lead may be due (in part) to water company pipes. The water company should investigate the extent of these interactions by taking additional unflushed samples following defined periods of stagnation and from nearby properties. Visual checks should also be carried out for any lead piping supplying the tap in the case of a lead failure. Nickel is more likely to be related to tap fittings therefore comparisons between unflushed and flushed samples can be useful. It should be remembered that lead can occur water even when lead pipes are absent, specifically in copper plumbing systems where lead solder has been used in contravention of the Water Supply (Water Fittings) Regulations 1999.

- 6.12 Failure of the prescribed concentration for copper may occur in houses with new copper plumbing or where a significant amount of copper pipe has been replaced. Following a failure to achieve the prescribed concentration for copper, the domestic distribution system should be inspected to ensure that it meets the requirements of the Water Supply (Water Fittings) Regulations 1999.
- 6.13 Unless the water company can demonstrate that the failure to achieve the prescribed concentration for copper or lead was due to exceptional circumstances and was therefore unlikely to recur, regulation 17(9) requires the water company to modify or replace its pipes or fittings that have potential for contributing to copper or lead in the water supplied to the premises. In addition to these requirements, Regulation 30 contains additional requirements regarding lead pipe replacement following a request from the consumer.

### **Regulation 17(6) - Notification to consumers**

#### *Notices to consumers*

- 6.14 Regulation 17(6) requires a water company that has identified by its investigation that a failure is due to the domestic distribution system or to the maintenance of that system to notify affected consumers in writing of the nature of the failure and to relay steps (if any) that the water company advises are desirable for the consumers to take in the interests of their health. Water companies should seek advice from their local Health Protection Unit and local authority Environmental Health Department as appropriate in respect of this, however the decision to issue advice to consumers is a matter for the water company. In making this decision the company should have due regard to the advice sought and received from local health professionals.
- 6.15 The notice from the water company should inform the consumer in simple layman's terms:
- (i) the parameter that has failed;
  - (ii) the concentration or value of that parameter in the sample taken from the consumers' premises;
  - (iii) the prescribed concentration or value of that parameter;
  - (iv) the significance of the failure (e.g. if the water company considers that advice on health matters should be sought); and
  - (v) the reason for the failure.

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<sup>4</sup> Sanitary tap fittings are commonly made from thermoplastic materials. In order to externally plate these fittings, a metallic layer of nickel is applied to the plastic body; as part of this process some of the nickel can "over-spray" into the spout of the tap. If subsequent plating over the nickel does not cover the "over-spray" this may lead to subsequent leaching of nickel.

- 6.16 The notice must also inform the consumer of the steps he/she should take. These steps will depend on the nature of the parameter and the cause and extent of the failure. Examples of the steps that the water company may consider are:
- (i) **failures of microbiological parameters** – advise boiling water for drinking and food preparation pending investigation of the problem – a plumbing inspection may assist in the investigation - where the failure is associated with an individual fitting advise repair or replacement of the pipework or fitting causing the problem
  - (ii) **failures of the lead parameter (or other plumbing metals)** – advise drawing off the water standing in the pipework and using for purposes other than drinking or food preparation – advise consideration of replacing the pipework within the premises contributing to the failure
  - (iii) **failures of other parameters** are likely to be caused by ingress to the pipework within the consumer's premises (by permeation, leaking pipes or back siphonage) – advise where necessary and appropriate boiling water for drinking and food preparation or not to use water for drinking and food preparation – advise a plumbing inspection - where the failure is associated with an individual fitting advise repair or replacement of the pipework or fitting causing the problem.

#### **Regulation 18 – Investigations: indicator parameters**

- 6.17 Regulation 18(1) requires a water company, when it has reason to believe that the water supplied does not meet the specification for indicator parameters, to investigate why the specifications were not met and, if the specification for coliform bacteria or the colony count parameter is not met, whether the cause was the domestic distribution system or the maintenance of that system or neither. Such an investigation must be carried out when a sample taken in accordance with the Regulations does not meet the specification for an indicator parameter. Investigation should also be carried out when an operational sample or a sample taken in respect of an incident or a consumer complaint does not meet the specification for an indicator parameter.
- 6.18 Regulation 18(2) requires the water company as soon as its investigations are complete to notify DWI of results of the investigations and whether the inability to meet the specification is likely to recur.
- 6.19 If a particular parameter for a particular water supply zone or group of water supply zones supplied by the same water treatment works does not meet the specification for indicator parameters, and the water company notifies DWI that it has not met the specification and the inability to meet it is likely to recur, then the water company need not investigate and notify on each subsequent occasion that the specification is not met, provided it is clear that the cause is the same and there are no changes in circumstances. If it is likely that the cause is different or there has been a change in circumstances the water company must carry out the investigations and the notification. This paragraph only applies to those indicator parameters that are unlikely to be affected by the domestic distribution system or the maintenance of that system – chloride, *Clostridium perfringens* (including spores), conductivity, sulphate, total indicative dose (for radioactivity), total organic carbon (TOC), tritium (for radioactivity) and turbidity.

- 6.20 All occasions when the specifications for indicator parameters are not met at consumers' taps must be investigated. In particular, investigations for coliform bacteria or colony count failures must address whether the inability to meet the specification is due to the domestic distribution system or the maintenance of that system. When it is due to the domestic distribution system the water company must notify the affected consumers and inform them of the nature of the problem and any steps that the water company or Health Protection Agency consider it desirable for the consumers to take in the interests of their health. Water companies should provide appropriate technical advice and may refer consumers to their Local Authority Environmental Health Department or the local Health Protection Unit of the HPA for advice on health matters. For the microbiological parameters that advice could be to boil water for drinking and food preparation and to get a plumbing inspection to identify the cause of the problem and to rectify the cause.

### **Regulation 19 – Action by DWI**

- 6.21 Regulation 19(1) permits the Secretary of State (in practice DWI) to require water companies to seek an authorised departure following a non trivial failure in respect of a Schedule 1 parameter that is likely to recur. Authorised departures are not permitted under the regulations for the *E.coli* and Enterococci parameters (i.e. Part 1 of Table A) and the DWI will proceed with an Enforcement Order under Section 18 of the Water Industry Act following non-trivial failures that are likely to recur.
- 6.22 The DWI general policy in response to failures of national parameters (Part II of Table A and Part II of Table B in Schedule 1) is set out in [Information Letter 3/2003](#) . This general policy is to continue to accept undertakings for national parameters, however undertakings can only be accepted where the supply of water in accordance with the undertaking does not constitute a potential danger to human health.
- 6.23 DWI will proceed with an Enforcement Order where the extent of any failure of a Schedule 1 parameter constitutes a potential danger to human health.
- 6.24 Regulation 19(4) permits the Secretary of State (in practice DWI) to require water companies to take steps following a notification under regulation 18(2) that there is a continued inability to meet the specification of an indicator parameter. DWI may only exercise this power where the inability to meet the specification poses a potential risk to human health.
- 6.25 Most indicator parameters do not have a direct influence on health but are included in the monitoring programme because they may indicate a problem or potential problem with the treatment or distribution of the water. In all cases exceedence of an indicator parameter value must be followed by an investigation by the water company. In many cases a change in the level of an indicator parameter may be more significant than the exceedence of a particular value. In many cases the nature of the raw water source will influence the significance of changes and exceedences of an indicator parameter's specification.

#### **(i) Ammonium** (specification: 0.50mgNH<sub>4</sub>/l)

The presence of ammonium in raw waters is usually associated with organic contamination (animal waste and sewage) of surface waters or from desorption of ammonium within anaerobic groundwaters. The exceedence of the indicator value in treated waters usually indicates that treatment of anaerobic groundwater or contaminated surface water has failed. The presence of ammonium in raw water may also compromise the efficiency of chlorination and therefore investigations into the

exceedence of the indicator parameter value should include checks to establish the adequacy of disinfection. Unpleasant tastes and odours may be associated with high concentrations of dichloramine and trichloramine that may be caused by high concentrations of ammonium. In some cases elevated concentrations of ammonium may be associated with cement-mortar pipe linings, ingress of contaminated water or back siphonage.

**(ii) Chloride** (specification: 250 mgCl/l)

The presence of chloride in raw waters results from diverse inputs which include leaching from soils, sewage or industrial discharges, run-off from de-icing and saline intrusion. In the latter two cases there is also an associated increase in the concentration of sodium. Increased chloride content may also increase the aggressivity of water. In rare cases increases in the concentration of chloride have been associated with contamination by sodium chloride used as a regenerant for the ion-exchange removal of nitrate. Higher than normal levels of chloride may also arise from its use in domestic water softeners. Whilst these softeners should not be upstream of the kitchen tap, it is always possible that they have been fitted not in accordance with best practice. As the concentration of chloride increases above the indicator concentration it is likely that there will be an increasing detection of taste from consumers. Typical taste thresholds are between 250 and 300 mg/l.

**(iii) *Clostridium perfringens* including spores** (specification: 0/100ml)

*Clostridium perfringens* are commonly found in human and animal faeces. As *Cl. perfringens* is generally present in faeces in much lower numbers than *E. coli* and Enterococci, it is less sensitive as an indicator of faecal contamination. The spores of *Cl. perfringens* are capable of surviving for significantly longer periods than vegetative bacteria such as coliforms or Enterococci. *Cl. perfringens* are removed from water by coagulation and filtration, but the spores of these bacteria can be resistant to chlorine at the concentrations normally used in water treatment. Low numbers may occasionally occur in water supplies, but their presence, in the absence of other faecal indicators, does not represent a risk to health. The main value of monitoring for *Cl. perfringens* at a point where the water leaves the water treatment works is to assess the efficiency of the treatment process. The presence of *Cl. perfringens* in treated water derived from groundwaters could indicate bacteriological contamination of the source. A change in the number of *Cl. perfringens* in treated water against the normal range for that supply is more significant than the exceedence of a particular value. Investigations into the exceedence of the indicator value should include checks to establish the quality of the source and the adequacy of treatment. See also section 4.6(iii) on monitoring.

**(iv) Coliform bacteria** (specification: 0/100ml)

This indicator value applies only to samples taken at consumers tap – the coliform parameter at treatment works and service reservoirs are mandatory national parameters. Coliform bacteria are a diverse group which are known to be present in soil, environmental waters and other environmental materials. Some members are also capable of growth in nutrient rich water and biofilms. As a result they are not considered to be specific indicators of faecal contamination. A few members of the coliform group can be associated with human infection as opportunistic pathogens or as hospital acquired infections. Whenever coliform bacteria are isolated from a drinking water supply, investigations need to be carried out to establish the source of contamination. Coliform bacteria detected from samples taken within consumers' premises may be associated with the domestic distribution systems such as kitchen

taps and sinks. Other potential sources of coliform bacteria in water supplies are sub-optimal operation of water treatment processes or ingress of contamination from breaches in the integrity of the distribution system (via hatches on service reservoirs, air valves, stop valves, cross connections and backsiphonage). In some cases additional information on the identity of the species of coliform bacteria present may prove useful in determining the sources and significance of the coliforms detected. Low numbers may occasionally occur in water supplies, but their presence, in the absence of other faecal indicators, do not represent a risk to health.

**(v) Colony counts** (specification: no abnormal change)

Colony counts are enumerations of the general population of heterotrophic bacteria present in a water supply. In environmental waters these represent bacteria whose natural habitat is the water environment or those that may have been washed from soil or vegetation. It is well recognised that only a small fraction of the viable heterotrophic bacteria population is estimated by enumeration on nutrient rich media with incubation at 22°C and 37 °C. However, monitoring of water supplies for colony count bacteria can be useful for monitoring trends in water quality and detecting potential sudden deterioration in water quality. Generally the colony count at 22°C represents those bacteria naturally present in water and are not of sanitary significance. They may, however, be of greater relevance to the food and drinks industries where high numbers may impact on the quality of products. An increase in the colony count at 37°C can be a sensitive indicator of ingress in the same way as coliform bacteria therefore further investigations should be undertaken to establish the source. Colony counts may be useful in assessing the efficiency of water treatment and the cleanliness and integrity of the distribution system. In all cases the value of monitoring is to establish data which characterises a water supply in terms of seasonal and longer term changes. Drinking water supplies derived from surface waters tend to support higher numbers of heterotrophic bacteria than those derived from groundwater sources. The onset of significant change in colony count results against the normal range established for that water supply is much more significant than the absolute values of individual results.

**(vi) Conductivity** (specification: 2500 µS/cm at 20°C)

Conductivity is a measure of the extent of dissolved inorganic ions that are present. It is a non specific measurement although a high value may indicate undesirably high concentration of ions. Increased values of conductivity in samples taken from consumer premises may indicate potential backflow or cross connections. A change in the concentration of conductivity against the normal range for that water supply is more significant than exceedence of a particular value. Further investigation and analysis is required to identify the predominant elements present. All of the significant individual elements have either standards or indicator values against which the need for action can be assessed.

**(vii) Hydrogen ion** (specification: pH 6.5 - 9.5)

Hydrogen Ion (pH) gives an indication of the degree of acidity of the water. Although pH does not usually have a direct impact on consumers, it is one of the most important operational water quality parameters and can have a significant impact on the efficiency of water treatment and water quality during distribution. A low pH water can affect water treatment and may result in pipe corrosion during supply to consumers. An elevated pH may, depending on the buffering capacity of the water, increase the solubility of metals and could have an adverse impact on the aesthetic

quality. Exceedence of the specification may arise as a consequence of poor acid or alkali dosing control at treatment works or from the effects of cement mortar lined pipes.

**(viii) Sulphate** (specification: 250 mgSO<sub>4</sub>/l)

High concentrations of sulphate may affect the taste of a water supply and there is also some evidence to suggest that it may have a laxative effect in vulnerable groups such as bottle fed infants. The Regulations require water companies to take further action to investigate the origin of concentrations that exceed the indicator value. The Inspectorate recognises that there may be a few instances, for example where a relaxation was in place under the 1989 Regulations, where the specification is regularly exceeded. In these circumstances there is little practical value in conducting repeated investigations but the company should work closely with the local Health Protection Unit of the HPA to ensure there are no risks to human health.

**(ix) Total organic carbon** (specification: no abnormal change)

Total organic carbon is a non specific index of the organic material in a water supply. The significance of an increase in the concentration of total organic carbon will require further investigation. In some cases the increase may be associated with increases in the concentration of assimilable organic carbon. As assimilable organic carbon provides a potential nutrient source for bacteria, water companies should investigate whether there is increased potential for the growth of biofilms.

**(x) Total indicative dose** (for radioactivity, specification: 0.10 mSv/year)

Where monitoring is being undertaken the level of gross alpha activity should be assessed against a screening level of 0.1 Bq/l and the level of gross beta activity assessed against a screening level of 1 Bq/l. If either screening value is exceeded additional analysis should be undertaken to establish which radionuclides are present. The range of radionuclides analysed should take into account relevant information on potential sources. The total indicative dose (TID) is then calculated from the individual isotope concentrations excluding any activity from tritium, potassium-40, radon and radon decay products. If the TID exceeds the indicator value of 0.10 mSv/year appropriate medical advice should be sought. The specification for total indicative dose is expressed in terms of the dose over a year. In interpreting the results of radioactivity monitoring it is necessary to take account of the variability in activity levels over time. Some water sources are likely to show seasonal variation due to natural processes. In addition, any short term increase in radionuclides that may result from radiological incidents should be assessed against guidance for food and liquids within guidance published by the former Department of the Environment (Civil Emergencies involving radioactive substances). See also paragraphs 4.22 – 4.24 and Appendices 4 and 4A.

**(xi) Tritium** (specification: 100 Bq/l)

Tritium is naturally present in the environment but only at very low concentrations. Tritium can also be an indication of contamination from artificial sources and water companies should take actions to investigate the source of any exceedence of the indicator value. If the indicator value is exceeded additional analysis should be undertaken to establish which isotopes are present and the total indicative dose calculated from the individual isotope concentrations. If the total indicative dose exceeds the indicator value of 0.10 mSv/year appropriate medical advice should be sought. The specification for total indicative dose is expressed in terms of the dose

over a year. In interpreting the results of radioactivity monitoring it is necessary to take account of the variability in activity levels over time. Some water sources are likely to show seasonal variation due to natural processes. In addition any short term increase in radionuclides that may result from radiological incidents should be assessed against guidance for food and liquids within guidance published by the former Department of the Environment (Civil Emergencies involving radioactive substances). See also paragraphs 4.25 - 4.28 and Appendices 4 and 4A

**(xii) Turbidity** (specification: 1 NTU)

The indicator value only applies at the treatment works. For this parameter there is in addition a mandatory maximum value of 4 NTU that applies at the consumers' tap. Exceedence of the indicator specification does not represent a direct risk to human health. However a significant increase in the level of turbidity may compromise the effectiveness of disinfection. The World Health Organisation has issued guidance on the level of turbidity required to allow satisfactory disinfection. The importance of optimising the operation of water treatment works to effectively remove *Cryptosporidium* oocysts has been identified by the Expert Group on *Cryptosporidium* in water supplies. An important element of this is controlling the effectiveness of particle removal by reference to the turbidity of filtered and final waters. Any exceedence of the indicator specification at a treatment works should initiate an investigation into the cause in line with the recommendations in the reports of the Expert Groups on *Cryptosporidium* in water supplies. [see also guidance on Regulation 26].

- 6.26 A summary of investigations in respect of indicator parameters is given in Appendix 3.

**Regulation 20 – Authorisation of a temporary supply of water that is not wholesome**

- 6.27 Regulation 20 allows the Secretary of State to authorise a departure from the provisions of Part III of the Regulations upon written request of a water company. Authorised departures are only applicable for parameters in Part II of Table A and Table B of Schedule 1. In practice this means authorised departures may not be granted for *E.coli* or Enterococci at customer taps or indicator parameters.
- 6.28 Authorised departures can only be granted subject to the criteria set out in Regulation 20(2). One of these is that the Secretary of State must be satisfied that the departure does not constitute a potential danger to human health. The Inspectorate will consider applications on a case by case basis. It will seek medical advice and will have due regard to representations made by the Health Protection Unit of the HPA which has knowledge of the local community and responsibility to advise on public health.
- 6.29 The information that shall be provided with an application for an authorised departure is detailed in regulation 20(3). An application form and notes on its completion are on the [Inspectorate's website](#) . Companies may submit additional information in support of their case should they so wish. Such information could include the likely maximum concentration, details of the time period of exceedence (for example if seasonal), details of any vulnerable consumers affected and the outcome of any discussions with the health authority. The Inspectorate expects companies to be actively engaged with their Health Protection Units of the HPA. They should discuss any potential applications with them in advance to enable any risk to the health of the communities in their care to be assessed and appropriate advice to be formulated.

Equally the Inspectorate is happy to discuss draft applications with companies before the formal application is made.

- 6.30 The formal application must be copied to every appropriate local authority, the relevant Health Protection Units of the HPA and the relevant committee of the Consumer Council for Water, who have 30 days to make any representations on the application. In its covering letter to these bodies the companies should remind them that they have 30 days to make representation and advise them of the name of the DWI Inspector dealing with the case.

### **Regulation 21 – Authorisations term and conditions**

- 6.31 Where the Secretary of State (in practice the DWI) considers that the failure to meet the prescribed concentration is trivial and that the PCV will be met within 30 days a shortened application as specified in regulation 21(4) is required.
- 6.32 An authorised departure may be granted for a maximum of three years and in each case will specify the extent to which any parameter may depart from the PCV specified in Schedule 1. In line with the Directive, the Inspectorate's approach will be to issue departures for as short a period as is reasonably required to complete the associated programme of work. The Inspectorate's general view is that in all cases it will be possible to restore a wholesome water supply within three years. In general, long term schemes, such as distribution system programmes, are being dealt with through undertakings.
- 6.33 Regulation 21(5) allows the Secretary of State to authorise a further departure again for up to a maximum period of three years. It is only envisaged that this provision will be used in exceptional circumstances. A third departure can be granted under Regulation 21(7) but only with the approval of the Commission.
- 6.34 Regulation 23 has been amended so that the normal route for advertising authorised departures becomes the placing of relevant information on the water company's website as opposed to placement of notices in local newspapers.

## **PART VII – WATER TREATMENT**

### **Regulation 25 - Interpretation**

- 7.1 This regulation has been revoked because it related to the interpretation of the Surface Water Directive which ceased to have effect with effect from 22 December 2007.

### **Regulation 26 - Disinfection and other treatment arrangements**

- 7.2 Regulation 26 which concerns the disinfection and treatment of water has been amended to bring it up to date and to clarify its scope in light of the fact that the previous guidance in the Surface Water Directive has ceased to have effect. The definition of disinfection has been amended also (see guidance on Regulation 2). The choice of treatment and disinfection processes is not specified in the regulation; this means that companies are free to decide on the most appropriate technology to apply at each treatment works. However DWI expects companies to have in place a water treatment policy and a disinfection policy covering all of the requirements of Regulation 26. Both design and operation must be covered by this policy which should be kept under regular review and be informed by appropriate studies and technical performance data. DWI also expects there to be documentation and procedures in place which ensure that at every treatment works it is unambiguous how Regulation 26 is being met both in principle and in practice. These procedures must identify all the critical controls. Companies must ensure that there is current and archived validation data for each critical control for disinfection.
- 7.3 Regulation 26 (5) (b) defines the preliminary treatment that companies must have in place to prepare water for disinfection. This means that companies must treat the water to modify its quality in respect of any properties (e.g. pH) and substances (e.g. ammonia) known to adversely affect the performance of the disinfection process (or processes). Where no preliminary treatment takes place DWI expects the company to be able to demonstrate from robust data why no preliminary treatment is required. The regulation makes it clear that the preliminary treatment must secure that turbidity in the raw water is reduced to below 1 NTU before water enters the final disinfection stages of treatment. DWI considers that this requirement means that as a minimum, companies should have a turbidity monitor installed at a point before water enters any inactivation process such as UV or chlorine. Where this is not the case (e.g. simple ground water source where turbidity in the source water is always reliably well below 1 NTU) then DWI will interpret the readings from the final water turbidity monitor as if this was measuring the turbidity before it entered the disinfection process. It is for companies to decide whether they are content to rely just on the measurements of a single final water turbidity monitor to demonstrate compliance with Regulation 26. Regardless of the location of the designated turbidity monitor(s), companies are expected to have alarms in place so that appropriate corrective action can be taken well before the measured value reaches 1 NTU.

### **Regulation 27 - risk assessment**

- 7.4 Prior to being amended Regulation 27 required a risk assessment that was specific to *Cryptosporidium*. The regulation now requires a comprehensive risk assessment for each treatment works and connected supply system which covers all hazards and hazardous events. These risk assessments shall be undertaken using the water safety plan approach published by WHO in the Drinking Water Guidelines 2004,

taking into account subsequent updates and associated guidance manuals published by WHO. Water Safety Plans require documentation of the hazards and hazardous events that potentially could arise in the catchment area for the source, during treatment, within the distribution system and within building plumbing systems (up to the consumers cold water tap). The methodology requires risk to be characterised for each hazard/hazardous event using a scoring system based on likelihood and consequence criteria. An example of such criteria has previously been published by DWI in relation to PR09 submissions (as Annex B to [Information letter 2/2008](#)). Risks should be characterised before and then after taking account of the existing permanent control measures in place. The scoring method should be capable of identifying “residual risks” which require further steps of mitigation (control measures) to be put in place. Residual risks may be either acceptable or unacceptable in nature. DWI considers that where “residual risks” as identified through water safety plan methodology are unacceptable in nature these should be interpreted as having the same meaning as the term “significant risk...of a potential risk to human health” in Regulation 27. This would therefore identify the need for further action to be taken to control or mitigate the risks Existing Cryptosporidium Risk Assessments and associated notices and monitoring arrangements remain in force until these new risk assessments have been completed and the Regulation 28 reports assessed by DWI.

### **Regulation 28 - Procedure following risk assessment and prohibition of supply**

- 7.5 The information required from companies by DWI as constituting a Risk Assessment Report as specified in Regulation 28 (2) and (3) is set out in [Information letter 07/2008](#). The annex of IL 07/2008 incorporates guidance notes. The format of the Annex may be varied to suit the risk assessment methodology of each company however companies are advised that their reports must adequately address each of the information requirements contained in the Annex. Whilst the reporting format as set out in the Annex can be varied by companies, attention is drawn to the fact that it has been designed so that once complete, it can be used to report simply on subsequent updates and reviews. The Inspectorate does not require water companies to provide updates of each risk assessment on a routine basis (e.g. annually) Instead it is the duty of each water company to keep each risk assessment under continual review and provide an updated report whenever there is any material change to risk categorisation or completion of any specified action relating to risk mitigation (implementation of a specified control measure). DWI will confirm receipt of a risk assessment report but companies need to be aware that such confirmation will not constitute approval of the risk assessment nor will it constitute a formal notice. Although Regulations 27 (5) and 28 (4) give the Secretary of State (in practice DWI) the power to issue notices, these are intended for only for those circumstances where DWI considers that it is necessary for either a further risk assessment or review be carried out or for the company to take a particular course of action. DWI is not in a position to give guidance on the extent and scope of the notices that it may be required to issue until the end of 2008 at the earliest.

### **Regulation 29 – Treatment for *Cryptosporidium***

- 7.6 Regulation 29 which amongst other things described the monitoring requirements for *Cryptosporidium* has been revoked. However DWI has agreed to retain on its website the following Standard Operating Protocols until such time as methods have been published through SCA or another recognised body. It is expected that companies will continue to carry out monitoring for *Cryptosporidium* using these protocols within the context of Regulation 27 risk assessments and Regulation 16A monitoring programmes. However, the forensic audit trail requirements no longer apply. The

recommended source of advice relating to oocyst typing methods is the UK *Cryptosporidium* Reference Unit at NPHS, Swansea.

- Standard Operating Protocol for the Monitoring of *Cryptosporidium* Oocysts in Treated Water Supplies - Part 1 Sampling and Transportation of Samples
- Standard Operating Protocol for the Monitoring of *Cryptosporidium* Oocysts in Treated Water Supplies - Part 2 Laboratory and Analytical Procedures
- Standard Operating Protocol for the Monitoring of *Cryptosporidium* Oocysts in Treated Water Supplies - Part 3 Validation of New Methods or parts of Methods for sampling and Analysis

7.7 The revocation of Regulation 29 means that companies can address a significant risk from *Cryptosporidium* by the use any appropriate water treatment technology. However the Inspectorate has agreed to retain its guidance on membrane filtration on its website and this will be enhanced in the near future by guidance on the use of UV for oocyst inactivation.

### **Regulation 30 - Contamination from pipes**

7.8 Regulation 30 deals with contamination of the water supply by copper or lead as a result of the supply and domestic pipework. Separate guidance exists on the way in which water companies should develop their plumbosolvency (and cuprosolvency if appropriate) treatment and control strategies. The prescribed risk relates to the supply of water to any individual premises and arises when copper or lead is the major component of the service pipe.

7.7 Regulation 30(4) requires water companies to modify or replace their part of any lead service pipe when it has reason to believe that the concentration of lead at the consumer's tap exceeds 10 µg/l. The water company is required to replace their part of the pipe when the owner intends to replace his own part of the service pipe and the owner has made a written request to the water company to replace its part.

### **Further guidance on the lead parameter**

7.8 Companies' approach to compliance with the lead parameter should be informed by their risk assessments of water supply systems. As with all risks, these assessments should consider the control measures in place to mitigate risks. Companies should identify in their risk assessment reports where there is an unacceptable risk associated with the lead parameter and identify appropriate mitigation as part of an integrated package of measures (for example to include measure taken by the water companies and joint local action plans with local authorities / HPU's to raise awareness in the community).

7.9 Regulation 17(9) applies to failure of the lead standard in force at that time. On that basis the trigger for action under this Regulation relates to 25µg Pb/l until 25 December 2013 at which time the trigger will reduce to 10µg Pb/l. This guidance has been updated to reflect the implementation over recent years by companies of water treatment (orthophosphate dosing, pH and alkalinity control, or both) measures for

plumbosolvency control. Any compliance, random daytime survey or samples taken specifically at the request of consumers (but excluding samples taken for research or operational purposes particularly those involving stagnation sampling techniques) which exceeds 25µg Pb/l at a consumer's tap should trigger the potential obligation to replace lead communication pipes.

- 7.10 Where a relevant sample is taken which triggers a potential obligation under regulation 17(9), the company must investigate as follows:
- (i) review results from the zone (and related zones where treatment control measures are in place at the supplying works) to determine if the failure is an isolated one
  - (ii) if it is an isolated failure and treatment has not been consistent and is not optimised then the company must make treatment improvements to ensure treatment is consistent and optimised. If there is lead present in the company's pipe then it must be replaced as required under Regulation 17 (9).
  - (iii) if treatment is consistent and optimised (or it has been determined from previous reviews that treatment was not necessary), then the isolated failure must be investigated further, as follows;
    - (iv) when the failure is in a sample from a tap in a domestic premises or other premises which is not a public building, no further samples are required and but a comprehensive investigation should be undertaken to establish if lead is present in the pipe work belonging to the company and the premises owner. If there is lead present in the company's pipe then it must be replaced as required under Regulation 17 (9). There should be auditable evidence for the conclusion reached by the company's investigation. For example if preliminary investigations are inconclusive then excavation/exposure of the company's pipework may be necessary. When the investigation concludes that there is lead in the supply pipe or the internal plumbing belonging to the owner, the consumers occupying the premises must be notified and given advice about how to protect their health.
    - (v) When the failure occurs in a sample taken from a tap in a public building the company must carry out a similar investigation to that described above, including the replacement of the company owned communication pipe where this is lead. When there is lead pipe within the pipe work belonging to the public building the owner of the building and the consumers using the building must be notified and given advice about how to protect their health. This should also include reminding them of their obligations under the Water Supply (Water Fittings) Regulations. The notification must be sent to the owner of the building and the local authority. Companies are expected to take a pragmatic view as how best to ensure the effective communication of this information to consumers who may use the public building. For example the head-teacher (in the case of a school) or the building manager (of a hospital or other public building) may be best placed to ensure that appropriate advice is communicated to potential consumers
  - (vi) DWI should be notified as soon as possible after each investigation is concluded of the results of the investigation and the action taken together with copies of notification of building owner and consumers (this will normally be as part of the company's monthly data return to DWI). The company should have a standard form for notifying the Inspectorate.
  - (viii) No further action is required for a single isolated failure in a zone or related zones.

- 7.11 If the failure is not an isolated one in the zone or related zones then the company must review the plumbosolvency control treatment in place and check that it has been consistent and optimised. If treatment is not consistent or optimised then action must be taken by the company to improve the treatment and continue to monitor it and lead concentrations to ensure it is consistent and optimised. However, if plumbosolvency treatment is not practised because previous reviews have determined it is not necessary then the company will need to review all results and consider whether plumbosolvency treatment is likely to reduce the lead concentration at consumer's taps. If it is concluded that treatment is necessary then the company should install treatment, obtain a consistent dose and optimise the dose as soon as practical. No further action is required, following optimisation, unless there is a subsequent failure in the zone or related zones.
- 7.12 If the company concludes that treatment is consistent and has been optimised then it should carry out the investigations and actions as set out above for an isolated failure and review their findings as part of their Regulation 27 risk assessment. Where a company's Regulation 27 risk assessment identifies an unacceptable risk relating to lead then companies are expected to identify an integrated package of measures to mitigate this risk. Where companies are proposing mitigation measures they should take into consideration current knowledge regarding options available to them. For example, the conclusions of recent work on the effectiveness of lead pipes replacement are summarised in Appendix 5.
- 7.13 In the period up to 24 December 2013 companies are strongly recommended to follow the same approach as set out above for any exceedences of the future lead standard of 10 µg/l because this will be required on or after 25 December 2013.

### **Regulation 31 - Application and introduction of substances and products**

- 7.14 Regulation 31 specifies the circumstances in which water companies may apply or introduce substances or products into water supplied for drinking, washing, cooking or food preparation. Paragraph (3) and (3)(a) refer to appropriate CE marking and other appropriate European technical specifications. Paragraph (3)(b) lists equivalent national measures that may be considered in the absence of European specifications. Paragraph (3)(i) requires water companies to adhere to national conditions of use that apply to substances and products applied or introduced under (3)(a) and (b). Paragraph (3)(ii) confirms that the UK will comply with the requirements of 98/34/EC - The Technical standards and Regulations Directive on the notification of national conditions of use as new technical requirements.
- 7.15 Paragraph (4)(a) provides for use of substances and products approved by the Secretary of State and paragraph (2) makes it clear that this approval route is available only in the absence of CE marking or appropriate European or national specifications. Provision is made for conditions of approval to be attached to the Secretary of State's approval. Paragraph (4)(b) provides for the Secretary of State to exercise his discretion not to require approval of a substance or a product that is considered to be unlikely to affect adversely the quality of the water supplied. Paragraph (4)(c) provides for authorisation by the Secretary of State of the use of unapproved substances or products, in accordance with a previously notified programme of testing or research. The length of the period of testing or research is subject to the 12-month limit, or other notified period, set out in paragraph (7) of Regulation 31.

- 7.16 Paragraph (5) authorises applications for approval to be made by any person. Paragraph (6) provides for variation or revocation of an approval, subject to the requirements of paragraphs (10) and (11) in respect of the giving of notice to those affected by the variation or revocation. Paragraph (8) provides for the Secretary of State to prohibit the use of any substance or product which water companies would otherwise be authorised to use, subject to the requirements to give notice as set out in paragraphs (10) and (11). Paragraph (12) requires the Secretary of State, at least once in each year, to issue a list of all substances and products for which approval has been granted, refused, modified, revoked or prohibited. The List of Approved Products is currently updated several times a year – details are available on the Inspectorate’s website ([www.dwi.gov.uk](http://www.dwi.gov.uk)).

### **Regulation 32 - Use of Processes**

- 7.17 Regulation 32 provides for the Secretary of State to give notice to a water company, requiring them to make an application for approval of any process. The notice may also prohibit use of the process for a specified period. Regulation 32 also provides for attaching conditions to an approval and for revocation of approval and modification of conditions of approval and publication of a list of approved processes. Provisions equivalent to those prescribed in regulation 31 in respect of giving notice apply to regulation 32.
- 7.18 Under the offences provisions of regulation 33, penalties are specified for contravention of: regulation 31(2) (use of unapproved products); 31(8) (contravention of a prohibition notice); 32(1) (use of a process in contravention of a prohibition notice); and 32(2) (failure to observe conditions of approval of a process). Regulation 33 provides also for prosecution of anyone providing false information in support of an application for approval, subject to the consent of the Secretary of State or the Director of Public Prosecutions.

### **Guidance on specific issues**

#### **Regulation 31(3) - Acceptable technical specifications**

- 7.19 For the time being, only the European standards for drinking water treatment chemicals (published as BS EN standards) satisfy the harmonised standard criteria of regulation 31(3). A full listing of BS EN standards and the relevant national conditions of use, are given in the Secretary of State's List of approved products. The list is posted on the DWI website ([www.dwi.gov.uk/](http://www.dwi.gov.uk/)).
- 7.20 The original intention was that a European Commission European Acceptance Scheme (EAS) initiative would lead to the production of harmonised standards for construction products used in contact with drinking water, possibly through the harmonisation of existing Member State schemes. However, it is unlikely that any such changes will now be implemented for several years. There are currently no European Technical Approvals applicable to drinking water construction products and none are expected to become available in the foreseeable future.
- 7.21 When assessing whether an appropriate British Standard or national standard of a European Economic Area (EEA) State is acceptable under regulation 31(3)(b), water companies must seek confirmation that:
- (i) the test requirements include an assessment of potential adverse effects on water quality; and

- (ii) the test conditions represent the worst case conditions under which the product will be used; and
- (iii) the test parameters include relevant Drinking Water Directive parameters and parameters derived from the product including odour and flavour, and the ability of the product to support and/or promote the growth of aquatic microorganisms; and
- (iv) a toxicological assessment of the leaching test data was carried out.

**Regulation 31(3)(b)(ii) - Requirements within the meaning of Council Directive 98/34/EC**

7.22 These requirements are the national conditions of use that affect the supplier or manufacturer of the product, as well as the water company e.g. restrictions on the purity of a product. Before these can be imposed as national conditions of use, they must be notified to the European Commission as a new technical requirement, under the provisions of the 98/34/EC Directive. The Directive requires Member States to notify technical regulations to the Commission in draft. They must then observe a standstill period of at least three months before adopting the regulation, in order to allow other Member States and the Commission an opportunity to raise concerns about potential barriers to trade. In this respect, national conditions of use that prescribe only dosing concentrations are not notified as they do not require any action on the part of the manufacturer or supplier.

**Regulation 31(4)(b) - Substances or products unlikely to affect adversely the quality of water supplied**

7.23 Water companies should assume that, in the absence of appropriate European or national specifications that satisfy the requirements of Regulation 31 (3), the approval of the Secretary of State will continue to be required for products used in contact with water in the following circumstances:

- (i) all chemicals used in the treatment of drinking water or used in association with the operation of water treatment processes;
- (ii) filtration and ion exchange media, membrane filtration and electro dialysis systems;
- (iii) all systems used to generate disinfectants *in-situ*;
- (iv) all construction products used in water treatment processes in contact with water intended for human consumption, including pipelines and water storage installations;
- (v) all *in-situ* applied repair materials;
- (vi) all construction products and coatings of construction products used in water supply pipelines (including raw water pipelines);
- (vii) all construction products and coatings of construction products used in treated and raw water storage installations; and

- (viii) all water retaining vessels and pipework used in the provision of water for emergency purposes.
- 7.24 Guidance on the approval requirements for small surface area products and certain traditional construction products is given in Advice Sheets 7 & 8 available in the [Regulation 31](#) section of the DWI website.
- 7.25 Water companies should note that the provisions of regulation 25 (1)(b) of the 1989 Regulations, whereby water companies could use un-approved products at their own discretion, are not available in the 2000 Regulations.
- 7.26 All information needed in order to make an application for approval by the Secretary of State can be found on the DWI website.

### **Regulation 31(4)(c) - Introduction for the purposes of testing or research**

- 7.27 When giving notice to the Secretary of State under Regulation 31(4)(c) of intention to use a substance or product for the purposes of testing or research, water companies must provide the information set out in the following paragraphs.

#### *Justification for testing or research*

- 7.28 Water companies, manufacturers or suppliers may wish to carry out tests to establish the performance of an unapproved substance or product. The justification should provide details of the product(s) to be tested and a statement explaining why a period of unapproved use is required.

#### *Scale of experimental plant*

- 7.29 The water company must describe the location and specification for the water treatment equipment that will be used. Testing and research should not be carried out at full scale. It may be appropriate to restrict the programme to designated units in a full-scale plant, or to a pilot plant. It should be possible quickly to shut down the experimental plant or to divert the treated water to waste. It follows therefore that the quantity of water produced in the experimental plant should not be critical to the overall demand in the area.

#### *Monitoring programme and reporting*

- 7.30 The water company must provide a detailed monitoring programme with clearly stated objectives covering a finite period. The monitoring programme must incorporate measurements of appropriate sensitivity and frequency that would permit the detection of an adverse effect on water quality arising from the use of the substance or product that is being tested. The monitoring programme must include unambiguous statements of what constitutes an adverse effect and describe the action that should be taken in the event of detection of any adverse effect. A log must be kept of the operation of the experimental plant and a report, describing the tests carried out and any conclusions drawn, must be prepared at the end of the monitoring period.

#### *Management of testing and research*

- 7.31 Water companies must provide full details of the arrangements for management of the programme of testing and research. A senior officer with appropriate experience and qualifications must manage the programme. Designated staff who are competent

to perform their respective tasks must carry out all experimental work. The responsibilities of all staff involved in the programme must be clearly stated.

#### **No contact or trivial or transient contact with water**

- 7.32 Substances and products used in the treatment and distribution of public water supplies which are: (i) not in contact with water; or (ii) used in situations where contact with water is transient or trivial; or (iii) only come into contact with water as a result of an accident or equipment failure, fall outside the scope of regulation 31. Approval by the Secretary of State is not required in these circumstances.
- 7.33 Examples of (i) include: roofing membranes and tanks and pipework used to store and transport water treatment chemicals. Examples of (ii) include pipe jointing lubricants and formwork release agents. Examples of (iii) include pump lubricants or release of substances from damaged probe sensors.
- 7.34 Regulation 31 has been amended to include a provision (Regulation 31 (13) that allow the Secretary of State (in practice DWI) to make a charge related to the administrative costs of processing an application for approval. DWI is currently considering whether to make such charges and developments in this regard will be communicated to those concerned and published on the DWI website.

## **PART VIII – RECORDS AND INFORMATION**

### **Regulation 34 - Maintenance of records**

- 8.1 Regulation 34 details the information that the company must record and make available to the public on request. It is no longer necessary for a company to provide access to the public record at its offices. The public record may be in hard copy or electronic format. The entries for the results of compliance analysis should be reported in the units of the Regulations.

### **Regulation 35 - Provision of information**

- 8.2 Regulation 35 (1) now requires a company to send any person a copy of the Regulation 34 record within 7 days of receipt of a request. This amendment enables a company to provide public record information either by post, email or through their website. Regulation 35 (5) requires the company to notify consumers of their rights under Regulation 35 (1) every year through the billing process.
- 8.3 There is no longer a requirement to provide local authorities with a report on the results of analysis of samples taken from water treatment works, service reservoirs, supply points and water supply zones that relate to the quality of water supplied to premises in the local authority's area. However companies are expected to consult with their respective local authorities with a view to determining what information they wish to receive in the future, over and above that contained in the Inspectorate's annual regional report.

### **Regulation 36 - Publication of information**

- 8.4 Regulation 36 has been revoked with the effect that companies are no longer required to publish an annual report about drinking water quality.

## APPENDIX 1

### REGULATION 16 – ANALYSIS OF SAMPLES

#### A1 Training of analysts

- A1.1 Water companies or their analytical contractor should produce a comprehensive analyst training manual and programme to cover all aspects of analysis.
- A1.2 Once trained, all analysts' performance should be monitored and subject to regular audit. Monitoring and audit procedures, and criteria for satisfactory performance and policy on retraining should be documented.
- A1.3 A training record should be produced for each analyst detailing the training given, with dates and assessment of competence to perform the task, results of any audits, any retraining or further training given and any re-assessment of that competence.
- A1.4 Guidance on the competence requirements of analysts, their supervisors and laboratory technical and quality management required to comply with Regulation 16(2)(d)(i) is given in [Information letter 08/2007](#).

#### A2 Suitability of equipment

- A2.1 In addition to equipment being of the type specified in the analytical procedure, it must comply with each of the following requirements before it can be regarded as suitable for the purpose:
- (i) located and used in appropriate conditions;
  - (ii) maintained according to the manufacturer's recommendations or auditable equivalent procedures;
  - (iii) have a current calibration that is both valid and traceable to national and international standards;
  - (iv) be used in accordance with the manufacturer's operating instructions or auditable equivalent procedures; and
  - (v) demonstrably comply with all system suitability and analytical quality control criteria.
- A2.2 General advice on calibration is given in 'Guidelines for Calibration in Laboratories' which is available on the DWI web site ([www.dwi.gov.uk](http://www.dwi.gov.uk)).
- A2.3 Sub-paragraph (e) of regulation 16(2) requires that all analysis, including field tests, must be subject to a system of analytical quality control (AQC) sufficient to demonstrate that the requirements of regulation 16(5) have been complied with for each analysis. For microbiological parameters either the specified method or an approved alternative must be used in conjunction with the practices and procedures given in 'The Microbiology of Drinking Water (2002)'.
- A2.4 Appropriate systems of AQC for all other parameters will include:
- Performance testing of the analytical system;

- Routine internal AQC; and
- External AQC (proficiency testing), if a suitable scheme is available.

A2.5 Sub-paragraph (e)(ii) of regulation 16(2) requires that a laboratory's system of AQC is subject to independent checking by a person who has been approved by the Secretary of State for that purpose.

### **A3 Initial Performance testing**

A3.1 Each laboratory or field testing organisation is required to have tested the performance of the analytical methods used for each parameter or each determined constituent of a parameter, and to have demonstrated that the system is capable of meeting the requirements set out in paragraph 16(5) and Schedule 4 before that system is used for routine analysis of compliance samples. Performance testing should cover the entire analytical procedure, including any sample preparation and concentration steps. Testing must be carried out in a manner emulating that used routinely, without taking special precautions which would not generally apply to achieve optimum performance.

A3.2 An analytical method is the specific combination of laboratory, analysts, instrumentation and analytical procedure used to analyse the sample, including any sample preparation or pre-treatment steps. Provided all analysts have been trained to the same standard and their competence has been assessed using the same criteria they can be regarded as equivalent for the purposes of initial performance testing of the analytical method.

A3.3 The analytical method should be subjected to testing of its trueness, precision and limit of detection, including spiking recovery and resilience against possible interferences. The minimum acceptable specifications for performance testing are given below. The design of tests and calculation of performance characteristics should be in accordance or consistent with the guidance given in 'A Manual of Analytical Quality Control for the Water Industry'(NS30).

A3.4 A laboratory using an analytical method which is not referenced to a fully validated authoritative method will be expected to demonstrate that the method has been fully documented and tested to the standard currently expected of an authoritative reference method. It should demonstrate that the following have been established:

- (i) the required tolerances of all measurements undertaken within the method (volumes, temperatures, masses etc);
- (ii) the forms of the determinand measured, including speciation;
- (iii) the effect of interferences has been widely investigated and quantified; and
- (iv) significant sources of error have been identified and adequate means of controlling them documented.

A3.5 Further guidance is given in section 4 of NS30. In the past some reference methods may have been validated to a lower standard than is now required by bodies such as the Standing Committee of Analysts. The data available plus the body of experience of use of these methods should be assessed when deciding whether the methods are suitable.

A3.6 For most parameters the minimum specification for the performance characteristics to be determined is as follows.

Estimate the within-laboratory total standard deviation of individual analytical results for blanks, standard solutions, samples and spiked samples on at least 5 separate days (further advice on number of batches and period of testing is given below). The number of replicate determinations of each solution in each batch should be the same and not less than two. The trueness for standard solutions, mean spiking recovery and standard deviation of spiking recovery should also be determined.

- A3.7 The range of the standard solutions tested should include the regulatory prescribed concentration or value wherever possible, but in all cases the whole calibrated range of the method must be covered subject to allowance for ensuring that all measurements fall within the calibrated range. This implies that a minimum of two different standard solutions must be included in the performance tests. All standard solutions should be prepared immediately prior to analysis for each batch, either from the pure substance or a stock solution which is known to be stable for the period of the tests.
- A3.8 All estimates of standard deviation used to estimate limit of detection or precision, or used in significance tests must have at least 10 degrees of freedom.
- A3.9 The sample, or if necessary samples, and spiked sample(s) selected for use should represent the type or types of drinking water normally analysed. The same bulk sample(s) should be used throughout the tests. Samples should be spiked immediately before analysis for each batch. The spiking standard should either be known to be stable for the period of the tests or be prepared as for standard solutions.
- A3.10 Where there is a choice of key instruments, including electrodes and chromatographic columns, each combination used should be regarded as a separate analytical method. In such cases the following guidance is given.
- A3.11 For identical instruments full validation is required of each method except where the results of limited testing of the instruments under the conditions used in the analytical method have demonstrated that there is no statistically significant (at the 95% confidence level) difference in performance between the instruments, in which case only one method requires full validation. The tests should be performed on a minimum of five separate days and include the analysis of typical real samples and spiked samples. If the internal AQC record subsequently shows a significant difference in performance between methods each system should then be fully validated. Alternatively, independent data may be available to demonstrate the equivalence of items such as chromatographic columns.
- A3.12 For instruments which are not identical full validation is required for each analytical method.
- A3.13 Laboratories should note that 5 batches of duplicate analyses does not give 10 degrees of freedom. While many combinations of number and size of batch may give 10 degrees of freedom or more, a minimum of 11 batches is required to guarantee that number of degrees of freedom, irrespective of the number of replicates included in the batch. Laboratories are therefore strongly recommended to adopt 11 batches of duplicates as their minimum specification. The formula for calculating degrees of freedom is given on page 57 of NS30.
- A3.14 For methods where the discrimination of the method is insufficient to record values other than zero for most blank determinations the within-batch standard deviation of either the low standard or the within-batch standard deviation of the sample may be used to calculate the limit of detection. Alternatively, a very low standard solution, at a

concentration approximately two to three times the expected limit of detection when using the best currently available method, may be used as a surrogate blank. Similarly a natural sample spiked at a similar low level may, if necessary, be used as a surrogate natural sample. Some methods, particularly those involving simple titrations or the use of comparators, may be incapable of measuring any within-batch differences. In such cases the limit of detection should be quoted as the lowest measurable concentration or value.

- A3.15 The bulk sample may not always be stable over the entire period of testing, resulting in an artificially high estimate of between-batch standard deviation. This instability may be recognised by a distinct trend in results for the sample over the period of testing and a between-batch standard deviation which, statistically, is significantly greater (at the 95% confidence level) than would be expected from the estimates obtained for the standard solutions. In such cases a surrogate between-batch standard deviation should be calculated using procedure (a) on page 53 of NS30. Where the instability is so great that the estimate of within-batch standard deviation is significantly affected it may be possible to improve stability by ageing of the sample. Where ageing is either impractical or ineffective in reducing sample instability sufficiently to avoid a statistically significant effect on the estimate of within-batch standard deviation, procedure (b) on pages 53 and 54 of NS30 should be used.
- A3.16 The period of testing should be continuous and not unduly long. Not more than 2 batches may be analysed on any one day. When 2 batches are analysed on the same day all instruments used should be shut down to overnight conditions, daily reagents freshly prepared and all test solutions freshly prepared between the first and second batches.
- A3.17 For physical parameters for which values are not truly additive spiking recovery tests may yield little useful information and need not be done. It is not possible to either analyse a blank or do spiking recovery tests for hydrogen ion. For these parameters the calibrated range (or ranges) must include the full range of values encountered and the PCV (the full PCV range for hydrogen ion), as samples cannot be diluted.
- A3.18 In the following paragraphs re-evaluation means the investigation of the analytical system and its performance to determine whether the most recent validation or revalidation of the analytical system remains appropriate. Re-evaluation may include, as necessary, assessment of the cumulative effect of minor changes to the analytical method, review of internal and external AQC and corrective action followed by limited testing to demonstrate that correct performance has been re-established.
- A3.19 In the following paragraphs revalidation means the redetermination of the performance characteristics of the analytical system as described above.
- A3.20 The performance characteristics of an analytical method should be revalidated whenever a significant change has occurred such as a change in:
- (i) the analytical procedure used;
  - (ii) the key equipment used;
  - (iii) the laboratory environment; or
  - (iv) change of staff carrying out the procedure. This does not include routine changes which normally occur within the laboratory which are supported by appropriate training and properly trained supervisors.

- A3.21 The significance of any change should be assessed by a competent analyst, and any decision that a change is not significant supported by the results of limited but adequate testing.
- A3.22 When a change of premises occurs it is not always possible to revalidate all analytical methods before they are used. In such cases it is essential that methods which on transfer also undergo a change of one of the types (i), (ii) and (iv) above are revalidated before they are used, as should those which are known to be susceptible to changes in laboratory environment e.g. ammonium and trihalomethanes. Other analytical methods should normally be revalidated within three months of relocation.
- A3.23 Analytical methods should also be re-evaluated and if necessary revalidated whenever the results of routine AQC (internal or external) indicate that a statistically significant deterioration in performance has occurred which cannot be corrected, or that there is a significant discontinuity in the routine AQC record, whether due to a failure to perform routine AQC or disuse of the analytical method. Laboratories may also wish to re-evaluate the performance characteristics whenever routine AQC indicates that a statistically significant improvement in performance has occurred. Statistical significance should normally be assessed at the 95% confidence level.
- A3.24 Analytical methods which are used infrequently should not require full revalidation when they are used provided a greater degree of internal AQC is employed than that recommended for routinely used systems. A suitable procedure is given in recommendation (iv) of the Harmonised Guidelines for Internal Quality Control in Analytical Chemistry Laboratories ISO/IUPAC/AOAC, Pure and Applied Chemistry, vol 67, No 4, pp 649-666, 1995 (The AQC Guidelines).
- A3.25 When an analytical method has been in continuous use for several years, typically between three and five years, without revalidation, the system should be re-evaluated, and the need for revalidation of the performance characteristics considered.

#### **A4 Routine Internal AQC**

- A4.1 As a minimum, the laboratory should use a control solution that contains a known concentration at or close to the PCV for each parameter or determined constituent of a parameter for each analytical method, except as provided for below. The term "close to the PCV" should be interpreted as meaning the PCV  $\pm$  25%. The PCV for a determined constituent of a parameter is the PCV for the parameter. The frequency of use of control solutions will vary according to the particular analytical technique used but normally between five and twenty percent of all samples analysed should be control solutions, subject to a minimum of one per batch of analyses for batches of less than 20 samples. All control solutions should be subject to the full analytical procedure that is used for analysing samples and analysed with each batch of analyses.
- A4.2 For permanent laboratory tests a "batch of analyses" should be regarded as a group of measurements or observations of standards, samples and/or control solutions which have been performed together in respect of all procedures, either simultaneously or sequentially, by the same analysts using the same reagents, equipment and calibration.
- A4.3 For field tests a "batch of analyses" should be regarded as a group of measurements or observations of standards, samples and/or control solutions which have been performed on the same day by the same analysts using the same reagents, equipment and calibration.

- A4.4 In the following cases the guidance on selection of control solutions given above is not appropriate:
- (i) the PCV represents a concentration or value outside the normal analytical range of a particular method;
  - (ii) there is no PCV;
  - (iii) the PCV is descriptive;
  - (iv) the PCV is a minimum; or
  - (v) the PCV is a range.
- A4.5 In these cases, as a minimum, a control solution with a known concentration or value within both the calibrated range of the method and the range of interest should be used.
- A4.6 When a wide range of concentrations or values is calibrated which includes the PCV but the overwhelming majority of drinking water samples have concentrations or values which are within a narrow band of the calibration range for which control at the PCV is inappropriate, as a minimum two control solutions should be used, one with a known concentration or value at or close to the PCV and the other with a known concentration or value within the range of interest.
- A4.7 As a minimum, all the results obtained from all control solutions should be used to plot, for each solution or calculated quality control characteristic, a Shewhart chart which is used to decide whether a method is in statistical control. When other types of chart are used, including those using statistics calculated from individual values, the laboratory or other organisation should demonstrate that its arrangements effect adequate statistical control over the systematic error, and both the within-batch and between-batch components of random error, though not necessarily as separate items.
- A4.8 Further guidance on the construction and use of control charts is given in NS30, the AQC Guidelines and "Guidance On The Interpretation Of Aspects Of Analytical Quality Control (AQC)" which is available from the Drinking Water Inspectorate.
- A4.9 The laboratory or other organisation should have properly documented policy and procedures for routine AQC that stipulate what action or actions should be followed when an out of control condition is shown to exist, include a definition of an out of control condition and detail the records to be made when such a condition exists. These documents should be consistent with the guidance given in the documents referenced above. The results of analyses obtained using a method not in statistical control should not be released except in exceptional circumstances, when each result so released should carry an appropriate commentary in all records and reports. The circumstances in which such results can be released should be fully documented and state that the cause of the out of control condition should first be identified and shown not to affect the results of analysis of samples intended for release.
- A4.10 The procedures should also include regular and frequent examination and review of all charts and include guidance for checking and investigating significant trends or changes in either random or systematic error, and for correct operation of the chart. The minimum examination and review periods for each chart should depend on the frequency with which datum points are produced but should not be less frequent than monthly for examination and annually for review. The examination and review should be carried out by a suitably qualified and competent person who is not directly involved in

the analysis, such as the laboratory quality manager. There should be appropriate rules for assessing revised control limits.

#### **A5 External AQC**

- A5.1 The laboratory should participate in an appropriate external AQC scheme for each parameter or determined constituent of a parameter for which an appropriate scheme is available. The laboratory should also have a properly documented procedure for investigating and recording all failures notified by the organiser of a scheme.
- A5.2 Guidance on the suitability of a scheme is given in "The International Harmonised Protocol for the Proficiency Testing of (Chemical) Analytical Laboratories" M Thompson, R Wood, Journal of AOAC International, Vol 76, No 4, 1993.
- A5.3 In line with the recommendations of this document laboratories are recommended to participate in schemes distributing drinking water samples of appropriate matrix and which conform to the relevant parts of the protocol. Samples should contain or be spiked with concentrations of interest (approximate range PCV/10 to twice the PCV) and with appropriate speciation where this is of interest. When, in respect of any parameter, a laboratory participates only in schemes which do not meet all the recommended criteria it will be expected to demonstrate that it is participating in the most appropriate scheme currently available.

#### **A6 Regulation 16(3)**

- A6.1 This regulation includes any organisation or person carrying out regulatory analysis in the definition of a laboratory. This includes all analyses carried out as field tests. Advice on the use of on line monitors is included above at paragraphs 5.13 – 5.19.

#### **A7 Regulation 16(4) Retention of records**

- A7.1 This regulation requires a water company to make and retain all records necessary to establish that all the requirements of regulation 16 have been complied with in respect of each analysis carried out.
- A7.2 The records required include:
- (i) instrument installation, commissioning, maintenance and repair records, including any instrument log or diary;
  - (ii) basic calibration records (including proof of traceability), system suitability checks and any other record necessary to demonstrate the suitability of any equipment used at the time of the analysis;
  - (iii) the analytical procedure used;
  - (iv) method performance testing data, including raw data and a full record of any re-evaluation of the method;
  - (v) routine internal and external AQC data, including charts, investigations of out of control conditions and corrective action; and
  - (vi) raw data for the whole analytical run.

- A7.3 Items (i) and (ii) above should be retained for not less than three years after the equipment has been decommissioned and disposed of. Calibration records should be retained for not less than three years after either disposal of the equipment or disposal of the calibration item, whichever is the longer.
- A7.4 Items (iii) and (iv) above should be retained for not less than three years after the last analysis to which they relate.
- A7.5 Items (v) and (vi) above should be retained for not less than three years.

## **A8 Regulation 16(5)**

- A8.1 This regulation sets the required standard for quality of analysis or, in the case of microbiological parameters, the method to be used.

### **Microbiological parameters**

- A8.2 Sub-paragraph (a) requires that the methods specified in column (2) of Table A1 in Schedule 4 must be used, unless an alternative has been approved. See regulations 16(7) to 16(11) below.

### **Hydrogen ion**

- A8.3 All pH measurements must have a trueness of 0.2 pH units and a precision of 0.2 pH units. Suitability of any analytical method used must be established before it is used to analyse samples. See *Initial performance testing* above. On commencement of use, the analytical method must then be continuously subject to routine internal and external AQC. See *Routine Internal AQC* and *External AQC* above.

### **Odour and Taste**

- A8.4 A method with a precision of 1 dilution number at 25°C must be used.
- A8.5 Methods A2 and B2 respectively in the publication *The Determination of Taste and Odour in Potable Waters 1994* in the series *Methods for the Examination of Waters and Associated Materials* (HMSO) should be used, omitting the intermediate screening steps in A2.8.2 and B.2.9.2. Performance characteristics cannot be determined for these parameters, nor is there currently available a suitable scheme of external AQC. One sample, which is expected to have a dilution number greater than zero, should be analysed in duplicate with each batch of samples put through the full procedure. The difference between the two results should be plotted on a control chart and used to provide information on precision of analysis of samples. All out of control conditions should be investigated and appropriate action taken. Further advice on the use of difference control charts is given in section 5.3.3 (pages 59 to 70) of NS30.

### **Parameters with no PCV or a descriptive PCV only**

- A8.6 The parameters residual disinfectant (free and/or total chlorine) and total organic carbon have no numerical value for the PCV and therefore do not appear in Table 2 in Schedule 4. The general guidance given below for all other parameters is appropriate, but satisfactory target values for limit of detection, precision and trueness need to be set by the laboratory. This should be done on the basis of fitness for purpose. Unless the water company is able to demonstrate that less stringent targets are appropriate the target values given below will be regarded as describing fitness for purpose for these parameters.

**(i) Residual Disinfectant:**

Trueness	The greater of 10% of the result or 0.05 mg Cl/l
Precision	The greater of 10% of the result or 0.05 mg Cl/l
Limit of Detection	0.05 mg Cl/l or the minimum concentration specified as either a target value or an action level at any of the water company's treatments works or in its distribution system, whichever is the lower concentration.

Guidance on calibration and AQC for chlorine measurement is given in [Information letter 03/2005](#) .

**(ii) Total organic carbon (TOC)**

Trueness	The greater of 10% of the result or 0.25 mg C/l
Precision	The greater of 10% of the result or 0.25 mg C/l
Limit of Detection	0.5 mg C/l

**All other parameters**

- A8.7 The performance requirements are given in Table A2 in Schedule 4 in terms of the maximum permitted deviation of the method for trueness and precision and the maximum value for the limit of detection. These terms are defined in regulation 16(6). For the purposes of these regulations, the precision quoted is numerically equal to twice the total within laboratory standard deviation of individual results.
- A8.8 Methods that measure the parameter as defined and are capable of achieving the stated performance should be selected. Due regard must be given to the effect of interferences. In general, the methods published by the Standing Committee of Analysts in the series 'Methods for the Examination of Waters and Associated Materials' will be capable of the required performance, but laboratories should ascertain this before using any particular method.
- A8.9 A laboratory using an analytical method which is not referenced to a fully validated authoritative method will be expected to demonstrate that the method has been fully documented and tested to the standard currently expected of an authoritative reference method. It should demonstrate that the following have been established:
- (i) the required tolerances of all measurements undertaken within the method (volumes, temperatures, masses etc);
  - (ii) the forms of the determinand measured, including speciation;
  - (iii) the effect of interferences has been widely investigated and quantified; and
  - (iv) significant sources of error have been identified and adequate means of controlling them documented.
- A8.10 Further guidance is given in section 4 (pages 31 to 48) of NS30. In the past some reference methods may have been validated to a lower standard than is now required by bodies such as the Standing Committee of Analysts. The data available plus the

body of experience of use of these methods should be assessed when deciding whether these methods are suitable.

A8.11 Table A2 in Schedule 4 only specifies precision and trueness at the PCV. At other concentrations or values the requirement is either the percentage figure given in Table A2 or one half of the value or concentration represented by that percentage figure at the PCV, whichever is the larger.

A8.12 For example, for aluminium the trueness and precision requirements are 10% at the PCV (200 µg/l). This equates to an absolute value of 20 µg/l at the PCV. The target for concentrations less than 100 µg/l (one half of the PCV) is one half of this, 10 µg/l (standard deviation 5 µg/l). For all concentrations above 100 µg/l the target is 10% of the result (standard deviation 5%). At one half of the PCV the target is the same whichever way it is calculated. A worked example for bromate is given below.

<b>Worked example for the bromate parameter</b>
<b>Limit of Detection</b>
Target 25% of PCV i.e. for bromate 2.5 ug/l
Calculated as 5 x within batch SD for blank <u>or</u> 3 x within batch SD of a natural sample
<b>Precision</b>
Target the greater of 25% of <u>mean result</u> or 25% of 0.5 x PCV i.e. for bromate 25% of mean or 1.25ug/l
This applies to all solutions
<b>Trueness</b>
<b>(i) Standards</b>
Greater of 25% of true value or absolute target of 25% of 0.5 x PCV i.e. for bromate 25% of prepared value or 1.25 ug/l
<b>(ii) Natural samples</b>
Not applicable
<b>(iii) Spiked natural samples</b>
Mean recovery of spike the greater of 25% of added spike or 25% of 0.5 x PCV i.e. for bromate 25% of added spike or 1.25 ug/l

A8.13 The suitability of any analytical system used must be established before it is used to analyse samples. See *Initial performance testing* above. On commencement of use, the analytical system must then be continuously subject to routine internal and external AQC. See *Routine Internal AQC* and *External AQC* above.

Guidance on the suitability of methods for the preparation of samples for analysis of metals, sample and sample extract preservation and storage requirements is given in [Information letter 12/2005](#).

A8.14 Performance of a method is satisfactory if either all the relevant criteria are met for all solutions or any difference between the target and the estimate is not significant at the 95% confidence interval.

## **A9 Regulation 16(6)**

A9.1 This regulation defines the terms ‘limit of detection’, ‘precision’ and ‘trueness’.

A9.2 Either of the methods of estimating the ‘limit of detection’ given may be used. The estimate of standard deviation used must be calculated from the initial performance testing data using ANOVA. An F-test may be used to determine whether a failure to achieve the target limit of detection is statistically significant.

A9.3 ‘Precision’ is twice the total within laboratory standard deviation. It must be calculated from the initial performance testing data using ANOVA. An F-test may be used to determine whether a failure to achieve the target precision is statistically significant.

A9.4 ‘Trueness’ must be determined using the calculated value of a standard solution or added spike as the true value, and the mean value calculated from the initial performance testing data using ANOVA. A t-test may be used to determine whether a failure to achieve the target trueness is statistically significant, provided precision is satisfactory.

## **A10 Use of Reporting Limits instead of the limit of detection**

A10.1 Analytical reporting limits (RLs) are values or concentrations, other than limits of detection (LODs), that are used by laboratories, and sometimes Water Companies, as a cut off below which all results for a particular test are reported as being less than that value or concentration. They should not be used for parameters that are defined as the sum of the detected concentrations of the constituent compounds, e.g. total pesticides, trihalomethanes, polycyclic aromatic hydrocarbons.

A10.2 RLs are sometimes used instead of the determined LODs because the LOD has a value or concentration that is not compatible with the laboratory’s or company’s policy on reporting results because it has more significant figures than are reported. This practice is only acceptable if the RL adopted is the LOD rounded up to the last reporting figure, and the RL is only applied to the final calculated result (including any conversion to regulatory units). Examples of acceptable and unacceptable RLs are given below.

### **Examples of inappropriate use of reporting limits**

LOD	Maximum permissible LOD	RL <sup>1,2</sup>	Reason given for adopting RL
0.31	2.5	2.5	Equals maximum permissible LOD and will not need revising if LOD changes
0.65	1	2	Set as a common RL for all determinands in the analysis suite

<sup>1</sup> Using these RLs on the public record instead of the actual result of analysis would contravene the reporting requirements.

<sup>2</sup> Applying these RLs to intermediate results (e.g. to nitrite and total oxidised nitrogen results before calculating the nitrate result) would contravene the requirements of regulation 16. The calculation is part of the analytical method.

### Examples of appropriate use of reporting limits

LOD	Number of decimal places reported for results close to the LOD <sup>3,4</sup>	Appropriate RL
0.141	3	0.141
0.141	2	0.15
0.141	1	0.2

<sup>3</sup> The number of decimal places reported should always be related to method performance.

<sup>4</sup> The examples of number of decimal places reported are given for demonstration of appropriate reporting limits only and do not reflect any view on the appropriate number of significant figures to report.

## A11 Regulations 16(7) to 16(11)

A11.1 Where a method of analysis is specified in Table A1 in Schedule 4, the prescribed method, laboratories must use the specified method unless an alternative method has been authorised (approved), in which case the authorised alternative may be used subject to any conditions given in the authorisation. An alternative method may not be used until written authorisation has been given to the appropriate water company.

A11.2 A laboratory wishing to use an alternative method that has not been approved must first make application, through the relevant water company, for authorisation of the method. Such application must be made in writing to the Drinking Water Inspectorate and must include a full description of the method to be used along with results of tests demonstrating both the reliability of the method and its equivalence to the prescribed method.

A11.3 More detail of the information and testing requirements and criteria are given in 'The Microbiology of Drinking Water 2002. An expert group of microbiologists from member states is to be established to provide advice to the Commission on technical issues such as performance testing of alternative microbiological methods.

A11.4 An alternative method will only be authorised if it is adequately documented and the results of tests demonstrate to the Drinking Water Inspectorate's satisfaction that results obtained using the method are at least as reliable as those produced by the use of the prescribed method.

A11.5 The Drinking Water Inspectorate may make any authorisation subject to such conditions as it considers appropriate, e.g. limitation of the types of sample matrix it may be used to analyse or specify extra quality control requirements. Authorisation

may be general or granted to a specific water company. It may also be revoked at any time, by notice in writing to any water company to which authorisation has been given. At least three months notice will be given of any revocation.

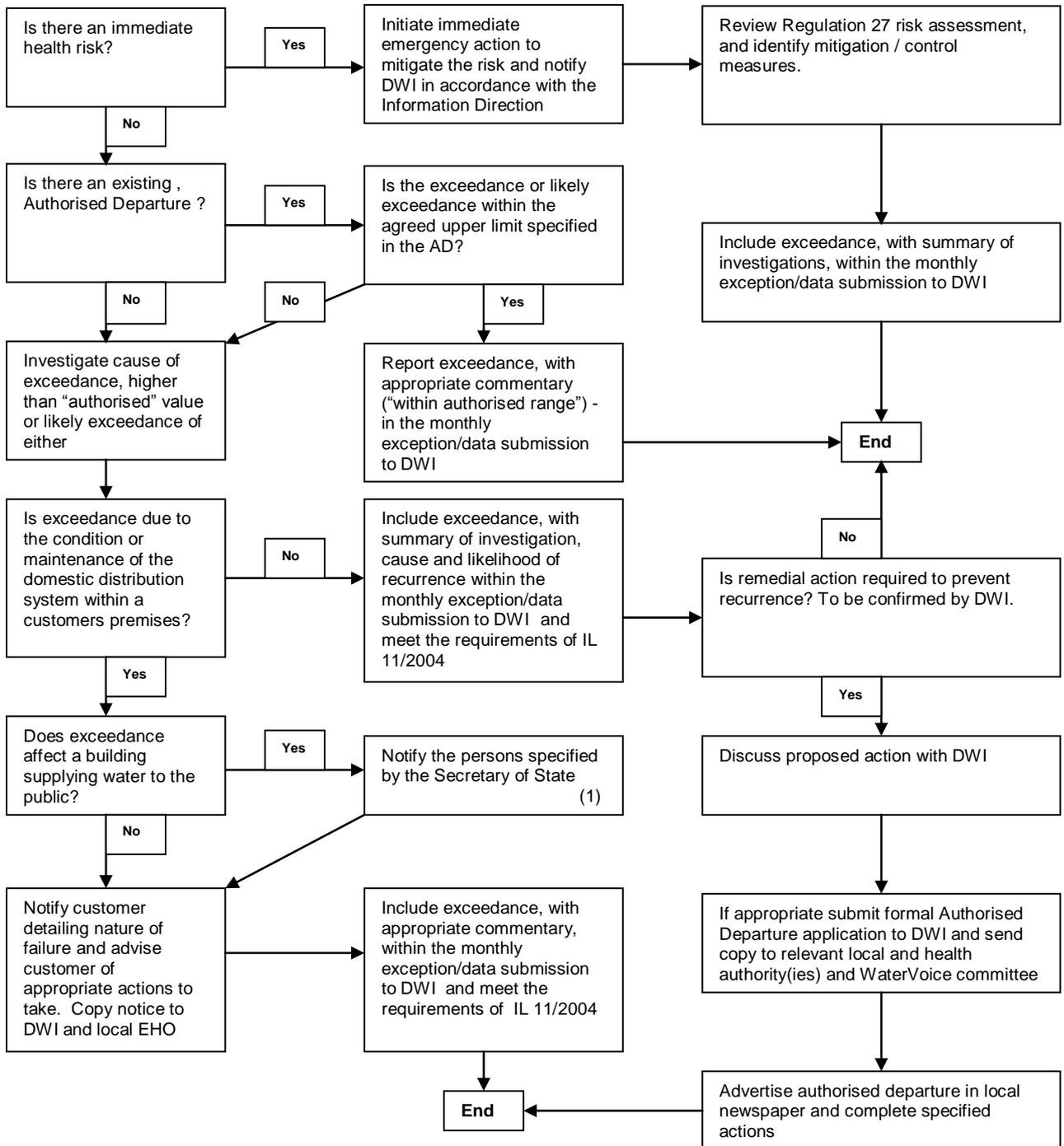
## **A12 Additional Information**

A12.1 In addition to the guidance given above and in the documents referenced in the Annex and the Introduction to the Guidance, advice on different aspects of AQC is given in a number of other documents, many of which are referenced within the reference documents. Further sources of relevant information are:

- 'Guidelines for Calibration in Laboratories', which is available on the DWI website ([www.dwi.gov.uk](http://www.dwi.gov.uk)).
- 'A Manual of Analytical Quality Control for the Water Industry'(NS30).
- Harmonised Guidelines for Internal Quality Control in Analytical Chemistry Laboratories ISO/IUPAC/AOAC, Pure and Applied Chemistry, vol 67, No 4, pp 649-666, 1995 (The AQC Guidelines).
- "Guidance On The Interpretation Of Aspects Of Analytical Quality Control (AQC)"
- "The International Harmonised Protocol for the Proficiency Testing of (Chemical) Analytical Laboratories" M Thompson, R Wood, Journal of AOAC International, Vol 76, No 4, 1993.
- "The Determination of Taste and Odour in Potable Waters 1994" in the series Methods for the Examination of Waters and Associated Materials (HMSO)
- "Quality Control Charts in Routine Analysis", Gardner M J, Water Research Centre, November 1996, WRc Ref: CO 4239
- BSi Draft for Development "Water Quality – Guide to analytical quality control for water analysis" BSi Ref: DD ENV ISO 13530:1999 (CEN Ref: ENV ISO 13530:1998 E. ISO Ref: ISO/TR 13530:1997(E)).
- "Quality Control Charts in Routine Analysis", Gardner M J, Water Research Centre, November 1996, WRc Ref: CO 4239.
- "The Microbiology of Drinking water 2002" and relevant updates in the series Methods Of Examination of Waters and Associated Materials. (<http://www.environment-agency.gov.uk/nls>)

## APPENDIX 2

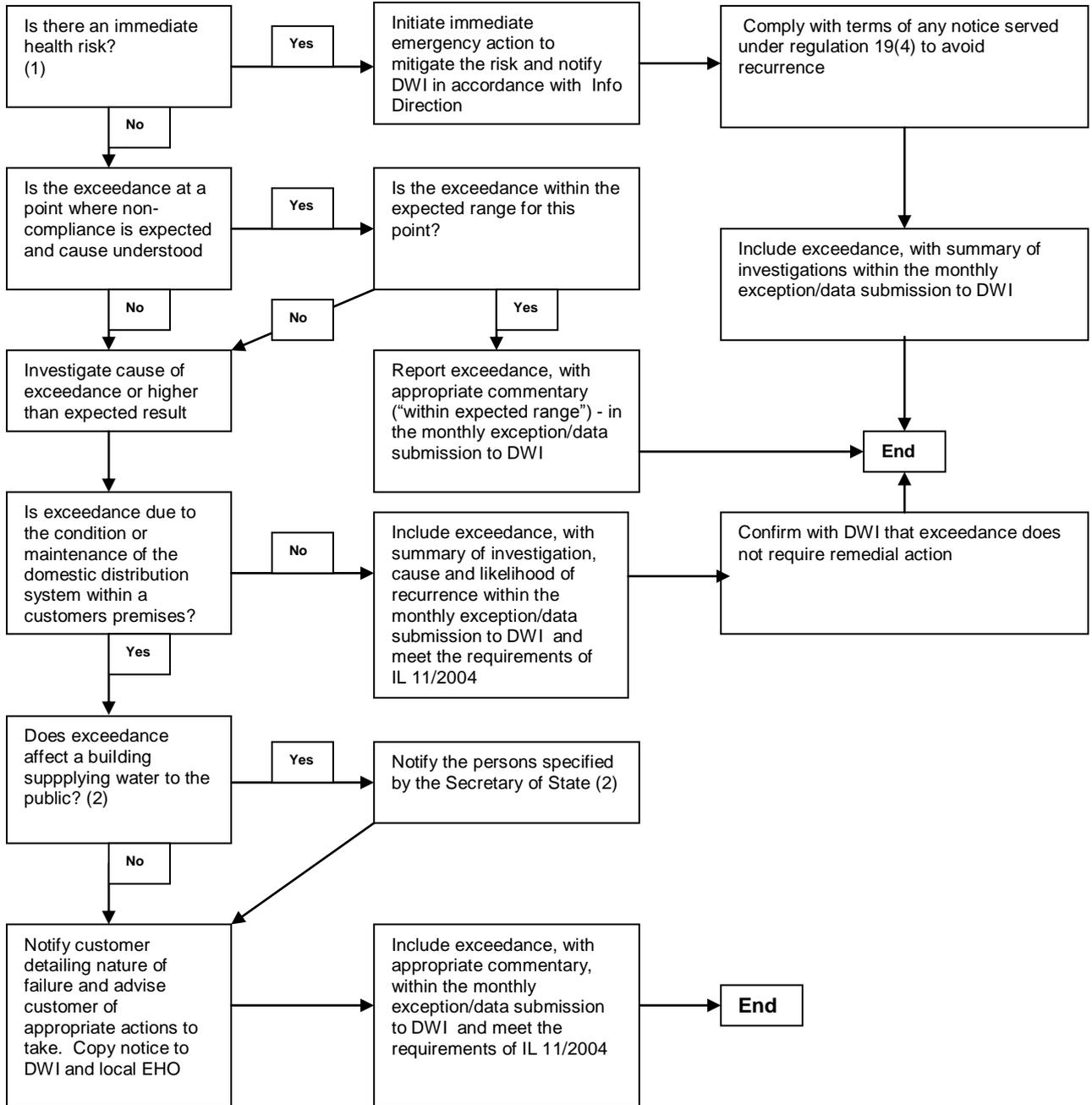
### PROCEDURE TO BE FOLLOWED IF MANDATORY PARAMETER FAILS OR IS LIKELY TO FAIL A PRESCRIBED CONCENTRATION OR VALUE



Note 1 See Information letter 10/2004.

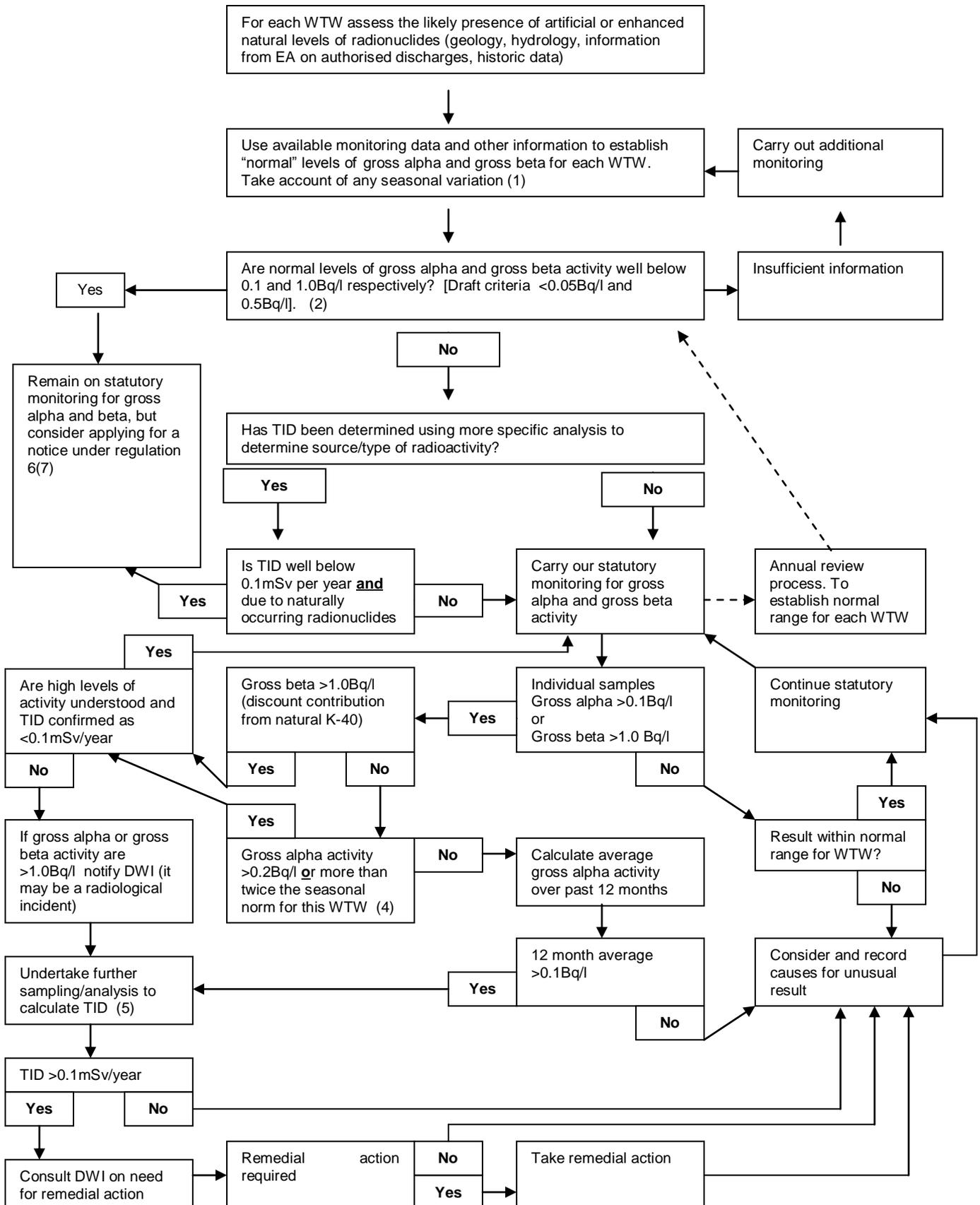
**APPENDIX 3**

**PROCEDURE TO BE FOLLOWED IF AN INDICATOR PARAMETER DOES NOT MEET A SPECIFICATION**



Note 1 An immediate health risk for an indicator parameter is very unlikely but possible (e.g. very high levels of radioactivity)  
 Note 2 see Information letter 10/2004

**APPENDIX 4  
FLOW CHART FOR MONITORING OF GROSS ALPHA AND GROSS BETA ACTIVITY  
AND TOTAL INDICATIVE DOSE**



## APPENDIX 4

### FLOW CHART FOR MONITORING OF GROSS ALPHA AND GROSS BETA ACTIVITY AND TOTAL INDICATIVE DOSE

#### Footnotes for the flowchart

- (1) Seasonal increases in river flow may dilute any inputs of artificial radionuclides or those associated with water reuse (e.g. potassium-40) but flood conditions may encourage an increase in soil run-off and increase the input of some naturally occurring radionuclides.
- (2) Excluding tritium, potassium-40, radon and radon decay products
- (3) Radioactivity is now a feature of the drinking water regulations. Therefore it is prudent for water companies to carry out an operational monitoring programme to demonstrate that there have been no significant changes over time.
- (4) The use of 0.2Bq/l is a tentative proposal in recognition of the fact that the World Health Organisation is likely to increase its screening value for gross alpha activity (possibly to 0.5Bq/l). Using 0.2Bq/l will minimise the need for more detailed analysis on those supplies that show seasonal variations that take occasional samples just above 0.1Bq/l.
- (5) Further analysis should not necessarily involve comprehensive analysis for all radionuclides. In the first instance the presence of naturally occurring radionuclides such as uranium-238 or radium-226 should be considered. If these substances account for the vast majority of the recorded activity (i.e. the unaccounted for activity is <0.05Bq/l or 0.5Bq/l respectively) then the Total Indicative Dose calculation should be based on these substances alone. It should be noted that ICP-MS methods can be used to give an initial and rapid indication of what substances might be contributing to the elevated levels of radioactivity.

## Appendix 4A - advice from the European Commission

- 1 Monitoring of drinking water for Total Indicative Dose (TID) shall be necessary where a source of artificial or enhanced natural radioactivity is present within the catchment and it cannot be shown on the basis of other surveillance programmes or investigations that the level of TID is well below its parametric indicator value of 0.1 mSv/year. Where monitoring for artificial radionuclide levels is required, it shall be carried out at the audit frequency.
- 2 Where monitoring for natural radionuclide levels is required, DWI will define an appropriate frequency considering all relevant available information provided by the water companies on temporal variations of natural radionuclide levels in different types of waters. Depending on the expected variations, monitoring frequency may vary from a single check-up measurement up to the frequency of audit monitoring. Where only a single check-up for natural radioactivity is required, a re-check shall be required at least where any change occurs in relation to the supply likely to influence the concentrations of radionuclides in the drinking water.
- 3 Where methods for removing radionuclides from drinking water have been introduced to ensure that a parametric indicator value is not exceeded, monitoring shall be carried out at the audit frequency.
- 4 Water companies should use screening methods for gross alpha activity and gross beta activity to monitor for the parametric indicator value for TID. If the gross alpha and the gross beta are less than 0.1 Bq/l and 1.0 Bq/l respectively, the water company may assume that the TID is less than the parametric indicator value of 0.1 mSv/year and no further radiological investigation is needed. If the gross alpha activity exceeds 0.1 Bq/l or the gross beta activity exceeds 1.0 Bq/l, analysis for specific radionuclides shall be required. The radionuclides to be measured shall be defined by taking into account all relevant information about likely sources of radioactivity. Where necessary, tritium, gross alpha activity and gross beta activity may be measured in the same sample.
- 5 Instead of the gross alpha and gross beta activity screening discussed above, water companies may use screening methods for specific radionuclides to indicate reliably the presence of radioactivity in drinking water. If one of the activity concentrations exceeds 20% of its reference concentration (see Table 1 below) or the tritium concentration exceeds its parametric value of 100 Bq/l, analysis of additional radionuclides shall be required. The radionuclides to be measured shall take into account all relevant information about likely sources of radioactivity.

### Calculation of the Total Indicative Dose (TID)

- 6 The TID is the committed effective dose for one year of intake resulting from all the radionuclides whose presence in a water supply has been detected, both of natural and artificial origin but excluding tritium, potassium-40, radon and radon decay products. The TID is calculated from the radionuclide concentrations and the dose coefficients for adults laid down in Annex III, Table A of European Directive 96/29/Euratom (laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation). Where the following formula is satisfied, water companies may assume that the TID is less than the parametric indicator value of 0.1 mSv/year and no further investigation is required:

$$\sum_{i=1}^n \frac{C_i(\text{obs})}{C_i(\text{ref})} \leq 1$$

where  $C_i(obs)$  = observed concentration of radionuclide  $i$   
 $C_i(ref)$  = reference activity concentration of radionuclide  $i$  (Table 1)  
 $n$  = number of radionuclides detected.

- 7 Where the formula is not satisfied, the parametric indicator value will only be exceeded if the radionuclides are persistently present at similar activity concentrations for a full year. DWI will define the degree of resampling necessary to ensure that the measured values are representative for an average activity concentration for a full year. Where representative sampling shows that the parametric indicator value is exceeded DWI will advise what action is necessary to achieve compliance.

**TABLE 1**  
**Reference concentrations for radioactivity in drinking water<sup>1</sup>**

Origin	Nuclide	Reference concentration
Natural	U-238 <sup>2</sup>	3.0 Bq/l
	U-234 <sup>2</sup>	2.8 Bq/l
	Ra-226	0.5 Bq/l
	Ra-228	0.2 Bq/l
Artificial	C-14	240 Bq/l
	Sr-90	4.9 Bq/l
	Pu-239/Pu-240	0.6 Bq/l
	Am-241	0.7 Bq/l
	Co-60	40 Bq/l
	Cs-134	7.2 Bq/l
	Cs-137	11 Bq/l
	I-131	6.2 Bq/l

<sup>1</sup>This table includes the most common natural and artificial radionuclides. Reference concentrations for other radionuclides can be calculated using the dose coefficients for adults laid down in Annex III, Table A of Directive 96/29/Euratom, or more recent information recognised by the competent authorities in the Member State, and by assuming an intake of 730 litres per year.

<sup>2</sup> One milligram (mg) of natural uranium contains 12.3 Bq of U-238 and 13 Bq of U-234. Table 1 allows only for the radiological properties of uranium, not for its chemical toxicity.

## APPENDIX 5 – Lead pipe replacement: summary of pilot trials

Strategic lead pipe replacement is defined as a replacement of all lead pipes in a zone or part of a zone (a hot spot of say older properties). Generally there is only a significant public health benefit in mounting such an exercise when both the company and the owners of premises replace their lead pipes (supply and internal plumbing) at the same time in respect of all properties in the hot spot. This is because on average about 75 – 80% of the lengths of lead pipe supplying a property are owned by the premises owner and therefore there is little benefit, on average, in replacing just the company's section of the lead communication pipe. Pilot trials in a number of company areas have led to the following conclusions;

- i. generally there is no significant reduction in lead concentrations by just replacing the company's lead communication pipe
  - ii. generally there is a significant reduction in lead concentration when the premises owners' lead pipes are replaced at the same time as the company's lead communication pipe
  - iii. when property owners are offered free replacement of their lead supply pipes there is a high take up in rural areas but a low take up in urban areas
  - iv. generally in urban areas there is very little interest from property owners or occupiers in replacing their lead supply pipes or internal lead plumbing at their own expense when the water company notifies its intention to replace its lead communication pipe.
- In view of the above conclusions it is strongly recommended that the company consults locally, particularly with the local authority and any housing associations and the owners of private premises about whether to mount a strategic lead pipe replacement exercise. The company should decide with the local authority if there is sufficient benefit in public health terms to warrant a strategic lead pipe replacement in exercise in a zone or a hot spot. The circumstances when such an exercise may be warranted are as follows: replacement of all the company's communication pipes (but not the owners pipes) when the average length exceeds the average length of the owners lead supply pipe and internal lead pipes.
  - replacement of all the company's lead communication pipes when a significant number of property owners are willing to replace their own lead supply pipes and their internal lead plumbing.
  - replacement of all the company's lead communication pipes when a significant number of property owners are willing to replace their own lead supply pipes (but not their internal lead plumbing). This may be justified because the length of lead pipe from the wall to the kitchen tap may be relatively short and in many cases internal lead pipes may have been replaced when kitchens have been refurbished.
  - in all cases there must be a joint decision by the company and the local authority about what is a significant number in relation to local circumstances.

## APPENDIX 6

<b>SUMMARY OF MONITORING REQUIREMENTS</b>											
Parameter	Unit	PCV (Specification for indicator parameters)	Point of monitoring	Check (high) monitoring	Audit (low) monitoring	Annual sampling frequency Water supply zones			Annual sampling frequency Water treatment works or supply points		
						Population	Reduced frequency range	Standard frequency range	Volume m <sup>3</sup> /d	Reduced frequency range	Standard frequency range
<b>Table A Microbiological parameters – Directive requirements</b>											
Enterococci	No/100 ml	0	T	X	Yes	Pop B <100	X	1-8 4	X	X	X
Escherichia coli	No/100 ml	0	T	Yes	X	>100	X	12 per each 5000	X	X	X
						<b>Table A Microbiological parameters – National requirements</b>					
Coliform bacteria	No/100 ml	0	T + SR + WTW	Yes	X	<100	X	4	Vol C	12-104 <sup>(1)</sup>	4-365
						>100	X	12 per each 5000			
<b>Escherichia coli</b>	No/100 ml	0	SR + WTW	Yes	X	X	X	X	Vol C	12 - 104 <sup>(1)</sup>	4 - 365
Residual disinfectant	mg/l	X	T + SR + WTW + SP	X	Yes	<100	X	4	Vol C	12 - 104 <sup>(1)</sup>	4 - 365
						>100	X	12 per each 5000			

Table B Chemical parameters – Directive requirements											
Parameter	Unit	PCV (Specification for indicator parameters)	Point of monitoring	Check (high) monitoring	Audit (low) monitoring	Annual sampling frequency Water supply zones			Annual sampling frequency Water treatment works or supply points		
						Population	Reduced frequency range	Standard frequency range	Volume m <sup>3</sup> /d	Reduced frequency range	Standard frequency range
Acrylamide	µg/l	0.1	PS	X	X	X	X	X	X	X	X
Antimony	µg Sb/l	5	T (or SP) <sup>(2)</sup>	X	Yes	Pop B	X	1-8	Vol E <sup>(2)</sup>	X	1-48
Arsenic	µg As/l	10	T (or SP) <sup>(2)</sup>	X	Yes	Pop B	X	1-8	Vol E <sup>(2)</sup>	X	1-48
Benzene	µg /l	1	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Benzo (a) pyrene	µg /l	0.01	T	X	Yes	Pop B	X	1-8	X	X	X
Boron	mgB/l	1	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Bromate <sup>(3)(4)</sup>	µg BrO <sub>3</sub> /l	10	T or SP	X	Yes <sup>(3)</sup>	Pop B <sup>(3)</sup>	X	1-8	Vol E <sup>(2)(4)</sup>	X	1-48
Cadmium	µg Cd/l	5	T (or SP) <sup>(2)</sup>	X	Yes	Pop B	X	1-8	Vol E <sup>(2)</sup>	X	1-48
Chromium	µg Cr/l	50	T	X	Yes	Pop B	X	1-8	X	X	X
Copper	mg Cu/l	2	T	X	Yes	Pop B	X	1-8	X	X	X
Cyanide	µg CN/l	50	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
1,2 Dichloroethane	µg/l	3	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Epichlorohydrin	µg/l	0.1	PS	X	X	X	X	X	X	X	X
Fluoride	mg F/l	1.5	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Lead <sup>(5)</sup>	µg Pb/l	25	T	X	Yes	Pop B	X	1-8	X	X	X
Lead <sup>(6)</sup>	µg Pb/l	10	T	X	Yes	Pop B	X	1-8	X	X	X
Mercury	µg Hg/l	1	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Nickel	µg Ni/l	20	T	X	Yes	Pop B	X	1-8	X	X	X

Parameter	Unit	PCV (Specification for indicator parameters)	Point of monitoring	Check (high) monitoring	Audit (low) monitoring	Annual sampling frequency Water supply zones			Annual sampling frequency Water treatment works or supply points		
						Population	Reduced frequency range	Standard frequency range	Volume m <sup>3</sup> /d	Reduced frequency range	Standard frequency range
<b>Table B Chemical parameters – Directive requirements (continued)</b>											
Nitrate <sup>(7)</sup>	mg NO <sub>3</sub> /l	50	T (or SP) <sup>(2)</sup>	Yes <sup>(7)</sup>	Yes	Check <sup>(7)</sup> Pop A	1 - 38	2 - 76	X	X	X
						Audit Pop B	X	1 - 8	X	X	X
Nitrite <sup>(8)</sup>	mg NO <sub>2</sub> /l	0.5	T	Yes <sup>(8)</sup>	Yes	Check Pop A	1 - 38	2 - 76	X	X	X
						Audit Pop B	X	1 - 8	X	X	X
Nitrite <sup>(8)</sup>	mg NO <sub>2</sub> /l	0.1	WTW	Yes <sup>(8)</sup>	Yes	X	X	X	Check Vol C <sup>(8)</sup>	12 - 104 <sup>(1)</sup>	4 - 365
									Audit Vol E	X	1 - 48
Aldrin	µg/l	0.03	T or SP	X	Yes	Pop B <sup>(12)</sup>	X	1-8	Vol E <sup>(12)</sup>	X	1 - 48
Dieldrin	µg/l	0.03	T or SP	X	Yes	Pop B <sup>(12)</sup>	X	1-8	Vol E <sup>(12)</sup>	X	1 - 48
Heptachlor	µg/l	0.03	T or SP	X	Yes	Pop B <sup>(12)</sup>	X	1-8	Vol E <sup>(12)</sup>	X	1 - 48
Heptachlor epoxide	µg/l	0.03	T or SP	X	Yes	Pop B <sup>(12)</sup>	X	1-8	Vol E <sup>(12)</sup>	X	1 - 48
Other individual pesticides	µg/l	0.1	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1 - 48
Total pesticides	µg/l	0.5	T or SP	X	Yes	Pop B	X	1-8	Vol E <sup>1</sup>	X	1 - 48
PAH	µg/l	0.1	T	X	Yes	Pop B	X	1-8	X	X	X
Selenium	µg Se/l	10	T (or SP) <sup>(2)</sup>	X	Yes	Pop B	X	1-8	Vol E <sup>(2)</sup>	X	1-48
Tetrachloroethane	} µg/l	} 10	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Trichloroethane											
Trihalomethanes	µg/l	100	T (or SP) <sup>(2)</sup>	x	Yes	Pop B	X	1-8	Vol E <sup>(2)</sup>	X	1-48
Vinyl chloride	µg/l	0.5	PS	X	X	X	X	X	X	X	X

Parameter	Unit	PCV (Specification for indicator parameters)	Point of monitoring	Check (high) monitoring	Audit (low) monitoring	Annual sampling frequency Water supply zones			Annual sampling frequency Water treatment works or supply points		
						Population	Reduced frequency range	Standard frequency range	Volume m <sup>3</sup> /d	Reduced frequency range	Standard frequency range
<b>Table B Chemical parameters – National requirements</b>											
Aluminium <sup>(10)</sup>	µg Al/l	200	T	Yes <sup>(10)</sup>	Yes	Check <sup>(10)</sup> Pop A	1-38	2-76	X	X	X
						Audit Pop B	X	1 - 8	X	X	X
Colour	mg/l Pt/Co	20	T	Yes	X	Pop A	1-38	2-76	X	X	X
Iron <sup>(10)</sup>	µg Fe/l	200	T	Yes <sup>(10)</sup>	Yes	Check <sup>(10)</sup> Pop A	1-38	2-76	X	X	X
						Audit Pop B	X	1 - 8	X	X	X
Manganese <sup>(11)</sup>	µg Mn/l	50	T	Yes <sup>(11)</sup>	Yes	Check <sup>(11)</sup> Pop A	1-38	2-76	X	X	X
						Audit Pop B	X	1 - 8	X	X	X
Odour	Dilution number	3	T	Yes	X	Pop A	1-38	2-76	X	X	X
Sodium	mg Na/l	200	T	X	Yes	Pop B	X	1-8	X	X	X
Taste	Dilution number	3	T	Yes	X	Pop A	1-38	2-76	X	X	X
Tetrachloromethane	µg/l	3	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1 - 48
Turbidity	NTU	4	T	Yes	X	Pop A	1-38	2-76	X	X	X

Parameter	Unit	Specification for indicator parameters	Point of monitoring	Check (high) monitoring	Audit (low) monitoring	Annual sampling frequency Water supply zones			Annual sampling frequency Water treatment works or supply points		
						Population	Reduced frequency range	Standard frequency range	Volume m <sup>3</sup> /d	Reduced frequency range	Standard frequency range
<b>Schedule 2 – Indicator parameters</b>											
Ammonium	mg NH <sub>4</sub> /l	0.5	T	Yes	X	Pop A	1-38	2-76	X	X	X
Chloride	mg Cl/l	250	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
<i>Clostridium perfringens</i> <sup>(9)</sup>	No/100 ml	0	T + WTW <sup>(9)</sup>	Yes <sup>(9)</sup>	Yes	Check Pop A	1-38	2-76	Check Vol D <sup>(9)</sup>	2-1095 <sup>(1)</sup>	2-2190
						Audit Pop B	X	1 - 8	Audit Vol E	X	1 - 48
Colony counts	Number / 1 ml 22°C Number / 1 ml 37°C	NAC	T + SR + WTW	Yes	X	Pop A	1-38	2-76	Vol C	12-104 <sup>(1)</sup>	4-365
Conductivity	µS/cm at 20°C	2500	T or SP	Yes	X	Pop A	1-38	2-76	Vol E	X	1-48
Hydrogen ion	pH value	6.5 – 9.5	T	Yes	X	Pop A	1-38	2-76	X	X	X
Sulphate	µg SO <sub>4</sub> /l	250	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Total indicative dose <sup>(13)</sup>	mSv/year	0.1	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Total organic carbon	mg C/l	NAC	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Tritium <sup>(13)</sup>	Bq/l	100	T or SP	X	Yes	Pop B	X	1-8	Vol E	X	1-48
Turbidity	NTU	1	WTW	X	X	X	X	X	Vol C	12-104 <sup>(1)</sup>	4-365
<b>Others</b>											
Nitrate / nitrite formula	mg/l	NO <sub>3</sub> /50 + NO <sub>2</sub> /3 =<1	T	X	Yes	Calculate from above sample results	X	X	X	X	X
<b>NOTES</b>											
X = Not applicable; NAC = No abnormal change; PS = Product specification; SP = Supply point; SR = Service reservoir; T = Consumers' taps in WSZ; WTW = Water treatment works; WSZ = Water supply zone											
<sup>(1)</sup> Reduced frequency not available if <20m <sup>3</sup> /d water supplied											
<sup>(2)</sup> Supply point monitoring only if authorised by the Secretary of State under regulation 8											
<sup>(3)</sup> Audit monitoring in WSZ is required only where sodium hypochlorite is added after water has left the WTW											
<sup>(4)</sup> Audit monitoring at SP is required only when sodium hypochlorite is not added after water has left the WTW											
<sup>(5)</sup> Prescribed concentration applies from 25 December 2003 until 24 December 2013											
<sup>(6)</sup> Prescribed concentration applies on and after 25 December 2013											
<sup>(7)</sup> Check monitoring in WSZ is required only where chloramination is practised.											
<sup>(8)</sup> Check monitoring is required only when chloramination is practised											
<sup>(9)</sup> Check monitoring is required only in respect of surface waters (see regulation 6(2) and Table 1 in Schedule 3)											
<sup>(10)</sup> Check monitoring is required when used as a flocculant or where the water originates from, or is influenced by, surface water											
<sup>(11)</sup> Check monitoring is required where the water originates from, or is influenced by, surface waters											
<sup>(12)</sup> If required by pesticide monitoring strategy						<sup>(13)</sup> If required by radioactivity monitoring strategy					

<b>SAMPLING FREQUENCIES</b>										
<b>Population A (Check) zones</b>	<b>&lt;100</b>	<b>100 – 4999</b>	<b>5000 - 9999</b>	<b>10,000 – 29,999</b>	<b>30,000 – 49,999</b>	<b>50,000 - 79,999</b>	<b>80,000 – 100,000</b>			
Reduced frequency	1	2	6	12	18	26	38			
Standard frequency	2	4	12	24	36	52	76			
<b>Population B (Audit) zones</b>	<b>&lt;100</b>	<b>100 - 4999</b>	<b>5000 – 100,000</b>							
Reduced frequency	N/A	N/A	N/A							
Standard frequency	1	4	8							
<b>Volume C (Check) WTW (m<sup>3</sup>/day)</b>	<b>&lt;20</b>	<b>20 – 1999</b>	<b>2000 – 5999</b>	<b>6000 – 11,999</b>	<b>&gt;12,000</b>					
Reduced frequency	N/A	12	52	104	104					
Standard frequency	4	52	104	208	365					
<b>Volume D (Check) Supply points (m<sup>3</sup>/day)</b>	<b>&lt;20</b>	<b>20 – 999</b>	<b>1000 – 1999</b>	<b>2000 – 5999</b>	<b>5000 – 9999</b>	<b>10,000 – 15,999</b>	<b>16,000 – 32,999</b>	<b>33,000 – 49,999</b>	<b>50,000 – 67,999</b>	<b>68,000 – 84,999</b>
Reduced frequency	N/A	2	6	12	18	26	52	78	104	130
Standard frequency	2	4	12	24	36	52	104	156	208	260
<b>Volume D (Check) Supply points (m<sup>3</sup>/day) continued</b>	<b>85,000 – 101,999</b>	<b>102,000- 119,999</b>	<b>120,000 – 241,999</b>	<b>242,000 – 484,999</b>	<b>485,000 – 728,999</b>					
Reduced frequency	156	183	365	730	1095					
Standard frequency	312	365	730	1460	2190					
<b>Volume E (Audit) Supply points (m<sup>3</sup>/day)</b>	<b>&lt;20</b>	<b>20 – 999</b>	<b>1000 – 49,999</b>	<b>50,000 – 89,999</b>	<b>90,000 – 299,999</b>	<b>300,000 – 649,999</b>	<b>&gt;650,000</b>			
Reduced frequency	N/A	N/A	N/A	N/A	N/A	N/A	N/A			
Standard frequency	1	4	8	12	24	36	48			
<b>Sampling frequency for all service reservoirs - one sample for each week in which the reservoir is in use</b>										