Implementation of Drinking Water Directive No 98/83/EC in England & Wales with emphasis on water safety requirements

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Principal Inspector
Drinking Water Inspectorate
Presentation Outline

• Structure of the water industry in England & Wales
• European & National Legislation
• The Drinking Water Inspectorate (DWI)
• Other key organisations
• Drinking Water quality compliance
• Water Safety Plan/Risk management
• Private water supplies (small supplies)
• Two parameters not listed in Annex 1
Some key dates in water industry development in England and Wales

• Pre 1974 Water industry largely run by local government (eg city and district councils) also some statutory water companies

• 1974 reorganisation of local government formation of 10 water authorities based on catchment areas eg Thames Water Authority

• 1989 privatisation of regional water authorities become private companies eg Thames Water Authority became Thames Water Utilities Ltd

• Formation of regulatory regime: financial, environmental and drinking water.
Structure of the Water Industry in England and Wales in 2012

- 26 Water companies
  - 10 Water and Sewerage
  - 16 Water Only
- Supplying on average 15,000 ML/day
- To more than 54 million people (99% of the population)
- More than 1,000 water treatment works
- More than 4,500 service reservoirs
- More than 338,000 km of water mains
- And 1,693 water supply zones
The Water Industry in England and Wales

1. Anglian Water Services Limited
2. Bournemouth and West Hampshire Water Plc
3. Bristol Water Plc
4. Cambridge Water company
5. Cholderton and District Water Company Limited
6. Dee Valley Water Plc
7. Dwr Cymru Cyfyngedig
8. Essex and Suffolk Water Plc
9. Folkestone and Dover Water Service Limited
10. Hartlepool Water Plc
11. Mid Kent Water Plc
12. Northumbrian Water Limited
13. Portsmouth Water Plc
14. Severn Trent Water Limited
15. South East Water Plc
16. South Staffordshire Water Plc
17. South West Water Limited
18. Southern Water Limited
19. Sutton and East Surrey Plc
20. Tendring Hundred Water Services Limited
21. Thames Water Utilities Limited
22. Three Valleys Water Plc
23. United Utilities Water PLC
24. Wessex Water Services Limited
25. Yorkshire Water Services Limited

Inset Appointment
26. Albion Water Limited
LEGISLATION

Three levels of legislation:
• EC Directive
  • 80/778 on the quality of water intended for human consumption.
  • 98/83 on the quality of water intended for human consumption (reviewed every five years)

• National Primary Legislation
  • Water Act 1989
  • Water Industry Act 1991
  • Water Act 2003

• National Secondary Legislation
  • Water Supply (Water Quality) Regulations 1989 – EC 80/778
  • Water Supply (Water Quality) Regulations 2000/2001 – EC 98/83
  • Private Water Supplies Regulations 2009
  • Water Supply Regulations 2010
DRINKING WATER DIRECTIVE

• General obligations - Article 4 - MS shall ensure water for human consumption is wholesome and clean which means
  • Free from any micro-organisms and parasites and substance in numbers or concentrations which constitute a potential danger to human health
  • Meet the minimum requirements of the Annex 1

• Annex 1
  • Part A Mandatory microbiological standards
  • Part B Mandatory chemical standards
  • Part C Indicator parameter

• Pesticide standard 0.1 µg/L except for 4 named substances - US standards for 19 substances all above 0.1 most well above 1 µg/L – AU standards for 150 compounds

• Article 5 Quality standards
  • value shall not be less stringent than those set in Annex 1
  • MS shall set values for additional parameters where protection of human health so requires
DRINKING WATER DIRECTIVE

• Article 6 – point of compliance
  – the point at which it emerges from the tap normally used for human consumption
  – MS have fulfilled their obligation where non compliance is due to deterioration within domestic distribution system
  – Requirement to reduce or eliminate risk where non compliance due the domestic distribution system

• Article 7 – Monitoring
  – MS shall ensure regular monitoring of the quality of water supplied
  – The monitoring programmes shall meet the minimum set out in Annex II
  – MS shall ensure where disinfection is practised its efficiency is verified and that contamination from disinfection by-product is kept as low as possible without compromising disinfection
  – MS shall ensure additional monitoring on a case by case basis for substances and micro-organism for which no parametric value has been set.
DRINKING WATER DIRECTIVE

• Article 8 - remedial action
• Article 9 - derogations
• Article 10 - treatment equipment and chemicals
• Article 11 - review of annexes
  • At least every five years the Commission shall review Annex 1 - current position on review

• Annex II defines check and audit monitoring
  • Check monitoring to provide information on the organoleptic and microbiological quality of the water supplied
  • Audit monitoring to provide information on whether or not all the Directive's parametric values are being complied with
PRIMARY LEGISLATION


- Water companies duty to supply wholesome water
- Secretary of State has power to
  - make regulations
  - appoint a Chief Inspector of Drinking Water
- Secretary of State’s duty to enforce when breach of regulations
- Chief Inspector has power to prosecute for supply of water unfit for human consumption (Criminal offence determined by the courts)
SECONDARY LEGISLATION

- **Water Supply (Water Quality) Regulations 1989**
  - Based on 1980 EC Drinking Water Directive

  - Based on 1998 EC Drinking Water Directive

- **Defined wholesomeness by reference to water quality standards**
  - Directive requirements
    » 28 standards (e.g. *E.coli*; lead; Pesticides)
    » Transposed from EC Directive
  - National requirements
    » 11 standards (e.g. Iron, Manganese)
    » Additional standards required by Government
SECONDARY LEGISLATION Cont’d.

• ‘Catch-all’ provision - Regulation 4(2)

  that the water does not contain

• (i) any micro-organism (other than a parameter listed in Schedule 1) or parasite; or

• (ii) any substance (other than a parameter listed in Schedule 1), at a concentration or value which would constitute a potential danger to human health

• Indicator parameters
  – 11 parameters (e.g. conductivity, radioactivity)
  – Require investigation (not un-wholesome)
SECONDARY LEGISLATION Cont’d.

- 2000/2001 Regulations also define requirements for:
  - Monitoring i.e. Sampling points & frequencies
  - Analytical requirements
  - Level of water treatment & disinfection
  - Approval of substances and products
  - Records Provision and publication of information
SECONDARY LEGISLATION Cont’d.

- Regulation  13 sampling at water treatment works

<table>
<thead>
<tr>
<th>Item</th>
<th>Substances and parameters</th>
<th>Volume of water supplied m3/d</th>
<th>Reduced</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>E. coli</td>
<td>&lt;20</td>
<td>-</td>
<td>4</td>
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<tr>
<td>2.</td>
<td>Coliform bacteria</td>
<td>20–1,999</td>
<td>12</td>
<td>52</td>
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<td>3.</td>
<td>Colony counts</td>
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<td>4.</td>
<td>Nitrite&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>6,000–11,999</td>
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<td>5.</td>
<td>Residual disinfectant</td>
<td>≥12,000</td>
<td>104</td>
<td>365</td>
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<tr>
<td>6.</td>
<td>Turbidity</td>
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</tbody>
</table>
SECONDARY LEGISLATION Cont’d.

- Regulation 14 sampling at service reservoirs
  - Weekly sampling for E coli, coliform bacteria, residual disinfectant and colony counts

- Regulations 7 – 9 sampling from water supply zones (consumers taps) or supply points (eg works reservoirs etc) see table B1 annex II

- Regulation 10
  - As soon as the relevant supplier has grounds for believing that any element organism or substance, other than a parameter, may cause a supply to be unwholesome it shall take sufficient samples to establish whether the water is wholesome (Article 7 (6))
<table>
<thead>
<tr>
<th>(1) Substances and parameters subject to monitoring</th>
<th>(2) Estimated population of water supply zone</th>
<th>(3) Reduced</th>
<th>(4) Standard</th>
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<tr>
<td>Subject to check monitoring</td>
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<tr>
<td>E. coli</td>
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<td></td>
<td>≥ 100</td>
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<tr>
<td>Coliform bacteria</td>
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<td>12 per 5,000 population(i)</td>
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<tr>
<td>Residual disinfectant</td>
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<tr>
<td>Aluminium</td>
<td>&lt;100</td>
<td>1</td>
<td>2</td>
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<tr>
<td></td>
<td>100–4,999</td>
<td>2</td>
<td>4</td>
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<tr>
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<tr>
<td>Ammonium</td>
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<td>Clostridium perfringens (including spores)(ii)</td>
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<td>18</td>
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<td>10,000–29,999</td>
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<td>30,000–49,999</td>
<td>38</td>
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<td>Colonies</td>
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<td>Colour</td>
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<td>Conductivity(iii)</td>
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<td>Hydrogen ion</td>
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<td>Manganese</td>
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<tr>
<td>Nitrate(iii)</td>
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<td>Nitrite(iii)</td>
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<td>Odour</td>
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<td>Taste</td>
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<td>Turbidity</td>
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<td>Subject to audit monitoring</td>
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<tr>
<td>Aluminium</td>
<td>&lt;100</td>
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<tr>
<td>Antimony</td>
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<td>Arsenic</td>
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<td>Benzene&lt;sup&gt;(a)&lt;/sup&gt;</td>
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<td>Benzo(a)pyrene</td>
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<td>Boron&lt;sup&gt;(ii)&lt;/sup&gt;</td>
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<tr>
<td>Bromate&lt;sup&gt;(iv)&lt;/sup&gt;</td>
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<td>Cadmium</td>
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<td>Chromium</td>
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<tr>
<td>Clostridium perfringens</td>
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<td>(including spores)</td>
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<tr>
<td>Copper</td>
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<tr>
<td>Cyanide&lt;sup&gt;(ii)&lt;/sup&gt;</td>
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</table>
SECONDARY LEGISLATION Cont’d.

• The Water Supply Regulations 2010:
  – tightened the requirement to investigate and take remedial action where failures are attributed to the domestic distribution system in buildings where water is supplied to the public
  – made explicit the requirement to ensure disinfection is verified and disinfection by-products are kept as low as possible
  – requirement for remedial action in the event of a non-compliance with an indicator parameter that poses a risk to human health
  – Confirm derogations are not permitted for *E.coli* or Enterococci
  – Clarify minimum sampling and analysis frequencies
THE DRINKING WATER INSPECTORATE (DWI)

• Established in January 1990 at time of water industry privatisation
• Now 38 posts - 28 professionally qualified staff. All based in Westminster, London
• Part of the Government’s Water Availability and Quality Group, Department for Environment, Food and Rural Affairs
• Chief Inspector operates autonomously in respect of regulatory activities
• NOT part of the Environment Agency or the Water Services Regulation Authority (Ofwat)
DWI ACTIVITIES

• Water companies carry out monitoring (sampling & analysis), report water quality results to DWI, take remedial action when non-compliance

• DWI audit the water company processes

• Technical audit of Water Companies includes:
  • Audit & site inspection
  • Incident Investigation
  • Investigations of Consumer Complaints
  • Assessment of methods of analysis

• Other DWI activities:
  • Technical advisors to Government on drinking water quality issues & regulations
  • Approval of Products & Processes in contact with drinking water
  • Advisors to Local Authorities on the regulation of private water supplies
  • Programmes of remedial work
  • Co-ordination of Drinking Water Quality and Health Research programme
POWERS AVAILABLE TO THE DWI

- Enforcement action under Section 18 of the Water Industry Act
  - For non-trivial breaches of a quality standard set by the Water Supply (Water Quality) Regulations 2000/2001
  - For a contravention by a water company of any other enforceable regulatory duty set out in the Regulations relating to sampling, analysis, water treatment or information requirements
- If a company fails to provide information to the Inspectorate
- The water company may give an undertaking under Section 19 of the Act to carry out appropriate remedial action within an agreed timescale
Other powers

• A water company can apply to DWI for an authorised departure (a derogation) following a non trivial breach of a Directive standard

• If a departure cannot be granted on health grounds i.e. failure of E.coli or Enterococci standard, DWI can issue a Notice under regulation 28 of the Amendment Regulations 2007

• If a water company does not comply with the terms and conditions of an authorised departure or undertaking, DWI can issue an Enforcement Order under Section 18 of the WIA 1991 which compels the company to take specified steps within a certain timescale.
Other Key Organisations

• Three water industry regulators:
  • Drinking Water Inspectorate (DWI) – Drinking Water Quality
  • Environment Agency – Environmental quality (water, land and air)
  • Office of Water Services (Ofwat) – Finance

• Health Protection Agency (HPA) – protect public health against infectious disease, surveillance and reporting of outbreaks of waterborne disease

• Local Authorities – statutory role particularly regarding private water supplies

• Consumer representative bodies (Consumer Council for Water)

• Industry or water company representative (Water UK)
Current Regulatory Framework in E & W

- **Public Supplies**: 26 water companies
- **Local Authorities**
- **Private Supplies**: 1% of the market
- **Consumers**: 99% of the market
- **Health Authorities**
- **Current Regulatory Bodies**:
  - EA
  - DWI
  - WSRA (OFWAT)
  - CCW
Compliance with the Drinking Water Directive

In 2009, England and Wales 99.95%
Introduction of Water Safety Planning

- >99.95% compliance but still ........
  - Reactive approach based on end point monitoring
  - Too much emphasis on treatment
  - Too many water quality incidents
  - Too many “significant” failures
  - Stakeholders not communicating
  - Consumer confidence undermined
Incidents reported to DWI from 2001 to 2008

- Number classified as incidents in 2008 = 144
WHO Water safety plan approach

• advocated since 3rd edition
• the most effective means of consistently ensuring the safety of a water supply encompassing all steps from catchment to consumer
• WSP comprises a minimum of three elements
  • a system assessment
  • effective operational monitoring
  • management and communication
Amendment to the Regulations

- The **Water Supply (Water Quality) (Amendment) Regulations** came into force at the end of 2007.
- Introduced Water Safety Planning on more formal basis
- Notable changes include:
  - The introduction of two regulations (27 & 28) requiring water companies to carry out risk assessments and report outcome to DWI
  - Failure to disinfect became a criminal offence
  - Monitoring of source water required to inform risk assessments and partial fulfilment of water framework directive (WFD)
- Guidance to the regulations recommended approach to risk assessment and risk management should be based on the WHO’s WSP approach.
- No change to the drinking water quality standards set out in 2000/2001 Regulations
The Water Safety Plan Approach

- Identification of actual & potential hazards [that could be a risk to human health] in catchment, at treatment works, in distribution and at consumers’ taps
- Assessment of short, medium & long term control measures required for each hazard identified
- Establish whether need for investment to mitigate risk either in the area of catchment control, or with treatment at works or in the distribution systems or perhaps combinations of these.
Implementation of WSP - Regulation 27.

- a risk assessment for each of its treatment works and connected supply system to establish whether there is a significant risk of supplying water that would constitute a potential danger to human health.
- keep its risk assessments under review.
- The Secretary of State may require a risk assessment or review to be carried out.
- Where a water undertaker becomes aware of any factors which make it likely that a risk assessment under this regulation would establish that there is a significant risk, it shall inform the Secretary of State specifying the relevant factors.
Implementation of WSP - Regulation 28

• Procedure following risk assessment
• Water company shall submit a report of the assessment
• depending on the circumstances the report shall contain all or some of the following—
  • a description of the methods used to carry out the assessment or review;
  • a statement confirming the risk; and
  • monitoring data which verifies the risks; and
  • details of measures it has taken or intends to take, to mitigate the risk
  • details of every property, organism or substance that has been identified as contributing to the risk; and
Implementation of WSP – Regulation 28

• Where a report identifies a significant risk the Secretary of State may, require the water undertaker or combined licensee—
  • (a) to maintain measures to mitigate the risk;
  • (b) to review, revise or make operational such measures to mitigate the risk;
  • (c) to audit whether the measures have been effective;
  • (d) not to supply water from specified treatment works or supply systems, or not to so supply unless specified conditions are satisfied; and
  • (e) to give him such information as he may require to monitor progress towards mitigation of that risk.
Water Safety Plan Manual
Step-by-step risk management
for drinking-water suppliers
Risk Characterisation

• Many different approaches to risk assessment adopted by water companies but all based on the WHO approach.
• Most are based on the 5x5 matrix of consequence x likelihood.
• At the start of Water Safety Planning in England and Wales, risk assessment was based on expert knowledge as well as data and evidence.
Outputs & Outcomes

• Risk assessment reports received for 807 drinking water supply systems (by 1 October 2008)
• Over 900 short, medium & long term actions identified to mitigate risks to human health identified
• Actions related to catchments, treatment works, distribution systems and domestic/commercial properties [reflects the WSP holistic approach from source to tap]
• Many of the actions being delivered by formal Notices issued by DWI specifying steps to be taken by key milestone dates
• Significant move towards addressing risks at catchment rather than by installing/upgrading treatment
• Potential for (a) reduction in capital costs & (b) more sustainable solutions
Outputs & Outcomes (cont.)

• Improved liaison with other stakeholders such as the Environment Agency, Health Protection teams and Local Authorities
• Greater clarity of ownership and responsibility for risks from catchment to tap
• Incorporation of proactive risk management in all aspects of water company operations
Main water quality issues identified

- Risks identified through WSP approach include:
  - Nitrates and Pesticides
  - Pathogens (*Cryptosporidium*)
  - Lead
  - Contamination of service reservoirs through ingress (Total Coliforms)
  - Taste and odour
  - Raw water deterioration (colour & impact on THM formation)
  - Discolouration in zones (Iron and Manganese)
How do the Amendment Regulations deliver the Drinking Water Directive?

• Article 4 (1)(a) and (b) – wholesome and clean water (a) free from any micro-organism, parameter and substance which could constitute a potential danger to human health and (b) meets minimum standards

• Article 7 (6) – additional monitoring on case by case basis for substances for which no parametric value has been set if present in amounts or numbers which could be a potential danger to human health

• Article 8 (3) – regardless of whether a failure of a parametric value has occurred, remedial action (including prohibition or restriction of use of water used for human consumption) should be taken to protect human health.
Private Water Supplies

• 1% of the population on private supplies (not ‘mains’ supply) – mostly ‘small water supplies > 5000 pop

• Private Water Supplies Regulations 2009 introduced risk based approach similar to public supplies regulation

• Local authorities responsible for carrying out risk assessment, monitoring & taking enforcement action to improve supplies

• DWI provides technical advice & support to Local Authorities.
Private Water Supplies cont.

• 316 Local Authorities are responsible for carrying out the risk assessment of PWS
• Approx 62,000 PWS in total in England and Wales
• 39,294 are single dwellings and are not subject to risk assessment or monitoring requirements
• 22,503 PWS will require risk assessment by 2014
Private Water Supplies findings - 2011

- About 13% of necessary risk assessments carried out
- Approx 10% samples tested failed to meet standards for microbiological parameters
- Failures of some 26 mandatory parameters in 2011 including
  - Arsenic 3%
  - Benzopyrene 5%
  - Boron 8%
  - Copper 5%
  - Fluoride 4%
  - Lead 3%
  - Nitrate 12%
- Some detailed case studies are described
Potential danger to human health - two examples

• NDMA

• PFOS
EATING just one sausage or three rashers of bacon a day can increase the risk of developing bowel cancer by a fifth, it is being claimed.

As little as 50g – less than 2oz – of processed meat contains enough cancer-causing substances called N-nitrosocompounds to put regular diners in extra danger, said Prof Martin Wiseman.

As little as 50g – less than 2oz – of processed meat contains enough cancer-causing substances called N-nitrosocompounds to put regular diners in extra danger, said Prof Martin Wiseman.

Prof Wiseman, medical and scientific adviser at the charity World Cancer Research Fund, added: ‘We are more sure now than ever before that eating processed meat increases your risk of bowel cancer and this is why we recommend that people avoid eating it.

‘Whether you are talking about bacon, ham or pastrami, the safest amount to eat is none at all. You can make a positive difference by cutting out as much as possible.’

Processed meat is smoked, cured, salted or has preservatives added. As well as hot dogs, salami and some
NDMA findings

• 41 water treatment works sampled
• Generally no detectable concentrations found (<1ng/L)
• Detectable concentration found in the final water at 3 works
• All concentrations in final water less than 10 ng/L
• All 3 works used the same ferric coagulant
Measurements of NDMA in diluted coagulant

![Graph showing measurements of NDMA concentration (ng/l) against dilution factor. The x-axis represents the dilution factor, ranging from 0 to 0.0012. The y-axis represents the NDMA concentration, ranging from 0 to 80 ng/l. The graph includes several data points indicating NDMA concentrations at different dilution factors.](Image)
Follow up actions

- Took health advice (ALARP)
- Informed manufacturer - who was able to reduce levels in coagulant
- Informed industry through an Information letter
- Issued guidance to industry on trigger levels
## Example of guidance

<table>
<thead>
<tr>
<th>Item</th>
<th>Regulatory requirement</th>
<th>Trigger</th>
<th>Minimum action to be taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>Regulation 27 (Risk assessment)</td>
<td>potential hazard</td>
<td>• Ensure considered as part of statutory risk assessment</td>
</tr>
<tr>
<td>Tier 2</td>
<td>Regulation 10 (Sampling: further provisions)</td>
<td>&gt; 1ng/l</td>
<td>• Pro-actively inform local health professionals;</td>
</tr>
<tr>
<td></td>
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<td>• continue to monitor concentrations in drinking water</td>
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<td>• identify causes or sources of NDMA in drinking water</td>
</tr>
<tr>
<td>Tier 3</td>
<td>Regulation 4(2) (Wholesomeness)</td>
<td>&gt; 10ng/l</td>
<td>As tier 2 plus:</td>
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<tr>
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<td>• Pro-actively consult with local health professionals;</td>
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<td></td>
<td>• put in place measures to reduce concentrations to below 10ng/l as soon as practicable</td>
</tr>
<tr>
<td>Tier 4</td>
<td>Water Undertakers Information Direction 2004 (Notification of events)</td>
<td>&gt;200ng/l</td>
<td>As tier 3 plus:</td>
</tr>
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<td></td>
<td></td>
<td>• initiate consultation with local health professionals as soon as possible;</td>
</tr>
<tr>
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<td>• take action to reduce exposure from drinking water within days.</td>
</tr>
</tbody>
</table>
Further research

• to investigate whether water treatment coagulants are a widespread source of NDMA
• most coagulants NDMA was either not detected or detected only at trace concentrations
• six ferric sulphate coagulants higher concentrations of NDMA (levels up to 19 µg NDMA per litre of product)
• Part way through the study, very high levels of NDMA (over 200 µg/L) were detected in one coagulant but steps were taken to reduce levels and the coagulant in question is no longer on the market
• advised the water industry to obtain more data on the nitrosamine concentrations in the ferric sulphate that they use
• will consider imposing a national condition of use on ferric sulphate coagulants
PERFLUOROOCTANE SULPHONATE (PFOS), PERFLUOROOCTANOIC ACID (PFOA)

- toxic, persistent and bioaccumulative in the environment
- Used in a number of different types of products, including as a fabric protector and as surfactants in fire fighting foams
- in 2006 European Union announced plans to practically ban the use of PFOS in finished and semi-finished products
**DWI action on PFOS/ PFOA**

- **Issued advice to water companies**
  - Tiered response similar to NDMA
  - Trigger level based on toxicological advice from HPA
  - Highlight the importance of water companies carrying out local risk assessments of their catchments

- **commissioned a survey of sources/supplies**
  - Neither PFOS nor PFOA appear to be a widespread background contaminant of raw and treated drinking water in England
  - PFOA was detected more often than PFOS
  - In respect of PFOS, where low levels were detected they were below the trigger values and only at sites already identified as high risk.
  - In respect of PFOA, only a single sample exceeded the Tier 2 level (0.3µg/l) and this concentration was not observed in subsequent samples from the same site.
MORE INFORMATION:

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