

# Implementation of Drinking Water Directive No 98/83/EC in England & Wales focusing on monitoring of drinking water quality including emerging issues

Pete Marsden

Principal Inspector

Drinking Water Inspectorate



guardians of drinking water quality  
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
- Emerging issues



# Structure of the Water Industry in England and Wales in 2011

- 26 Water companies
  - 10 Water and Sewerage
  - 16 Water Only
- Supplying on average 15,000 MI/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

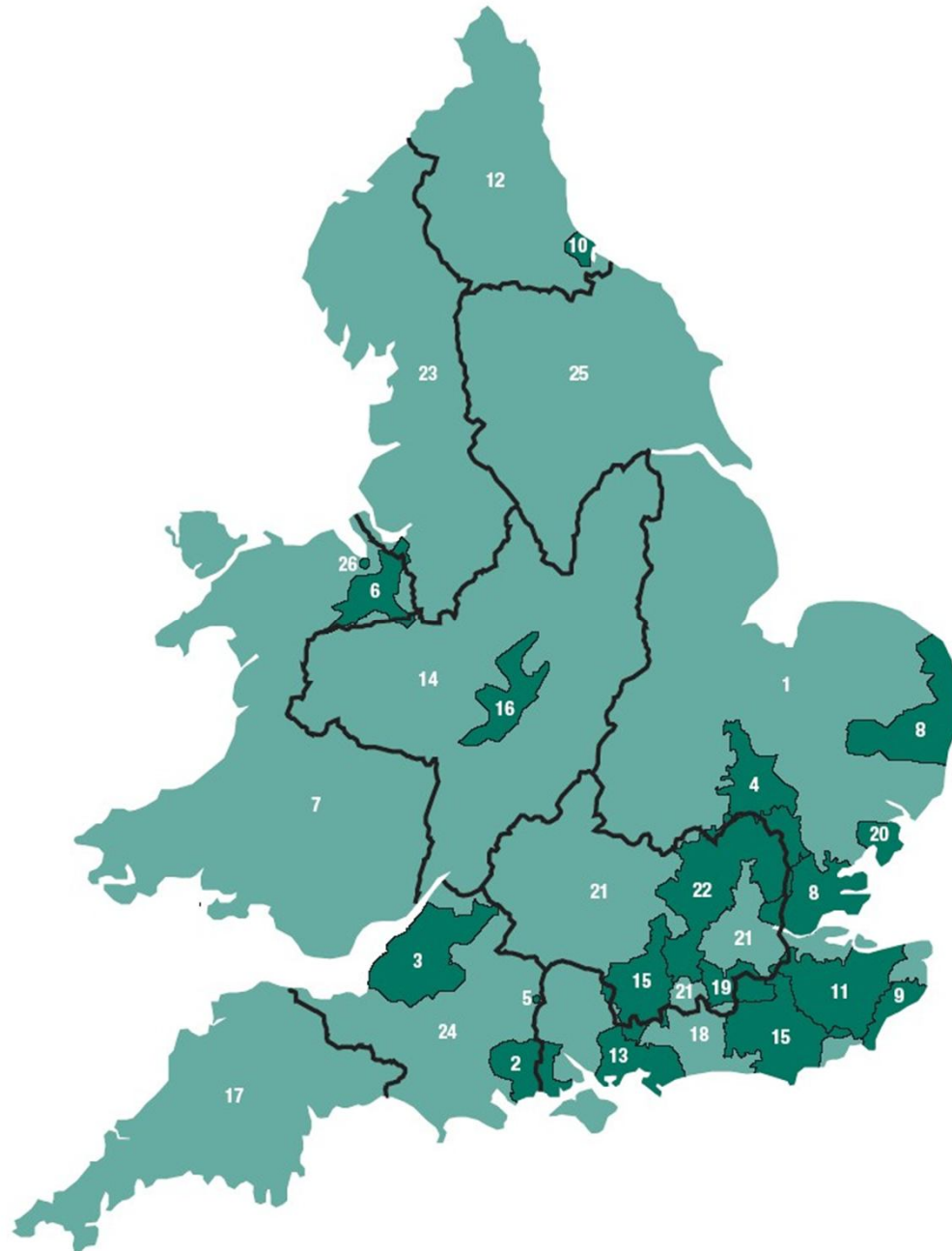


# The Water Industry in England and Wales

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
  - Water Supply (Water Quality) Regulations 2000 (2001 in Wales)(Amendment) Regulations 2007
  - 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  $\mu\text{g/L}$  except for 4 named substances - US standards for 19 substances all above 0.1 most well above 1  $\mu\text{g/L}$  – 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 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.
- 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 Act 1989, Water Industry Act 1991, Water Act 2003 set out:**

- 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
- **Water Supply (Water Quality) Regulations 2000 (2001 in Wales)**
  - 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.

- Indicator parameters
  - 11 parameters (e.g. conductivity, radioactivity)
  - Require investigation (not un-wholesome)
- '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



## 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

(1) <i>Item</i>	(2) <i>Substances and parameters</i>	(3) <i>Volume of water supplied m<sup>3</sup>/d</i>	(4) <i>Reduced</i>	(5) <i>Standard</i>
1.	<i>E. coli</i>	<20	-	4
2.	Coliform bacteria	20–1,999	12	52
3.	Colony counts	2,000–5,999	52	104
4.	Nitrite <sup>(i)</sup>	6,000–11,999	104	208
5.	Residual disinfectant	≥12,000	104	365
6.	Turbidity			

## 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))



(1) <i>Substances and parameters subject to monitoring</i>	(2) <i>Estimated population of water supply zone</i>	(3) <i>Reduced</i>	(4) <i>Standard</i>
<i>Subject to check monitoring</i>			
<i>E. coli</i>	< 100		4
Coliform bacteria	≥ 100		12 per 5,000 population <sup>(i)</sup>
Residual disinfectant			
Aluminium	<100	1	2
Ammonium	100–4,999	2	4
	5,000–9,999	6	12
<i>Clostridium perfringens</i> (including spores) <sup>(ii)</sup>	10,000–29,999	12	24
	30,000–49,999	18	36
Colony counts	50,000–79,999	26	52
Colour	80,000–100,000	38	76
Conductivity <sup>(ii)</sup>			
Hydrogen ion			
Iron			
Manganese			
Nitrate <sup>(iii)</sup>			
Nitrite <sup>(iii)</sup>			
Odour			
Taste			
Turbidity			

<i>Subject to audit monitoring</i>			
Aluminium	<100		1
Antimony	100–4,999		4
Arsenic	5,000–100,000		8
Benzene <sup>(ii)</sup>			
Benzo(a)pyrene			
Boron <sup>(ii)</sup>			
Bromate <sup>(iv)</sup>			
Cadmium			
Chromium			
<i>Clostridium perfringens</i> (including spores)			
Copper			
Cyanide <sup>(ii)</sup>			

## 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.

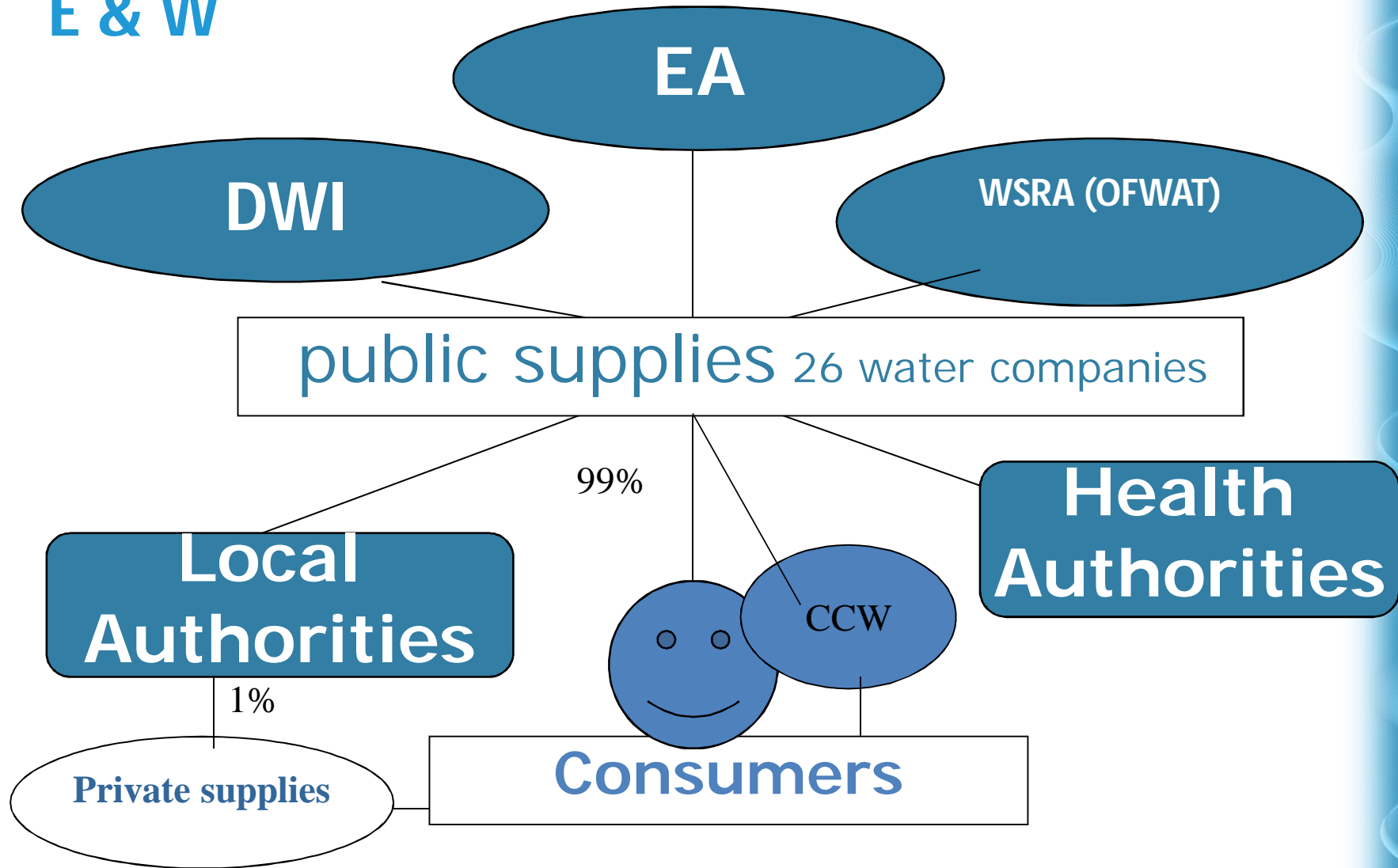


# Other Key Organisations

- 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)

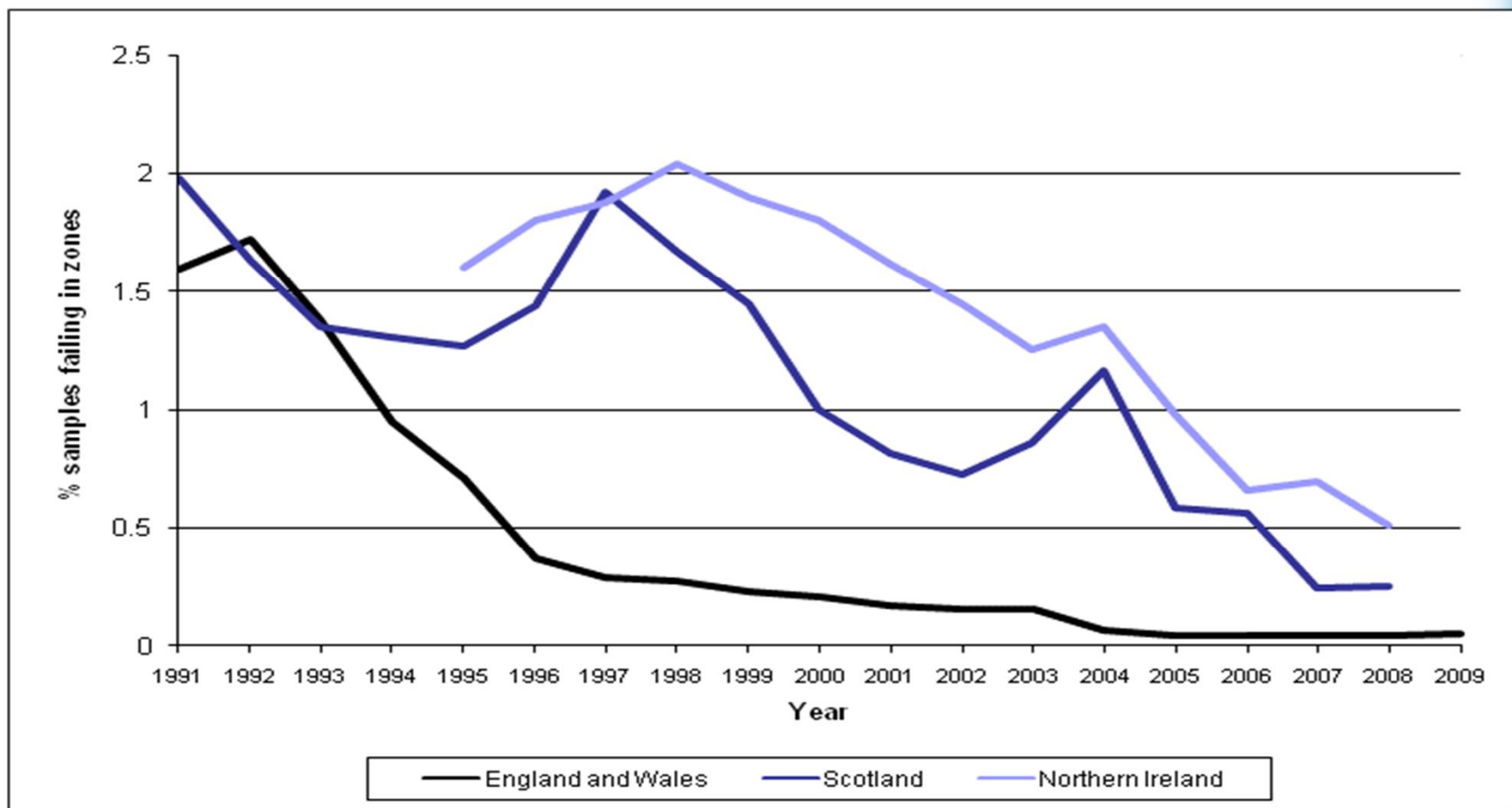


# Current Regulatory Framework in E & W



# Compliance with the Drinking Water Directive

In 2009, England and Wales 99.95%



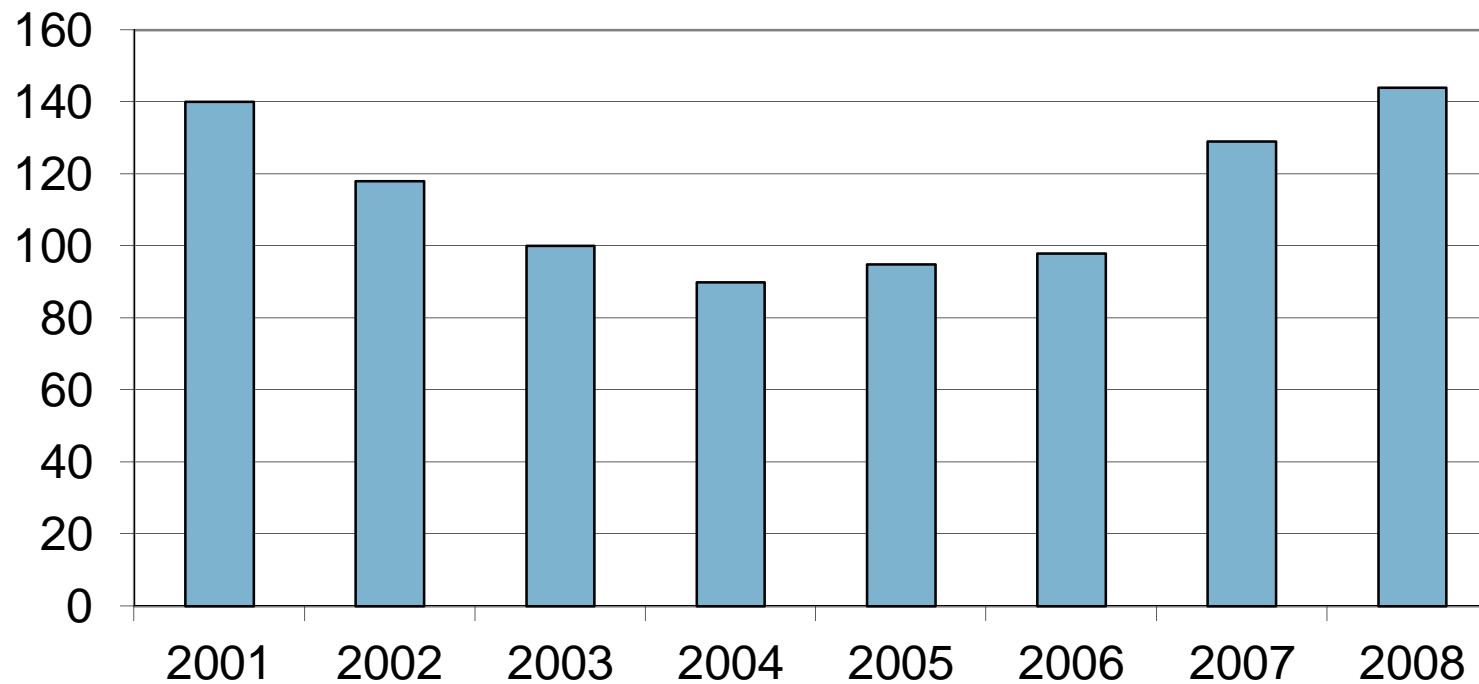
# Introduction of Water Safety Planning

- >99.96% 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**



# 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.



# 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.
- In order for risk characterisation model to be applied effectively and consistently, water companies recognised need for clear definitions and guidance.



# 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?

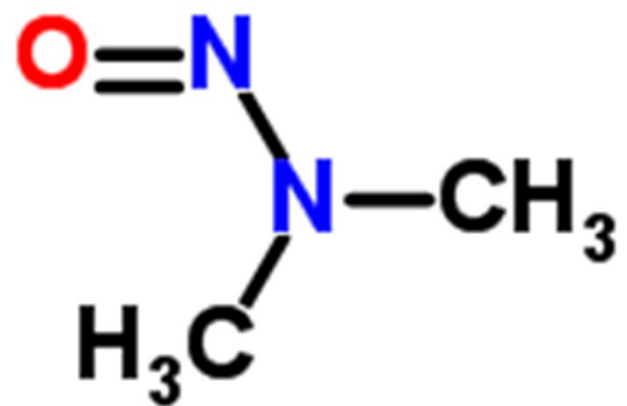
- Article 4 (1)(a) and (b) – wholesome and clean water (a) free from any micro-organism, parameter and substance which could constitute a potential danger to human health and (b) meets minimum standards
- Article 7 (6) – additional monitoring on case by case basis for substances for which no parametric 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.



# Emerging issues

- NDMA
- PFOS
- Pharmaceuticals
- Lead
- Manganese
- Chromium VI





Yeah, I did have a crush on Simon Cowell

Monday, March 31, 2008

www.metro.co.uk

# Eating one sausage a day raises cancer risk 20 per cent

BY SARAH HILLS

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-nitroso compounds 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

sausages, hamburgers and minced meat may also count if they have been preserved with salt or chemical additives, Prof Wiseman warned.

Bowel cancer is the third most common type of the disease in the UK, killing 16,000 people every year.

But there is also some evidence that processed meats may increase the risk of cancers of the oesophagus, lung, stomach and prostate, Prof Wiseman warned.

Sarah Hill, director of health information for Cancer Research UK, backed the findings but added: 'It is also important to remember that many other parts of your diet and wider lifestyle can affect the risk of bowel cancer, along with the genes.'

Ian Campbell, of the National Pig Association, advised shoppers to buy 'good-quality sausages which had not been preserved or processed. He added: 'Eating a balanced diet is the key.'



Jet disaster: A firefighter surveys the smoking wreckage

## Three jet dead

THREE people killed when their light aircraft hit a bus. They were touring car champion David Leslie, 54, from motor-racing executive Richard Lloyd and pilot of ex-Roberts, who owned several planes. Two other people executed jet hit an empty home in Farnborough, Kent. Full story – See Pages 4 and 5



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-nitroso compounds 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.'

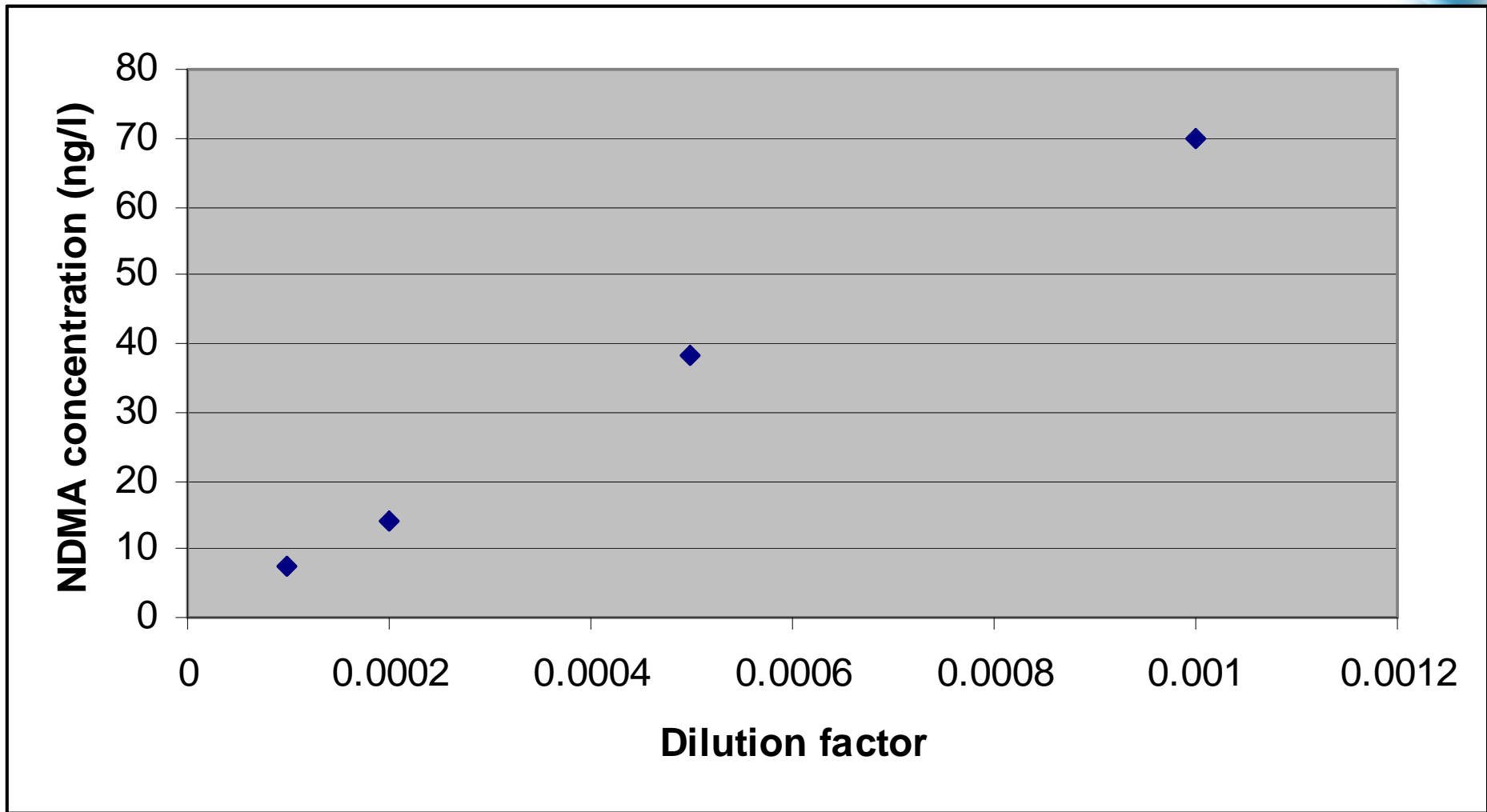
Processed meat is smoked, cured, salted or has preservatives added. As well as hot dogs, salami and some

# 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



## 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

Item	Regulatory requirement	Trigger	Minimum action to be taken
<b>N-nitrosodimethylamine (NDMA)</b>			
Tier 1	Regulation 27 (Risk assessment)	potential hazard	<ul style="list-style-type: none"> <li>• Ensure considered as part of statutory risk assessment</li> </ul>
Tier 2	Regulation 10 (Sampling: further provisions)	> 1ng/l	<ul style="list-style-type: none"> <li>• Pro-actively inform local health professionals;</li> <li>• continue to monitor concentrations in drinking water</li> <li>• identify causes or sources of NDMA in drinking water</li> </ul>
Tier 3	Regulation 4(2) (Wholesomeness)	> 10ng/l	As tier 2 plus: <ul style="list-style-type: none"> <li>• Pro-actively consult with local health professionals;</li> <li>• put in place measures to reduce concentrations to below 10ng/l as soon as is practicable</li> </ul>
Tier 4	Water Undertakers Information Direction 2004 (Notification of events)	>200ng/l	As tier 3 plus: <ul style="list-style-type: none"> <li>• initiate consultation with local health professionals <u>as soon as possible</u>;</li> <li>• take action to reduce exposure from drinking water within days.</li> </ul>

## 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.





# WHO position on pharmaceuticals

- Pharmaceuticals are normally governed by stringent regulatory processes and require rigorous preclinical and clinical studies to assess their efficacy and safety before commercialization. Therefore, pharmaceuticals are generally better characterized than other environmental contaminants.
- Published literature and national studies have shown that concentrations of pharmaceuticals in surface water and groundwater sources impacted by wastewater discharges are typically less than 0.1  $\mu\text{g/l}$  (or 100  $\text{ng/l}$ ), and concentrations in treated drinking-water are usually well below 0.05  $\mu\text{g/l}$  (or 50  $\text{ng/l}$ ).



# WHO position on pharmaceuticals

- Trace quantities of pharmaceuticals in drinking-water are very unlikely to pose risks to human health because of the substantial margin of exposure or margin of safety between the concentrations detected and the concentrations likely to evoke a pharmacological effect.
- Concerns over pharmaceuticals should not divert the attention and valuable resources of water suppliers and regulators from the various bacterial, viral and protozoan waterborne pathogens and other chemical priorities, such as lead and arsenic.



# WHO position on pharmaceuticals

- Routine monitoring of pharmaceuticals in water sources and drinking-water at the national level and the installation of specialized drinking-water treatment infrastructure to reduce the very low concentrations of pharmaceuticals in drinking water are not currently deemed necessary given the limited additional health benefits.
- However, where specific circumstances, such as a catchment survey, indicate a potential for elevated concentrations of pharmaceuticals in the water cycle (surface water, groundwater, wastewater effluent and drinking-water), relevant stakeholders could undertake targeted, well-designed and quality-controlled investigative studies to obtain more information to assess potential health risks arising from exposure through drinking-water.



# Findings of desk study

- Worst-case modelling showed that even in the scenario with the highest estimated concentrations, the margins of exposure (comparison of the minimum therapeutic dose to the estimated intake from drinking water) for most of the major used pharmaceuticals and illegal drugs were significantly greater than 1000 and provided a high safety margin.
- Only 10 substances produced exposure ratios less than 1000 and four of these were illegal drugs. In only one case was the exposure ratio less than 100 and this was the special case, using a combined total for all NSAIDs at the lowest minimum therapeutic dose. It therefore appears that even in this worst case situation **there is no significant risk from pharmaceuticals discharged to drinking water sources.**
- In view of the dearth of measured data on the concentrations of pharmaceuticals and illegal drugs in UK drinking waters it would be prudent to carry out a small scale survey



# Conclusion of the monitoring study

- Concentrations of pharmaceuticals and drugs in drinking waters are generally significantly lower than seen in surface waters indicating that the treatment systems in use in England and Wales are effective at removing these contaminants. Comparison of measured concentrations of the study compounds in drinking waters with information on therapeutic doses demonstrated that levels of these compounds in drinking water in England are many orders of magnitude lower than levels that are given to patients therapeutically. **It would therefore appear that the presence of low levels of pharmaceuticals and illicit drugs in drinking waters in England and Wales do not pose an appreciable risk to human health.**



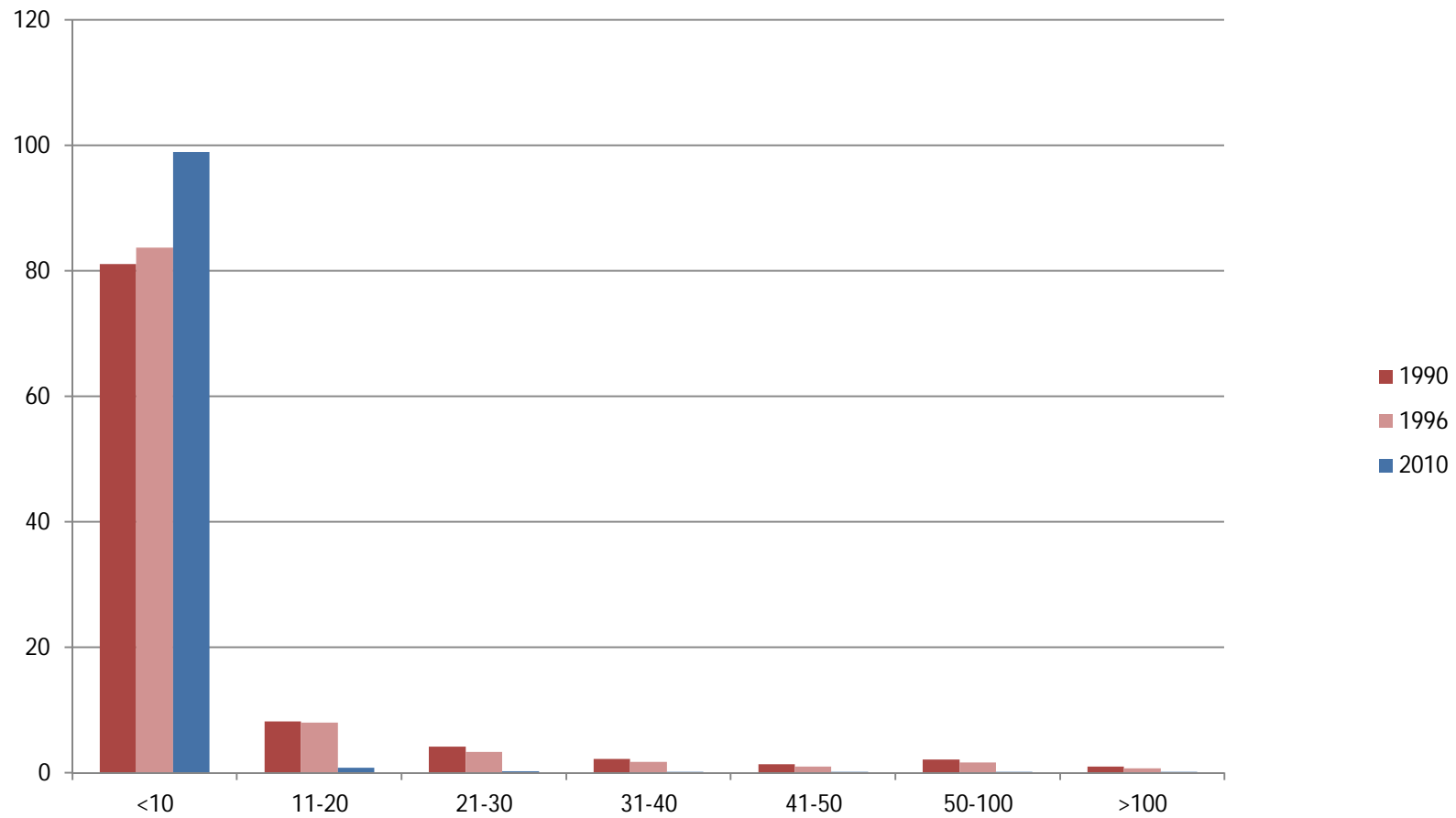
# Advice to water companies

- Companies should review the report and use the information to update Regulation 27 risk assessments and raw water monitoring programmes (Regulation 16A). In particular the Inspectorate expects companies to check that the substances addressed in this report are incorporated within the water safety plan methodology in use. This group of substances should be included and documented already (in hazard lists) and the publication of this report enables further refinement of the methodology by companies to target the substances of interest. The Inspectorate expects that in some instances the refined methodology will lead a company to enhance the raw water monitoring underpinning a specific water supply risk assessment.

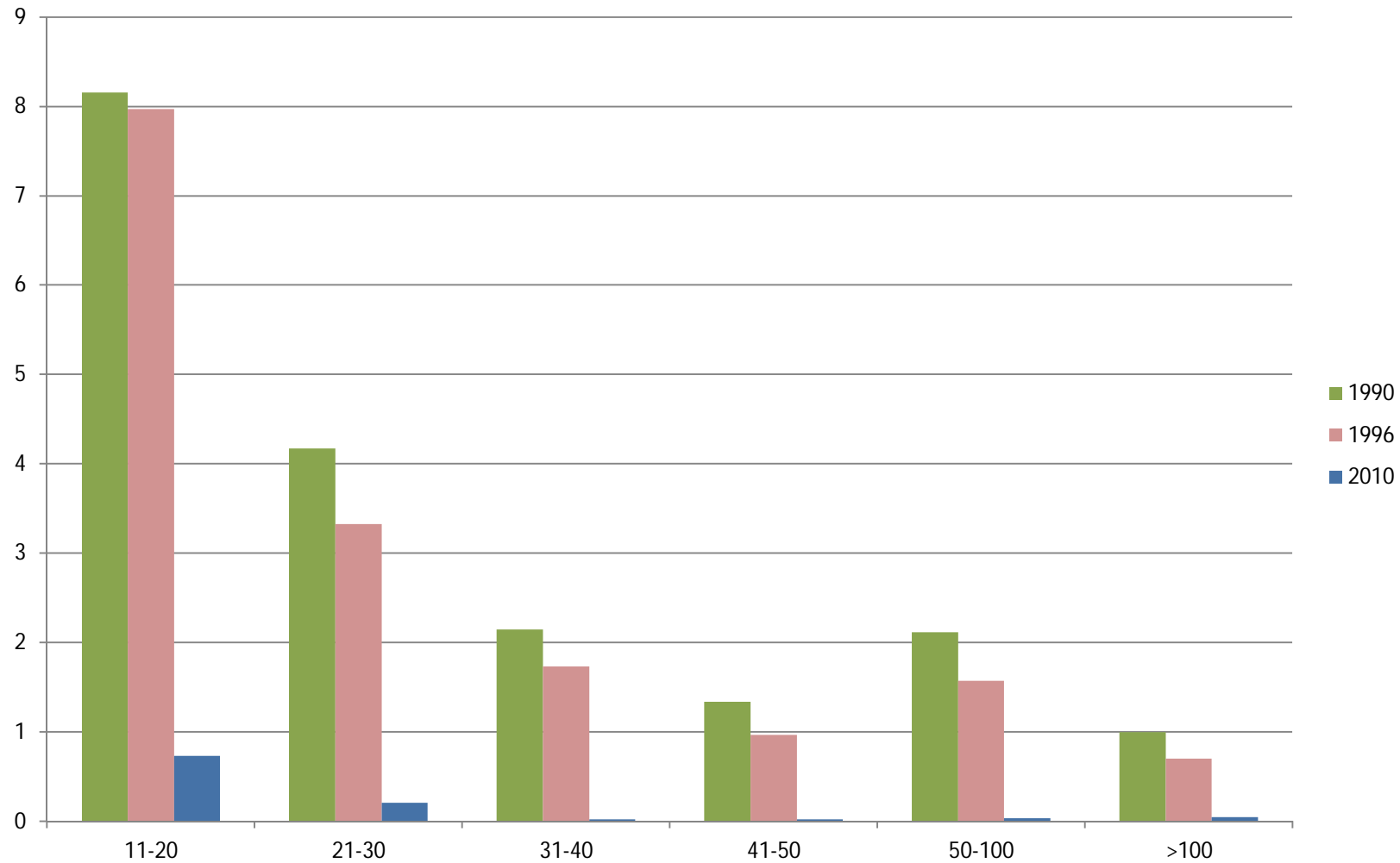


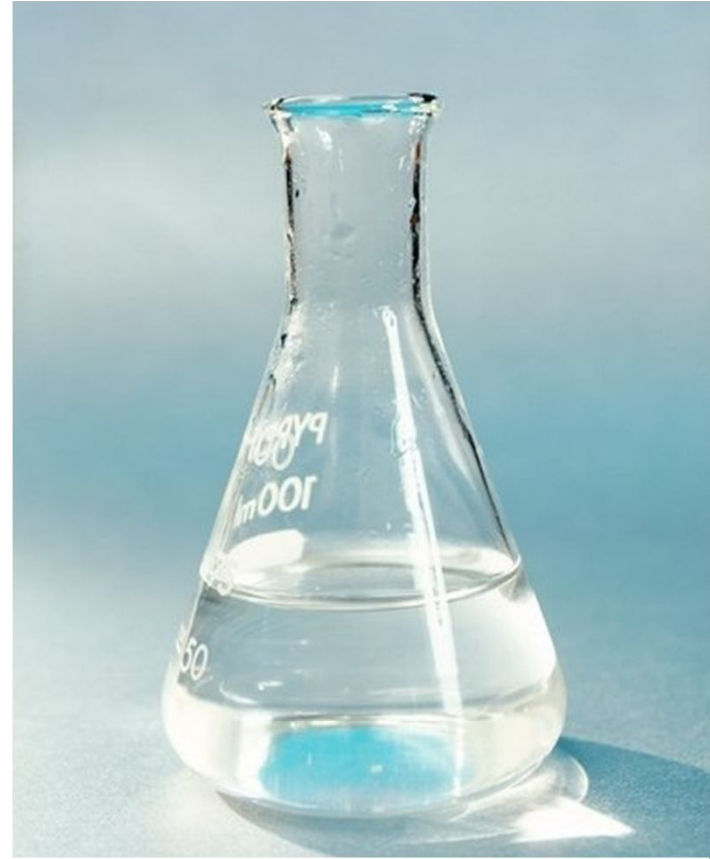


# Distribution of lead concentrations



# Distribution of lead concentrations above the standard





# Chromium



## **MORE INFORMATION:**

**Drinking Water Inspectorate  
Ergon House  
Horseferry Road  
London  
SW1P 2AL**

: 030 0068 6400

: [dwi.enquiries@defra.gsi.gov.uk](mailto:dwi.enquiries@defra.gsi.gov.uk)

: [www.dwi.defra.gov.uk](http://www.dwi.defra.gov.uk)