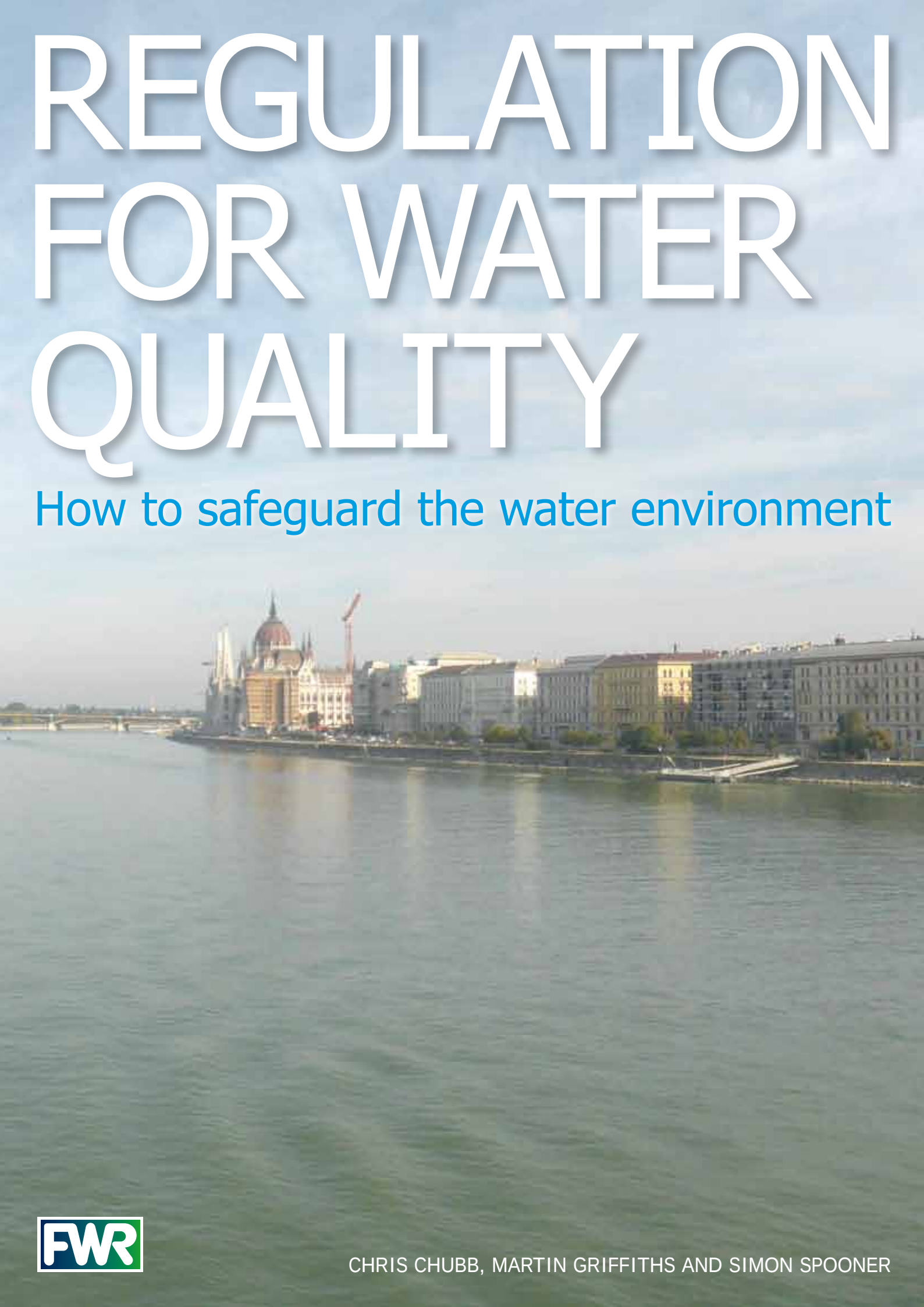
REGULATION FOR WATER QUALITY

How to safeguard the water environment



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FOUNDATION *for* WATER RESEARCH

OUR MISSION...

...is to advance the education of the public in the science, engineering and management of water resources, water treatment, water supply and use of water, the collection, treatment and re-use of wastewaters, the water environment in general and related subjects

OUR VISION...

...is a society well informed on water and related environmental matters. One whose citizens are knowledgeable about issues affecting the sustainable management of water and are thus empowered to contribute to environmental stewardship

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FOREWORD

WATER IS A MOST PRECIOUS RESOURCE. ALL LIFE DEPENDS ON IT. WE MUST MANAGE ITS USE WISELY. REGULATION IS AN IMPORTANT TOOL.

FOREWORDS

SONIA PHIPPARD

Director of Water and Flood Risk Management at Defra

We have put significant effort into improving the quality of UK waters and the policy and regulatory structure is critical to drive investment and infrastructure provision. Translation of EU Directives into UK law, policy and guidance and the technical expertise from the Environment Agency are exemplified in this book. I hope that making some of the UK regulatory experiences easily available will be helpful for other countries around the world.
www.defra.gov.uk

DR PAUL LEINSTER, CBE

Chief Executive of the Environment Agency for England

Water is vital for life and livelihoods and supports diverse and important ecosystems in wetlands, lakes, rivers, estuaries and the sea. It is essential that there is enough water, of the right quality, for people, businesses, agriculture and the environment both now and in the future. This can require balancing sometimes competing demands and needs. Extremes of weather, growing urban areas, land management practices, population growth, changing expectations of consumers and climate change are all factors that need to be considered in this context.

Good regulation in relation to water quality and quantity, coupled with effective compliance checking and appropriate enforcement have played a vital role in protecting and improving the environment and ensuring there is sufficient water of the right quality for people, businesses and agriculture.

It is good to see the information in this document being made widely available for others to use, adapt and build on. We, in the Environment Agency, continue to engage widely with others in Europe and further afield to benefit and learn from their experiences as well as sharing our own, as we seek to take forward this important area of work.
www.gov.uk/government/organisations/environment-agency

JORGE RODRIGUEZ ROMERO

Team leader, Water Framework Directive at the European Commission, DG Environment

I am pleased to recommend this book as a useful guide on how EU environmental obligations with regard to water pollution can be converted into clear requirements at operator level. This is an essential component of river basin management. The book was developed initially as part of the EU China River Basin Management Programme but the regulatory principles and information has global applicability for water management and I'm pleased that it is being made available to a wider audience.
http://ec.europa.eu/dgs/environment

DR JOHN SEAGER

Chairman of IMPEL

On behalf of the IMPEL network of European regulators and authorities, I fully endorse this publication. This book is directly relevant to the work of IMPEL and will help in providing an overview of the principles of water regulation and permitting and in the understanding, implementation and enforcement of EU environmental law. It will become an essential reference work for our regulatory partners across Europe. It will also help us to broaden our focus into water and wider environmental protection issues.
http://impel.eu/

JIN HAI

Vice-President of the Development Research Centre
of the Ministry of Water Resources, Beijing, China

I was privileged to work with the China Europe River Basin Management Programme which developed the initial outline and specifications for this book and its publication in Chinese. It has been used extensively to develop thinking and to enhance water regulatory activity in China. Subsequent knowledge exchange programmes have been undertaken within the Ministry of Water Resources and Development Research Centre using core elements of this reference book. I look forward to continuing work with this team under the new China Europe Water Platform, and recommend its use in China and in other developing and emerging nations around the world. I believe that its application may help increase water security in China and in other water scarce parts of the world.
http://www.waterinfo.com.cn/English/

PROFESSOR ALAN JENKINS

Director for Water and Pollution Science at CEH. Centre for Ecology and Hydrology

Water research is crucial to meet the current and future challenges of improving water security around the world. However, research knowledge can only be implemented through sound strategy, policy and guidance. I am keen that researchers understand the links and how to optimise new knowledge in securing improvements to water resources and water quality. This book will provide access to regulatory policy and guidance that can be used to target and adapt research findings for maximum environmental gain.
http://www.ceh.ac.uk/

DR. HÅKAN TROPP

Managing Director, Knowledge Services at the Stockholm International Water Institute

On behalf of the Stockholm International Water Institute we are privileged to co-sponsor the publication of this book. It directly aligns with our policy aims, including knowledge exchange and informing decision-making towards water wise policy. It will assist in policy and regulatory research, building institutional capacity and sharing information across the global water sector. This book will add to the knowledge base and assist us in encouraging and developing best regulatory practice on an international scale.
http://www.siwi.org/

PROFESSOR TOM STEPHENSON

Professor of Water Sciences and Pro Vice-Chancellor Research & Innovation, Cranfield University

As an exclusively postgraduate university specialising in science and technology, Cranfield delivers a wide range of research and taught degrees in water. We take students from around the globe, all of whom would benefit from access to the policy and guidance information in this book. In my role as advisor to the water sector, I appreciate the wide ranging applications that the information could meet. I appreciate the free and open access that the web and e-book versions provide and I am happy to recommend this to students, staff and the wider networks who work with Cranfield.
http://www.cranfield.ac.uk/

MIKE WOOLGAR

Managing Director Environmental & Water Management Atkins Global

I am pleased to directly co-sponsor the publication of this book, via the Foundation for Water Research. As leading global water consultants we advise on policy, infrastructure and water engineering for clients in government, public sector, the water industry and other commercial clients. Knowledge of policy options and best practice is essential for us to optimise water resource solutions. This book originates from the work that Atkins led as part of the EU-China River Basin Management Programme. I will be pleased to make publication available to staff and clients of Atkins and I believe that it will help in developing a more secure water future.
http://www.atkinsglobal.co.uk/group/sectors-and-services/sectors/water

CARYLL STEPHEN

Chief Executive, Foundation for Water Research

The Foundation for Water Research aims to advance the education of the public in science, engineering and management of water. We are pleased to sponsor the publication of this book and to host it on our web-site. Open access to information is a key element of our working. Making such a wealth of water management information available through this not for profit publication is regarded as an important initiative for us. We hope that it will promote thinking and make available essential information for the proper governance of water across the world.
http://www.fwr.org/

DISCLAIMER

This document relies heavily on published information or information in the public domain. In many ways it is a collation of that information, presented in a logical sequence.

The authors acknowledge their debt to the many hundreds of experts whose knowledge they have tapped into whilst compiling this book. In all cases we acknowledge the copyright of the publishers of the documents referenced or downloaded for this publication and of the providers of all the photographs used.

This book seeks to summarise the key elements of Water Quality Regulation in an accessible format. There is a tremendous amount of information available and therefore in the electronic version, (available on the FWR Website www.fwr.org), much of the technical detail is provided via Internet links to Web Pages, or to hyperlinks to downloaded documents which form an integral part of the electronic version of this book.

Links are depicted by blue text

REGULATION FOR WATER QUALITY

This book aims to present the key principles of effective regulation needed to achieve a high standard of water quality management and to protect water resources, human health and the environment. Increasingly this is viewed in terms of water security, and contributing to sustainable development, responding to a changing climate and a growing population.

WATER IS ESSENTIAL FOR LIFE AND IS A SCARCE AND PRECIOUS NATURAL RESOURCE

1 PREFACE

It can be argued that water is the most precious of all natural resources, and is therefore most in need of good regulation. Too much water causes floods, too little causes water scarcity and drought. Activities that pollute water make it unavailable for drinking, industry, food production and wider societal use. Cleaning up polluted water is very expensive and therefore water protection and pollution prevention activities are very cost-effective options.

Good stewardship of water allows society to flourish. The prosperity and wellbeing of citizens and businesses flow from equitable, effective and efficient regulation.

Industrial, commercial and social development activities that cause or discharge pollution to watercourses, or reduce the quantity of water available, result in degraded ecosystems that are less capable of sustaining a healthy society. This book provides some of the regulatory tools and operational methods needed to optimise water use for people and the environment.

Human activities threaten the sustainable use of water, and in a changing climate and a growing population, water resources come under great pressure. Such activities must therefore be regulated efficiently and effectively to ensure water security for society and protection for the water environment.

Regulation is an important component of optimising this precious resource. For current and future generations regulation is essential in protecting and sharing water fairly with society within the framework of sustainable development, namely in societal, economic and environmental terms.

If there were no polluting dischargers, there would be no need for regulation or permits. Operators discharging effluent or contaminated water need to be aware of their impact on the water environment and other water users in the catchment. Discharge permits should be seen as a privilege and a benefit to the holder. Without a permit dischargers would be subject to appropriate legal sanction for discharging polluted water.

This book provides an overview of the European approach to regulation, viewed from a UK (mostly England & Wales) implementation and regulatory standpoint. As with all regulatory activities we work to ensure that the overall principles are common, logical and legally sound. However, the detail of the guidance and implementation is critical if the regulatory regime is to be effective and efficient in achieving the aims and outcomes in terms of water quality.

The authors have been working within the European and UK system for many years and hope that this experience will be useful to water managers looking for the most effective ways of protecting their water resources. They have been responsible for regulatory development and implementation within the Environment Agency Water Quality Policy team and as water planning consultants. In these roles they have worked closely with government, industry and academia to advise, negotiate and develop new policy and guidance, both within the UK, with European equivalents and in a number of other countries. This book reflects that experience. However, it is important to be critically aware that the methods described are only one way of addressing the overall policy objective of sustainable water use. It is important to seek ways of implementation suitable for individual water catchments within their geographical and societal situation.

One advantage of taking a UK view of water regulation is that so much of the essential regulatory information and guidance is written in English. In addition, the UK tends to have a robust legal system and a mature and transparent approach to developing and implementing water legislation. The relatively clear and logical approaches developed in the UK are equally transferable to emerging countries and to developed regimes. All the policy and guidance is in the public domain, but can be difficult to find and interpret. The aim of this book is to make this more readily available and to provide context and the confidence to use it in the most effective way to improve water quality. Some elements can transfer directly to other countries water regulatory regimes, others may need adaptation and change. With ongoing dialogue and partnership we hope that continuous improvements will be made to policy and guidance that can be shared with the overall aim of increasing water security.

The significant improvement in UK water quality over the past 20 years has been driven by sound water quality planning and the implementation of progressively tighter regulation and water permit standards. Most has been driven by water management initiatives and Directives from the EU, translated into UK action largely via water quality permits. Societal expectation for safe drinking water and a clean water environment has increased with this progressive improvement. This expectation for water security and environmental protection and improvement continues to drive regulation.

The majority of UK water infrastructure development and expenditure was

undertaken to overcome issues which developed from UK industrial development and the growth of our cities. During this growth we did not pay the 'full external cost of water' and current generations are paying for this in water charges and in the price of goods and services. In developing countries the problem is often seen as 'too big', 'too expensive' or 'we need to pollute to maintain growth, and then we will be able to afford to clean up'. All of these views are understandable in the short term; it is important, however, that water managers have the long term vision and the tools to ensure sustainable water use and to reduce the risk of potential water disasters, both for society and the environment.

Water resource planning is a long term process with horizons of 20 to 30 years. Good planning of water resources depends on many mechanisms for delivery of objectives. It needs stable governments, governance and institutions. It needs good quality information based on evidence from monitoring and modelling data on discharges and the receiving water environment. Regulation depends on high quality permits, inspection, enforcement and reporting. Other regulatory tools, including pollution prevention, can be used in combination to achieve the right outcomes for society and the environment. Clear strategies for water improvement and protection, together with their effective and efficient implementation at all levels, are crucial for success.

This book focuses on the EU Water Framework Directive (WFD) as the current core mechanism for continued water protection and improvement. The WFD provides a long term and common water planning mechanism for all waters in the EU. It was developed following significant dialogue and exchange between water experts from across the EU and is acknowledged to be the best practice mechanism, with potential for global application across river basins. The principles within the Directive and the wealth of guidance documents provide a rich source of information for water managers working on large or small river basins in almost any geographical location.

The EU WFD was ratified by all EU Member States in 2000 and reflected the understanding of water resource challenges of that time. In 2012 the Commission launched a review of water issues and risks to water security through a risk assessment process known as the Blueprint to Safeguard Europe's Water Resources, 2012. The outcome of this initiative will change priorities in some of the river basin plans and will target research and innovation on mitigating these risks. However, the EU WFD will remain as the main delivery vehicle and the Blueprint will influence the second and third, five year planning cycles.

Within this book we use the term 'water managers' to include:

- government officials dealing with water policy
- water regulatory officials
- water and environmental consultants
- business managers dealing with uses of, or interactions of, their business with water
- environmental NGOs with an interest in water
- the general public using water as a recreational or cultural resource.

Increasingly, biological and environmental indicators are used to measure the quality of water. This follows the Scandinavian view that, if the water environment can support balanced plant and animal communities, then it will be capable of supporting any human requirement. It is this overall view that underpins the EU Water Framework ▶

◀ Directive philosophy and the outcome-based regulation necessary to achieve good ecological status.

However, this is difficult to achieve in one step, especially for developing countries that face grossly polluted waters and rapid industrial growth. Similar difficulties arise in developed countries, especially where the water environment has been neglected during periods of rapid growth. In both cases, a number of regulatory steps will be needed to bring pollution under control. First, by ensuring that basic permits are in place, and are enforced. Secondly, bringing the gross pollution under control and progressively moving towards a 'river needs' position, based predominantly on physical and chemical standards. Finally, the biological and ecological approach can follow. Provided this sequence and endpoint is agreed and understood, much of the preparatory work can be undertaken in parallel, allowing the process to be accelerated whilst supporting economic and social development. However, the protection of remaining high-quality waters from pollution and over-exploitation is a high priority.

In addressing water regulatory issues, the Plan-Do-Check-Review cycle works well, and is a fundamental component of success. It results in clear accountabilities, aids information flow, and helps to build trust through transparency of process. It helps to make water regulation an integral issue and the responsibility of all business sectors and all citizens.

This book aims to present the key principles of effective regulation needed to achieve a high standard of water quality management, to protect water resources, human health and the environment, and to ensure human development is in balance with the capacity of the environment.

We seek to summarise the key elements of water quality regulation in an accessible format. There is a tremendous amount of information available and therefore much of the technical detail is provided via internet links to web pages, or via hyperlinks to downloaded documents contained in Appendix files which form an integral part of the electronic version of this book. Most of this information is in the public domain and has been developed by EU Member States to guide the implementation of the Water Framework Directive and other key water Directives. As regulators we tend to develop policy and guidance, implement change and move on. Little is drawn together in a logical framework or with a view to wider access and use. This book aims to do so.

Whilst we hope that the book has sufficient integrity to be read cover to cover, we have formatted it to allow the reader to select specific issues and topics in isolation. In this way direct access to technical information can be achieved. There is inevitably some duplication of information in Chapters to facilitate this.

It should also be noted that the EU, Member States, civil servants, consultants,

The book is aimed at senior and middle managers and scientists engaged in river basin planning and water resource protection. It can be read at high level by those influencing the broader policy and implementation. It also provides a depth of technical information and reference to enable those directly engaged in developing, commissioning and implementing regulatory systems and permits to achieve effective water quality management.

academics, industry sectors, non-governmental organisations (NGOs) and individuals have invested significant sums of money and personal effort into developing the regulatory instruments and guidance referenced in this book. It is a privilege to have all of this in the public domain, available to all. For this reason the book has been developed as 'a not-for-profit publication' and we are very grateful to the Foundation for Water Research for underwriting the funds necessary to make this readlity available to all. We hope that you share the overall aims of increasing the security of water to society and assisting in the long term protection of the water environment and human health.

This book was originally written for, and funded by the EU as part of a knowledge exchange programme between the EU and China, facilitated by the EU China River Basin Management Programme. The EU China water dialogue is being maintained via a new China Europe Water Platform (CEWP) and its web site contains significant supporting information, in both English and Chinese.

We hope that you find this compendium of regulatory information useful and that it inspires the adaptation, innovation and new thinking required to protect and improve water resources in many geographical and societal situations. ■

This book seeks to summarise the key elements of Water Quality Regulation in an accessible format. There is a tremendous amount of information available and therefore in the electronic version, (available on the FWR Website www.fwr.org), much of the technical detail is provided via Internet links to Web Pages, or to hyperlinks to downloaded documents which form an integral part of the electronic version of this book.

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2 INTRODUCTION

The aim of this book is to outline the methods adopted in the EU to secure effective regulation of activities that might otherwise cause deterioration or harm to water quality or quantity – 'water resources'. Throughout this book the term 'water resources' means the combination of water quality and water quantity, either or both of which can be limiting in a given situation.

We introduce the principles of the approach to environmental regulation in the EU, the legal framework defining those principles, and the legal and technical tools used to implement them with regard to protecting and improving water quality. Particular attention is paid to the European concepts of using legal permits to control behaviour. We describe the technical processes in the calculation of the terms of such permits and the means for assessing and enforcing compliance and punishing transgressors.

There are a number of high level water management strategies and principles that need to be considered in order to give context to the regulatory approaches used.

2.1 WHY SHOULD WE REGULATE AND PERMIT WATER RESOURCES?

It is useful occasionally to step back and consider 'why regulate water resources'? Challenges against regulation come from many quarters, including politicians, industry, agriculture and economists. Under the pressure of day-to-day work, ▶

water managers can too easily forget the 'big picture' and get bogged down in process and detail. It is important to consider the core reasons for undertaking water protection and regulation.

In developing countries the overriding reason is to protect human health through ensuring the availability of good quality drinking water. Even in developed countries this reason is neglected at our peril. For example, protecting London's drinking water remains one of the core duties of the Environment Agency in the River Thames catchment. The loss of all or a proportion of this water resource through pollution or other incident would be potentially catastrophic and rapidly impact on society and business in the city. Flood and droughts rapidly focus attention on water security and the risks to modern society of interruptions to water supply are high. Water security is high on the tables of National Security Risks in the UK and in most other countries, although on a day-to-day basis it is taken for granted.

Regulation enables water resources to be used, protected and shared by society within the framework of sustainable development, namely in societal, economic and environmental terms, for current and future generations.

Taking the sustainable development model, the need for, and benefits of, regulation and permitting can be seen in Box 2.1.

Fair, efficient and effective regulation of water resources is an essential element for ensuring water security in an increasingly uncertain world. If used well it should optimise societal wellbeing within a framework of sustainable development.

The following quotation from OECD assists this understanding:

> Environmental permitting is a key instrument for reducing industry's environmental impacts, facilitating its compliance with environmental requirements and promoting technological innovation.

BOX 2.1 REGULATION AND PERMITTING – BENEFITS TO SUSTAINABLE WATER RESOURCES

SOCIETAL

- To ensure public health, clean water supply and sanitation for all
- To ensure equitable sharing of water resources within international, national, regional and local boundaries and/or at river basin, sub-basin and water body level
- To accommodate and provide for urban and agricultural development
- To reduce the impacts of floods and drought
- To ensure the affordability of potable water and sanitation for essential uses
- To ensure food production through irrigation (water efficiency needed here)
- To optimise fish production for food
- To ensure access for recreation, education and tourism
- To ensure religious and cultural wellbeing (e.g. religious bathing in India)

ECONOMIC

- To promote sustainable economic development, industry and wealth creation
- To allocate scarce water resource equitably between sectors. For instance, for agriculture, industry and domestic users, whilst leaving enough for the river ecology to continue to thrive.
- To ensure a level playing field (internationally, nationally and locally) for industry which requires water for production and processing
- To ensure certainty and to reduce investment risks within a marketplace
- To ensure affordable raw water and wastewater costs and to clearly indicate treatment cost and liabilities
- To prevent monopoly water suppliers from distorting markets
- To ensure clear requirements for water use and pollution control measures through clear and understandable permits and regulatory delivery.
- To ensure navigation, ports and trade, tourism and recreational industries are maintained and developed
- To improve the health and safety of workforce and local communities
- To reduce risks to industry, including continuity of supply, quality of supply, and regulatory and prosecution risk
- To ensure that the polluter pays
- To encourage innovation
- To optimise environmental service provision from the natural environment

ENVIRONMENTAL

- To ensure healthy ecosystems and wetlands
- To protect biodiversity and the aquatic systems that they rely on
- To optimise river morphology and encourage best ecological potential for heavily modified waters
- To optimise river catchment function to reduce flooding and drought
- To ensure continuity of flow, environmental signals (eg freshets for migratory fish) and minimal physical barriers
- To ensure at least minimum river flows, manage sedimentation and maintain river morphology
- To ensure sustainable groundwater levels and soil-water interactions
- To optimise sustainable use of environmental services by society at least cost
- To identify and reduce anthropogenic risks to wildlife, fisheries and the natural environment
- To promote awareness and knowledge of environmental value through education
- To ensure the precautionary principle is applied with regard to ecosystem protection
- To preserve landscape, geography and water related features

2.2 INTEGRATED RIVER BASIN MANAGEMENT

Integrated river basin management (IRBM) is at the intellectual heart of the EU approach to water management but the extent of application differs in individual countries and river basins. A review of current water resource status will determine development of regulatory options for delivering effective pollution control and river basin management.

Isolated measures to improve water security cannot be successful without taking account of what happens upstream and downstream. Integrated river basin management adopts an holistic approach to protecting the whole body of water, its source, tributaries, its main rivers, lakes and groundwater, through a coordinated strategy involving all the interested parties in decision-making. The river basin approach is acknowledged in Europe as the best way to manage water.

In 2000 the European Union took a ground-breaking step when it adopted the Water Framework Directive (WFD). It introduced a new legislative approach to managing and protecting water, based not on national or political boundaries, but on natural geographical and hydrological

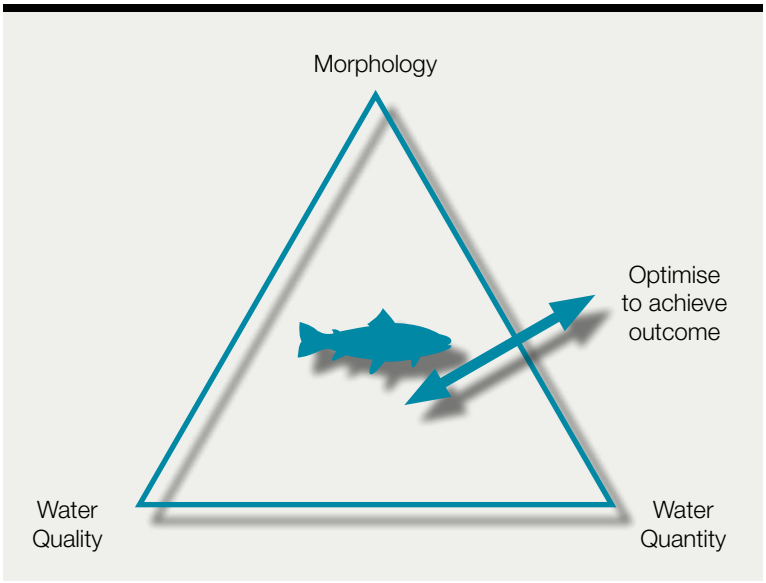


Figure 2.1 Optimise interventions to achieve outcome *Paul Logan Environment Agency*

formations: river basins. These are known as River Basin Districts. IRBM needs clear coordination and collaboration between administrative authorities and stakeholders within each river basin.

In many countries IRBM is in place, but is at different stages of development and application. Political boundaries within countries can cause significant administrative difficulties, and trans-boundary rivers can take this to a higher level of difficulty. Significant levels of negotiation and diplomacy are needed to optimise water resources between countries. However, good examples exist and the International Commission for the Protection of the Rhine (ICPR) and the International Commission for the Protection of the Danube River (ICPDR) provide best practice benchmarks within Europe. Without the work undertaken in these complex river basins, the EU WFD would not have been possible.

China is another example where IRBM is applied through river basin water resources commissions, for instance the Changjiang Water Resources Commission and the Yellow River Conservancy Commission. However, this is hampered by provincial authorities having significant authority over tributaries and limited representation in the Commissions. China seeks to overcome this and a 2011 No.1 policy document signals a significant reform in approach and acknowledges the need to include the tributaries in future priorities.

2.3 WATER QUALITY, WATER QUANTITY AND FLOW OPTIMISATION

To make improvements to the water environment, regulatory and management interventions must strike a balance between water quality, water quantity and morphology and all three elements can be influenced. In reviewing options, water managers must consider all options, and combinations of options, to achieve the agreed outcomes. Figure 2.1 summarises the optimal approach where all three interventions are balanced in the most cost effective way.

Traditionally, in a polluted river, point source impacts are often most evident and can be reduced or prevented by permit reductions. This may be undertaken in a phased way according to an agreed strategy and investment in treatment processes. There is subsequently an improvement in the receiving water and existing diffuse or intermittant impacts, previously masked by the point source pollution, may become ▶

more evident and are then targeted. Improvements to grossly polluted waters can be made quickly using a variety of treatment options, especially from known point sources.

However, water abstraction, lack of dilution and flow may be the key issues. In this case, abstractions may need to be reduced, increasing dilution and 'environmental flow'. Significant work is being undertaken to estimate the critical flows and flow regimes needed to maintain a healthy river. This may be difficult if much of the water is used for potable supply and changes to licences are notoriously difficult. In the UK, laws are being changed to make this easier to achieve.

Increasingly, river morphology (the shape, depth, substrate, marginal vegetation and the wetlands that feed surface and groundwaters) is understood to constitute the most limiting factor for the aquatic ecosystem. It is the morphology that determines flows, speed of run-off and the habitat for river organisms. Often, river restoration can provide multiple benefits in terms of self-purification, flow balancing, flood risk management, habitat creation and recreational opportunities.
The creation of 'blue space' in cities through river restoration has many advantages. The true potential of this intervention is still to be fully exploited in the management options available. This can be problematic in crowded places and land and/or riparian ownership can also make it difficult. However, the benefits are high and water planners working with spatial planners are beginning to make progress, and there are some good examples around the world. 'Soft engineering' options, particularly for flood risk management, are beginning to find favour.

All options can be modelled to gauge effectiveness and the most cost effective combination chosen to suit the social, geographic and economic circumstance.

All human endeavour requires water, land and air as fundamental resources. If we are to deliver sustainable development we must conserve them and provide good stewardship. The efficient and effective regulation of activities that threaten the sustainable use of these resources is essential.

2.4 LINKS TO SPATIAL PLANNING

Maintaining water security requires a long term vision and should be integrally linked to spatial planning for urban and regional development in both developing and developed areas. Water resource management is a fundamental element of development planning and should be designed into infrastructure projects at an early stage, taking into account the social and economic development opportunities improved water resources can bring. Modelling can test future development scenarios and identify options that could optimise decisions.

There must be a balance, however, between spatial planning and the availability of water. Planners must realise that the availability of water, and the capability to treat effluent, is not endless and this may constitute one of the most limiting factors impacting on city and industrial development. Dialogue must be maintained on these issues and options to minimise impact developed. In some cases, optimisation of water can bring design innovation in building and in water-saving societies. The concept of eco-cities has developed from this dialogue.

Ultimately, the availability of water will be limiting and water planners and regulators may have to say no to further water exploitation in water scarce areas. In the UK the environmental regulator has the final say, subject to appeal to Ministers. This is usually imposed via a refusal to grant a permit, or by imposing environmentally protective conditions in permits, that may render the industry uneconomic. Industry then has to decide whether a new installation is viable or not with current technology, and whether to innovate new solutions to meet regulatory constraints.

2.5 LINKS TO ENVIRONMENTAL IMPACT ANALYSIS (EIA)

Environmental Impact Analysis (EIA) is often the mechanism by which dialogue and interaction between spatial and water planners is achieved. EIA can help to analyse the environmental issues and communicate options and risks to decision makers, industry and the public.

In many countries, and for most complex installations, EIA is an integral part of the application and permit determination process. The technical information gathered determines the permit conditions and public consultation.

The Environmental Impact Assessment (EIA) Directive is essentially a development planning tool, intended to ensure that, for major development proposals, a proper consideration of potential environmental impacts are identified early in the development planning process, so that avoidance of harm, and mitigation where limited harm is unavoidable, can be built into the development plan. The EIA process and development control procedures may identify the need for environmental permits, but in the UK the detail of such permits rests with the environmental regulator, not the development planning authority.

In the UK an EIA is usually undertaken in parallel with the permit application process for large installations, especially those under the integrated Pollution Prevention and Control (IPPC) Directive. Impacts on air, land and water are considered. It is used to gather information and to facilitate dialogue between all parties. A high quality approach to EIA development and validation is critical to the process.

The EIA Directive has been modified three times since its introduction in 1985, and the European Commission is currently consulting on a further review. The general objective of the proposal is to adjust the provisions of the codified EIA Directive, so as to correct shortcomings, reflect ongoing environmental and socio-economic changes and challenges, and align with the principles of smart regulation. Further details on the Directive can be found on the relevant Europa Web page.

EIAs are an important mechanism to logically analyse and communicate issues surrounding the potential impact of a permitted abstraction or discharge, including the wider spatial planning context and sustainability issues. However, an EIA is only as good as the information that it contains, and the consequent protection measures applied via the permit. There are examples where a poor or biased EIA is undertaken by developers or industry as a procedural step and is used as a 'tick box' to press through development without adequate protection. In these cases an EIA can be counter-productive or damaging to the process of coming to a balanced decision on the development proposal.

Many major infrastructure schemes have, in the past, been significantly delayed by the UK development planning process, particularly in respect of challenges to Environmental Impact Assessments, which have often resulted in repetition ▶

of planning applications and associated investigations. In an attempt to minimise duplication of effort on EIAs in England and Wales, and to ensure regulatory consistency, the government has developed policies for Nationally Significant Infrastructure, such as major roads, railways and power stations. These are known as National Policy Statements, and they identify the common core components of government policy and environmental concerns for a suite of large scale projects, particularly those that may affect more than one local authority.

More detail on Nationally Significant Infrastructure issues is provided in Chapter 24.

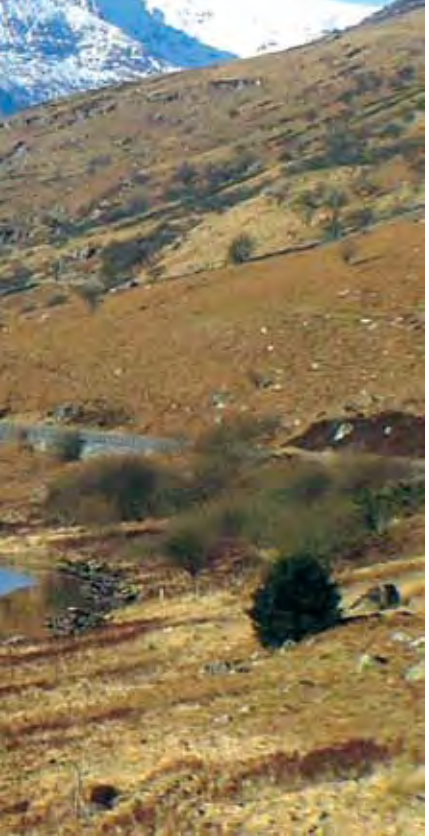
2.6 SPECIAL NATURE CONSERVATION PROTECTION (HABITATS AND BIRDS DIRECTIVES)

Many rare or vulnerable natural environments are at risk of degradation by man's activities, and governments have long realised that unless they are given significant protection under the law they will be lost forever.

At EU level there are two complementary Directives –the Habitats Directive and the Birds Directive. Both require Member States to identify special areas for protection of listed Habitats and Birds respectively, forming a European network of protected sites collectively known as Natura 2000. Member States must ensure that development and regulatory permits for developments that might affect them are only given after strict appraisal and confirmation that the development will have negligible impact on the designated features of interest, or that sufficient compensatory measures are in place to rectify or mitigate the damage caused. Developers for sites that might affect Natura 2000 sites are required to undertake a detailed Habitats Assessment as part of their planning application process. Further details of Habitats Regulations requirements are given on the Joint Nature Conservation Committee (JNCC) web site.

2.7 PROPORTIONATE AND RISK-BASED APPROACH TO PERMITTING

It is important to ensure that regulatory activities, including permitting, are proportionate to the risks posed by the permitted activity. This means that there must be a balance of risk, regulatory pressure and benefit to the permit holder and the regulator. The demands of the permit application process, monitoring, reporting and other issues on the operator should be reasonable. However, the regulator, on behalf of society, must ensure adequate protection and certainty that the permitted activity is operating safely and that risks are minimised. The resources allocated by the regulator must be allocated according to those risks and the potential benefits that can be achieved.



The optimisation of this proportionate approach and improving the balance between regulated and regulator is the subject of many of the Modern Regulation reforms that are taking place around the world. This is highlighted in chapters 8 and 9.

2.8 EU APPROACH AND THE WATER FRAMEWORK DIRECTIVE

Regulation and permitting of activities which have the potential to result in pollution is one of the fundamental management processes that underpin the Water Framework Directive (WFD) and other EU legal instruments and Directives. Such systems are implemented in each EU member state through regulation to ensure human development is balanced with the capacity of the environment.

The primary aim of the WFD is to provide a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. The full aims are presented in Box 2.2.

The Water Framework Directive sets the context for control of activities impacting directly or indirectly on water. Direct impacts include point source discharges and abstractions. Indirect impacts include pollutant emissions to air, and land activities that do not directly result in a discharge to water, but which alter or interfere with natural drainage of rainfall to sea. For regulatory efficiency and to cover as many environmental risks as possible in a common framework, it is worth considering a common model for all environmental permitting.

This book focuses mainly on the regulation of discharges made directly to receiving surface waters (rivers, lakes, estuaries and coastal waters) and to groundwater.

It is important to note that the prime target of most environmental regulation is some sort of biological response, whether to avoid human harm, or harm to the ecosystem itself, or ecosystem processes on which we all depend. Aquatic biology is complex, variable and can be difficult to measure. For most 'routine' environmental regulation we use the convenient shorthand of physico-chemical determinands and measurements that have been linked, by experiment and observation, to biological responses. Thus, water quality standards and discharge permits aimed at protecting biology are mostly expressed in terms of chemical concentrations or total amount of chemical discharged, as these can be readily measured. Proof of 'success' in planning water quality and in permitting discharges is nevertheless dependant on biological ▶

BOX 2.2 PRIMARY AIM OF THE EU WFD IS TO:

Establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which:

(a) prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems;

(b) promotes sustainable water use based on a long-term protection of available water resources;

(c) aims at enhanced protection and improvement of the aquatic environment, inter alia, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of the priority hazardous substances;

(d) ensures the progressive reduction of pollution of groundwater and prevents its further pollution, and

(e) contributes to mitigating the effects of floods and droughts.

monitoring and surveillance of ecosystems. The attainment of healthy biological communities is the fundamental driver for improvement and the targeted outcome of the water quality regulatory activities.

2.9 THE EU WFD APPROACH UPDATED – THE EU BLUEPRINT 2012

The EU WFD was ratified in 2000 after significant negotiation and development. As with all regulatory instruments, it is a product of its time and the external issues prominent at that time. It will be re-launched and re-focused on current water resource challenges identified through the Blueprint to Safeguard Europe's Water Resources, 2012.

The outcome of this initiative will change priorities in some of the river basin plans and will target research and innovation on mitigating these risks. However, the EU WFD will remain as the main delivery vehicle and the Blueprint will influence the second and third, five year planning cycles.

The EU describes the Water Blueprint as follows:

The achievement of EU water policy goals is threatened by a number of old and emerging challenges, including water pollution, water abstraction for agriculture and energy production, land use and the impacts of climate change.

The EU's policy response to these challenges is the [forthcoming] 2012 Blueprint to safeguard Europe's water resources. The overall objective of the Blueprint is to improve EU water policy to ensure good quality water, in adequate quantities, for all authorised uses. The Blueprint will encourage a move towards what we call 'prevention and preparedness'. It will ensure a sustainable

balance between water demand and supply, taking into account the needs of both people and the natural ecosystems they depend on.

The Blueprint's policy recommendations will be based on the results of the following ongoing assessments:

- *Analysis of the WFD's* ***river basin management plans****: giving information on how Member States have improved their water management.*
- *Review of the 2007 policy on* ***water scarcity and drought****:*
  - *including water efficiency measures*
  - *The evolution of water resources*
- ***water's vulnerability to climate change*** *and man-made pressures such as urbanisation and land use.*
- *Outcome of the* ***fitness check of EU freshwater policy****:*
  - *gap analysis to identify any uncovered areas and assess the adequacy of the current framework.*

The results of these four reviews, together with other EU studies, will provide knowledge to help better implementation of EU water policy.

2.10 WATER QUALITY REGULATORY CYCLE – HIERARCHY

There is a fundamental hierarchy, or cascade, of principles and action in the regulation of water pollution:

- It is best to prevent pollution rather than having to respond to it
- If it can't be prevented then minimise pollution if possible and practicable
- And then remedy the cause of pollution if possible and practicable
- And also mitigate the impact of the pollution

Prevention is always better than cure, and invariably cheaper in the long run.

For some activities, e.g. those emitting pollutants to the environment, ongoing active regulation including permitting, monitoring, and enforcement are essential. This book focuses on such activities, and the evidence needed by regulators and the regulated to ensure that water quality and quantity objectives are met fairly, without excessive cost or excessive risk, and to the benefit of society in general.

It should always be noted that it is more effective for developers and operators to minimise impact through good planning and design, thus reducing the need for, or risk of, point source discharges or diffuse emissions. In addition, there must be good ongoing management of all construction and operational processes. It is very important that early in the planning process any water resources implications of the development are considered. In many cases a simple change of tack early in the planning process can avoid the risk of subsequent water pollution. If risk of environmental harm is identified early in the planning process for a development, it is more likely that cost-effective risk-mitigation measures can be adopted, allowing lighter touch regulation of any residual risk.

Nevertheless, effective regulation of local discharges and of diffuse pollution is essential. It is best when founded on statistically robust scientific evidence of cause and effect, but it is rare for comprehensive long term data sets of the complex environmental variables to be readily available for a specific location. For intended discharges it is usually necessary to use empirical modelling methods to establish the discharge characteristics that, if met, will ensure there is no deterioration in river or lake quality status; or, if an improvement in status ▶

towards the target class is planned, that the discharge will make a proportionate contribution towards that improvement.

Accidental or deliberate releases of polluting substances also occur and may cause significant impacts and pollution incidents. Enforcement actions for 'accidental' pollution are necessary and are an important aspect of regulatory activity, and may involve criminal or civil sanctions. These issues are dealt with in Chapters 16, 23 and 25.

For many common pollutants the EU Water Framework Directive establishes Quality Standards, the value of which may vary according to the intended Quality Status of the receiving water. These standards have, for the most part, been derived from long term data sets and robust statistical evaluation, moderated by expert scientific opinion, drawn from all Member States. They are mostly expressed as summary statistical concentration limits, such as annual mean or 95 percentile concentrations, though limitation of total amount (load) may also be specified.

These water quality standards form the basis of discharge permit decision-making, and provided that they are met in the receiving water, after initial mixing of the effluent, there is a low probability of deterioration in Ecological Status occurring.

The Water Framework Directive in Article 10 adopts a 'combined approach' to regulation of discharges, allowing a variety of methods of regulation, using control of pollution at source through the setting of emission limit values, and using environmental quality standards. The methods are not absolutely specified but may include:

- Preventing the generation of pollution in industrial processes
- A prohibition on the entry of certain pollutants into water
- Prior authorisation of processes and/or discharges
- Registration of activities based on general binding rules
- Laying down emission controls for specified pollutants
- Setting environmental quality standards and ensuring they are met through permit limits and other regulatory actions

Some sectors are subject to the Integrated Pollution Prevention and Control (IPPC) Directive and the recent Industrial Emissions Directive which require use of 'Best Available Techniques' (BAT) to minimise emissions and/or risk of pollution of any media. BAT may result in emission limit values that are more stringent than are required to meet the receiving water quality standard. But where the use of BAT will not deliver the required water quality then more stringent emission limits must apply, sufficient to ensure that the receiving water meets the required quality standard.

Receiving-water-quality based permit limits for discharges are therefore determined on the basis of effluent volume and concentration (load) of specified pollutants, compared against the receiving water flow and the concentration of those pollutants in the receiving water upstream of the discharge. The permit will specify statistics of discharge flow and concentration that, if complied with by the discharger, will ensure that the status of the receiving water downstream of the discharge mixing zone will not deteriorate.

Calculation of the permit is normally a relatively straightforward activity, using statistical mass-balance determination methods, described in Chapters 20 and 21. A bigger challenge to the regulator is determining the amount of effort to be

spent in policing the permit. If permits are not rigorously enforced then permit holders (polluters) may benefit from their illegal and antisocial behaviour, to the detriment of all. The EU espouses the 'Polluter Pays Principle', and there are various mechanisms within Member States to ensure that dischargers pay for permits and pay full cost recovery for the regulatory and enforcement actions associated with these permits. Most regulators require the discharger to monitor the discharge and report the data to the regulator, allowing the regulator to audit operator performance, rather than having to actively monitor the discharge routinely. There is a significant emphasis on management systems and quality control to ensure that falsification of records is very difficult to achieve without detection.

In the event that an operator fails to comply with the permit, the regulator needs powers to intervene to force remedial action or, in extreme cases, to stop the activity. These powers may extend to pursuing criminal conviction of culpable persons.

A conceptual and underlying planning cycle or process is common to all scales of regulation, - EU, Member State, regulator, sector, business, management, and employee. This cycle is the fundamental process for successful issue resolution, and is at the core of catchment scale river basin management. It can be described in many ways but at its simplest it comprises five components:

- Defining the issue, its boundaries, accountabilities for resolution, and resources available
- Planning the actions and how success will be measured
- Doing the planned action(s)
- Checking that each action has been done as planned, and relevant data collected
- Reviewing the sum of all actions against success criteria to establish if the issue has been satisfactorily resolved and, if not, start another cycle

This is shown diagrammatically in Figure 2.2.

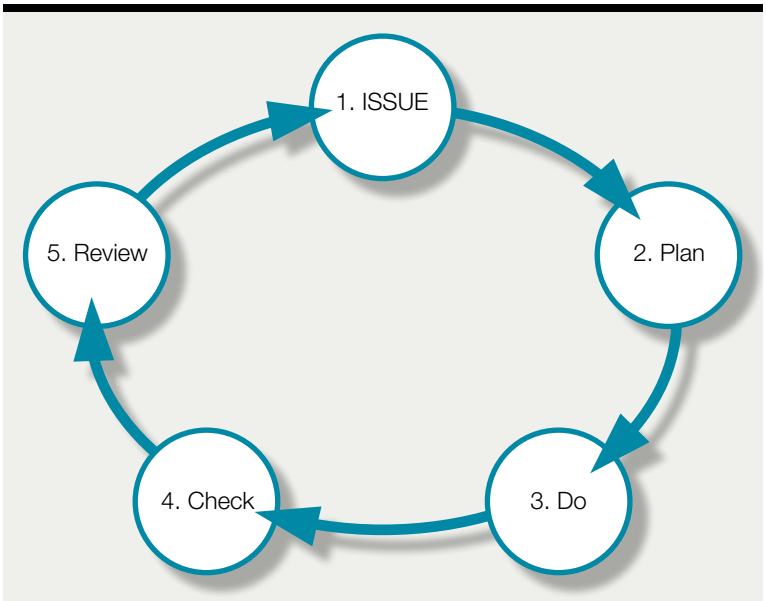


Figure 2.2 The Basic Planning or Issue Management Cycle

Throughout this book there is an implicit assumption that the regulatory activities and issues described will be managed in accordance with this planning cycle. It is also implicit that the Planning stage defines the data and information to be collected in the Do and Check stages to inform the Review Stage. Note that the Review must also address unplanned or unexpected variances from plan, so it is unlikely that the full scope of Review can be set out in the Plan. In practice it is often the case that the Plan fails to specify sufficient information that needs to be captured in the Do and Check phases for a successful Review. ■

BACKGROUND – EU REQUIREMENTS

Some 70% of the Earth's surface is covered by seas and oceans, and these produce almost three quarters of the oxygen we breathe. We can use directly only 1% of this water, however, and many forms of human activity put water resources under considerable pressure. Polluted water, whatever the source of the pollution, flows one way or another back into our natural surroundings – into the sea or water tables – and en route or at destination it can have a harmful effect on human health and the environment.

3 OVERVIEW OF EU REGULATORY PRINCIPLES & LAW

The European Union was established after the Second World War with the aim of promoting trade between Member countries, thereby increasing interdependence and lessening the prospect of conflict. Increasingly the interdependence of Member States and functioning of the Common Market has led to the realisation that the environment and natural resources are critical to success and need protection and management at European level as well as within each Member State.

*** This section consists of extracts and quotes from EU Treaties & European Commission documents, all of which are published on the web. Source pages are quoted in each sub-section.**

3.1 WHAT IS EU LAW?

Source - EU Law Introductory Web Page http://ec.europa.eu/eu_law/introduction/welcome_en.htm

The main goal of the EU is the progressive integration of Member States' economic and political systems and the establishment of a single market based on the free movement of goods, people, money and services

To this end, its Member States cede part of their sovereignty under the Treaty on the Functioning of the European Union (TFEU) which empowers the EU institutions to adopt laws.

These laws (Regulations, Directives and Decisions) take precedence over national law and are binding on national authorities. The EU also issues non-binding instruments, such as Recommendations and Opinions together with rules governing how EU institutions and programmes work, etc.

3.2 EU KEY ENVIRONMENTAL PRINCIPLES

The key environmental principles applicable to all Member States, the European Council and the European Commission are set out in the Treaty on European Union, an extract of which is presented below.

The Treaty on European Union is available on the web. A downloaded copy of the full text is included here.


26.10.2012
EN
Official Journal of the European Union
C 326/13
CONSOLIDATED VERSION OF
THE TREATY ON EUROPEAN UNION

3.3 WHAT ARE EU REGULATIONS?

Regulations are the most direct form of EU law - as soon as they are passed, they have binding legal force throughout every Member State, on a par with national laws. National governments do not have to take action themselves to implement EU regulations.

They are different from Directives, which are addressed to national authorities, who must then take action to make them part of national law, and they differ from Decisions, which apply in specific cases only, involving particular authorities or individuals.

Regulations are passed either jointly by the EU Council and European Parliament, or by the Commission alone.

The Europa Web Site provides useful summaries of EU legislation and links to much more detail on EU legislation and programmes.

3.4 WHAT ARE EU DIRECTIVES?

EU Directives lay down certain end results that must be achieved in every Member State. National authorities (governments) have to adapt their laws to meet these goals, but are free to decide how to do so. Directives may concern one or more Member State, or all of them.

Each Directive specifies the date by which the national laws must be adapted - giving national authorities the room for manoeuvre within the deadlines necessary to take account of differing national situations.

Directives are used to bring different national laws into line with each other, and are particularly common in matters affecting the operation of the single market (e.g. product safety standards).

EXTRACT FROM TREATY ON EUROPEAN UNION – ENVIRONMENT

Article 191

1. Union policy on the environment shall contribute to pursuit of the following objectives:

- **preserving, protecting and improving the quality of the environment,**
- **protecting human health,**
- **prudent and rational utilisation of natural resources,**
- **promoting measures at international level to deal with regional or worldwide environmental problems, and in particular combating climate change.**

2. Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay. In this context, harmonisation measures answering environmental protection requirements shall include, where appropriate, a safeguard clause allowing Member States to take provisional measures, for non-economic environmental reasons, subject to a procedure of inspection by the Union.

3. In preparing its policy on the environment, the Union shall take account of:

- **available scientific and technical data,**
- **environmental conditions in the various regions of the Union,**
- **the potential benefits and costs of action or lack of action,**
- **the economic and social development of the Union as a whole and the balanced development of its regions.**

4. Within their respective spheres of competence, the Union and the Member States shall cooperate with third countries and with the competent international organisations. The arrangements for Union cooperation may be the subject of agreements between the Union and the third parties concerned.
The previous subparagraph shall be without prejudice to Member States' competence to negotiate in international bodies and to conclude international agreements.

3.5 WHAT ARE EU DECISIONS?

Decisions are EU laws relating to specific cases. They can originate from the EU Council (sometimes jointly with the European Parliament) or the Commission.

They can require that authorities and individuals in Member States either do something or stop doing something, and can also confer rights on them.

EU decisions are:

- addressed to specific parties (unlike regulations)
- fully binding.

3.6 WHAT ARE 'NATIONAL IMPLEMENTING MEASURES'?

'National implementing measures' are texts officially adopted by the authorities in a Member State to incorporate the provisions in a Directive into national law. All such texts are sent to the European Commission by national authorities for scrutiny to ensure that they will actually implement in that Member State all the measures required in the Directive.

3.7 IMPLEMENTATION OF COMMUNITY ENVIRONMENTAL LEGISLATION

This section is based on information from the EU web page 'Implementation of Community environmental legislation'. This page contains links to Legislation, Implementation (including EC Enforcement and EC Case Law,) Liability, Environmental Crime (including legislation and studies), and the Aarhus Convention (public access to information and participation in decision making). The sections that follow include selective extracts from some of these pages and contain further embedded web links.

In the past 30 years the EU has adopted a substantial and diverse range of environmental measures aimed at improving the quality of the environment for European citizens and providing them with a high quality of life. Our environment can only be well protected if Member States properly implement the legislation they have signed up to.

Implementation of Community environmental legislation is to be ensured in the first place by Member States.

In addition to any implementation and enforcement action taken at national level, the European Commission fulfils the role of 'Guardian of the Treaty': according to Article 211 first indent of the EC Treaty, the Commission is to ensure that the provisions of the Treaty and the measures taken by the institutions pursuant thereto are applied. In performing that function, the Commission checks that Member States have implemented the EU legislation and if there are deficiencies in implementation the Commission may open infringement procedures.

3.8 EUROPEAN LAW - JUDICIARY

Next to administrative authorities, judges in the Member States have to play a very important role since rights and obligations deriving from Community law are enforced on a daily basis by national courts and tribunals. The European Union Forum of Judges for the Environment promotes the enforcement of national, European and international environmental law by contributing to a better knowledge for judges of environmental law.

To support the implementation and enforcement of Community environmental legislation focused on the 'polluter pays' principle, the Community has adopted ▶

the Directive on environmental liability, the recommendation providing for minimum criteria for environmental inspections and the Directive on the protection of the environment through criminal law.

Whatever the means used, the overall objective of the Commission is to ensure that EU environmental legislation is implemented in full, correctly and on time. This is important because legislation which is either incorrectly or not implemented will not achieve the desired effect on the environment.

3.9 EUROPEAN LAW - LEGAL ENFORCEMENT

It is the Commission's responsibility under Article 17(1) of the Treaty on European Union to ensure that both the Treaty on European Union and the Treaty on the Functioning of the European Union, in addition to measures adopted pursuant to them, are correctly applied. The Commission is therefore often referred to as the 'Guardian of the Treaties'. With over 200 legal acts to monitor in 28 Member States, this is a major task in the environmental field.

These legislative measures cover all environmental sectors, including water, air, nature, waste, noise, and chemicals, and others which deal with cross-cutting issues such as environmental impact assessment, access to environmental information, public participation in environmental decision-making and liability for environmental damage. Over the last 40 years, the body of EU environmental law which makes up the 'European environmental acquis' has steadily expanded, although in more recent years it has been reaching maturity. Nevertheless, this body of law is continually under assessment with significant developments having taken place in the chemicals sector, and also in the waste, air and water sectors.

The Commission has adopted a Communication on implementing European Community Environmental Law which sets out plans to improve the implementation of the European Union's environmental protection laws. This fits within a wider Commission strategy for improving implementation of EU law announced in a previous Communication of 2007: A Europe of Results - Applying Community Law.

3.10 KEY EU WATER-RELATED LEGISLATION

The following links provide access to the various laws and general information about their implementation on most aspects of European Union water management.

Links to the main water-relevant pages on the EU web site are listed below:

- GENERAL FRAMEWORK
  - Water protection and management (Water Framework Directive)
  - Protection of Nature and Biodiversity
  - Pricing and long-term management of water
  - Flood management and evaluation
  - Water scarcity and droughts in the European Union
  - Urban waste water treatment
- SPECIFIC USES OF WATER
  - Quality of drinking water
  - Bathing water quality (until 2014)
  - Bathing water quality
  - Water suitable for fish-breeding
  - Quality of shellfish waters
- MARINE POLLUTION
  - Strategy for the marine environment
  - Maritime safety: compensation fund for oil pollution damage
  - Maritime safety: prevention of pollution from ships

- Ship-source pollution and criminal penalties
- Maritime safety: prohibition of organotin compounds on ships
- Maritime safety: Bunkers Convention

- REGIONAL WATERS
  - European Union Strategy for Danube Region
  - Baltic Sea Strategy
  - Environment strategy for the Mediterranean
  - Strategy to improve maritime governance in the Mediterranean
  - Black Sea Synergy
  - Danube - Black Sea region

  - Regional convention
    - Barcelona Convention for the protection of the Mediterranean
    - Helsinki Convention on the protection of the Baltic Sea
    - Helsinki Convention: trans-boundary watercourses and international lakes
    - Convention for the Protection of the Rhine
    - OSPAR Convention

- DISCHARGES OF SUBSTANCES
  - Industrial emissions
  - Integrated pollution prevention and control (IPPC Directive)
  - Environmental quality standards applicable to surface water
  - Protection of groundwater against pollution
  - Detergents
  - Elimination and minimisation of production, use and release of persistent organic pollutants (POPs)
  - Pollution caused by nitrates from agricultural sources
  - Maximum concentrations of certain industrial Mercury discharges
  - Community strategy concerning mercury
  - Protection of the aquatic environment against discharges of dangerous substances (until 2013)
  - Other substances: protection of groundwater

- WATER TRANSPORT
  - Waterborne transport

One of the most important pieces of legislation in this area is the Water Framework Directive which is described in Chapter 2 and forms a core component of many of the Chapters in this book. ■

4 A SUMMARY OF THE EUROPEAN REGULATORY CYCLE

The European Treaty sets out the ground rules for developing and delivering concerted action by Member States.

4.1 ISSUE IDENTIFICATION

For an issue to become subject to European Law it needs to be of sufficient importance to be recognised by the European Parliament, Council and Commission as needing Community Action. The European Commission then produces a draft Communication or Directive and engages in consultation with interested parties across Member States.

4.2 DIRECTIVE FORMULATION

The draft Proposal is debated and modified in European Parliamentary Committees (and finally in the European Parliament). The European Parliament agrees the final text of the Directive, which the Commission then publishes in the Official Journal. The Commission then monitors the transposition of the Directive into national law in each Member State, checking that it is complete and on time. (If transposition is incomplete or late the Commission may initiate legal proceedings in the European Court of Justice against the Member State, which may result in heavy fines on a daily tariff until the Directive is properly transposed.)

4.3 MEMBER STATE IMPLEMENTATION

Each Member State has its own legal, institutional, and administrative system. For a given Directive the details of cascade of responsibility for delivery of Directive obligations from the lead national government department to 'on the ground' delivery will vary between Member States. In general, national government deals with macro-scale economic and policy issues, with detailed delivery of national transposed Directive obligations delegated to a subsidiary level of government – e.g. an agency or local government. The legal mechanism may be via 'administrative' law or 'criminal' law. Somewhat surprisingly, but presumably because it might be seen as interfering with national autonomy, the European Commission has not published comprehensive details of the institutional and delivery mechanisms adopted by Member States for delivering their environmental Directive obligations. In all cases it is the national government that has ultimate responsibility for delivery.

At transposition the Member State's national government issues an appropriate legal instrument (e.g. Act, Decree, Regulations, etc.), identifying the competent authority (e.g. government department or appointed regulator) for implementation of the Directive obligations. The national government also provides high level guidance for the competent authority, regulators, and affected businesses, e.g. water quality requirements and timescales for delivery.

4.4 REGULATOR ACTION

The regulator provides detail guidance and advice to affected parties, e.g. businesses and stakeholders, including non-governmental organisations; and provides application forms for those targeted by the Directive, e.g. operator and discharger, to apply for permits. Detail permitting processes vary between Member States. In the UK virtually all the permitting and compliance process is in the public domain, the exceptions being matters of National Security and Commercial Confidentiality. The regulator may charge for processing applications and for the subsistence of the permit.

4.5 OPERATOR ACTION

The operator or discharger then applies to the regulator for a permit. The regulator considers the application, consults interested parties, and determines the application. The regulator normally sets conditions consistent with Directive obligations in the permit, but if satisfied that the proposed activity would nevertheless place an unacceptable risk of pollution on the receiving water, they may refuse the application. The applicant either accepts the permit or may appeal to a government appointed appeal body, whose decision is binding on both parties.

If a permit is granted, the regulator prepares an inspection plan (see Chapter below) and the operator or discharger monitors the activity or discharge(s) in accordance with permit requirements, and reports data to the regulator. The regulator assesses compliance and initiates appropriate enforcement action in the event of any non-compliance or deterioration in performance.

4.6 REPORTING PROGRESS

The regulator collates and summarises data and reports to National Government, which in turn reports the Member State dataset to the European Environment Agency (EEA). The regulator may also publish data and summaries for public awareness of operator performance.

The EEA then collates Member State submissions and reports this information to the European Commission. The Commission produces a report on the results of implementation of the legislation to the European Parliament and Council, and makes recommendations as to any further need for regulation, etc. The European Parliament and Council then consider the information and instruct the European Commission on the action to be taken, including commencing another regulatory cycle to update requirements.

The overall process is summarised in Figure 4.1. ■

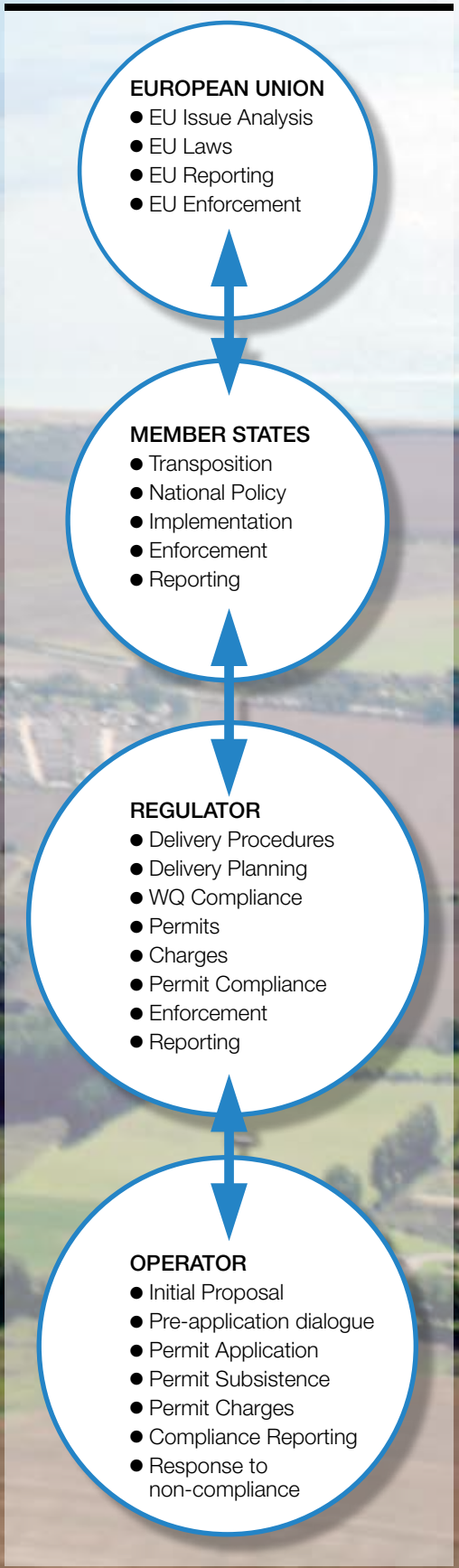
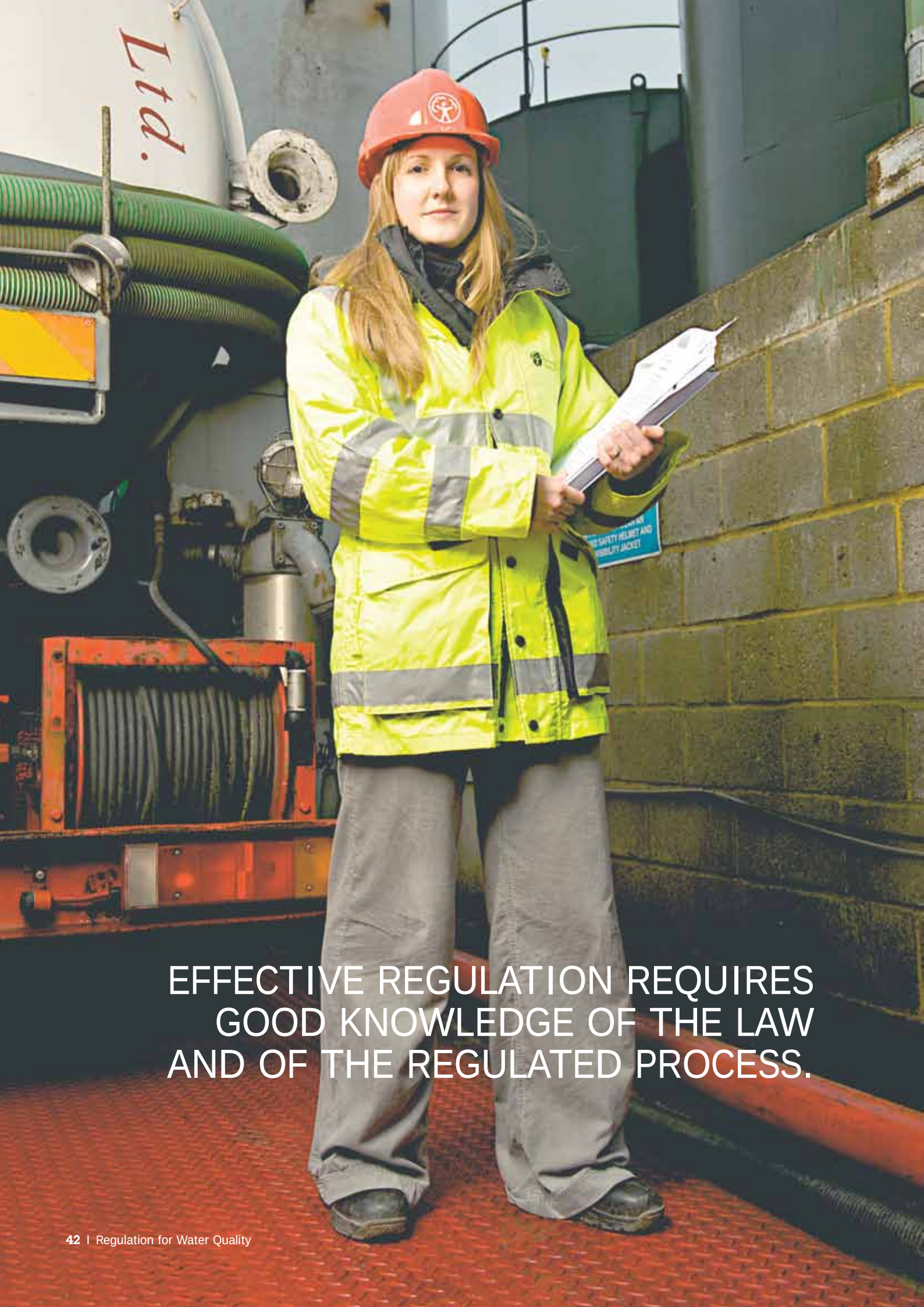


Figure 4.1 EU Policy to Delivery – Roles and Accountabilities



EFFECTIVE REGULATION REQUIRES GOOD KNOWLEDGE OF THE LAW AND OF THE REGULATED PROCESS.

5 ENVIRONMENTAL REGULATORY IMPLEMENTATION AND ENFORCEMENT AT THE EUROPEAN UNION LEVEL

Close cooperation between national authorities and the European Commission contribute to better implementation.

5.1 IMPEL

The European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL) is a network of the environmental authorities of EU Member States, acceding and candidate countries, and Norway. It provides a framework for policy makers, environmental inspectors and enforcement officers to exchange ideas, and encourages the development of enforcement structures and best practices.

IMPEL has produced two very useful books, key references for regulatory inspectors of discharges to water, on implementation of environmental regulation - The IMPEL Reference Book for Environmental Inspection (1999) and a step by step guidance book for planning environmental inspections 'Doing The Right Things 2 (2007)'.

The books are focused on site-based regulation, primarily for sectors whose emissions are regulated under the IPPC and associated Directives, now consolidated under the Industrial Emissions Directive, which are covered in more detail later in the book. They provide a more locally focused approach that complements and supports delivery of intended river basin planning outcomes. They are structured so as to initially provide and discuss high level regulatory principles and policy, with subsequent, more detailed chapters on approaches and techniques. Although not specifically focused on water, the books provide an excellent synthesis of principles and practice for the inspection and enforcement of permits for discharges or emissions affecting water.

5.2 ENVIRONMENTAL INSPECTION

The Reference Book for Environmental Inspection (1999) can be summarised as follows:

It is aimed at senior and middle managers as well as field inspectors. Top and middle management will find useful information on the administrative and inspection framework in addition to the organisation of inspectorates in EU Member States. Field inspectors will find a step-by-step and practical approach for inspection work. The step-by-step approach is supported by practical examples from all EU Member States.

Part III of the Reference Book is probably the most relevant for the work of the inspectors. Together with the other parts of the Reference Book, it contributes to:

- Improving human resources management and financial planning by senior and middle management, and strengthening the institutional framework of the inspectorates through the presentation of state-of-the-art management techniques related to running inspectorates, and descriptions of management aspects of inspectorates EU-wide.
- Reviewing, and if possible measuring, the quality of the inspectorates' performance, and measuring the quality of compliance activities by competent authorities, including evaluation of their effectiveness.

To provide an insight into site and permit inspection actions some important extracts from the IMPEL reference book are presented overleaf. ▶

Extract from EU Network for the Implementation and Enforcement of Environmental Law (IMPEL) Reference Book for Environmental Inspection (Section 8.6 – Checklist)

INSPECTION PLANNING A: CHECKLIST FOR THE INSPECTOR

Did you check the completeness of the dossier on the installation?

- **If so, check:**

- ■ Licence of the facility and details of the application procedure, including operator self-monitoring programme, EMAS, etc and reports from the operator to the authority
- ■ Up to date information about BATNEEC / IPPC / etc.
- ■ New regulations that are of importance to the facility
- ■ Technical drawings of the facility
- ■ Map of the facility premises
- ■ Descriptions of eventual new processes, expansions, modifications etc. in the facility that have been subjected to recent change (this should have resulted in issuing a revised licence)
- ■ Diagrams of the processes in the facility
- ■ Reports, letters, notifications etc. from previous inspections
- ■ Notices sent to the facility (depending on the character of the on-site visit (announced versus unannounced))
- ■ Seasonal influences that are of importance for the outcome of the visit
- ■ Essential environmental facts
- ■ Incidents which have taken place in the past
- ■ Earlier infringements
- ■ Aspects of the facility's operations which have not been thoroughly investigated and approved during a previous inspection
- ■ Notifications of environmental incidents
- ■ Research reports or environmental reports

Did you co-ordinate your activities with other (non-environmental) Inspectors?

- **If so, by:**

- ■ Deciding whether the inspection will have an integrated or a single media character
- ■ Contacting the regional and local officers (in Government service) to find out which facilities in their juridical area they will inspect in the near future. Ask them to send a list of those facilities
- ■ Sending those lists to the officers of other boards (e.g. the water quality board) to find out which facilities have an adequate licence
- ■ Trying to find out whether some facilities will be visited by more inspectors within short notice. Try to plan the on-site visit together with them
- ■ Contacting the police-officer(s) in charge of environmental affairs and the public prosecutor to know about complaints of the public, former prosecutions, sentences, reports etc.
- ■ Having meetings with the above-mentioned inspectors
- ■ You are accompanied by a colleague (in case of a serious incident).This in order to collect corroborated legal evidence (if necessary) and to question a person simultaneously

Which of the listed inspection tools are needed for the site visit?

- ■ Checklists (either site-specific or branch specific)
- ■ Information to hand out, e.g. about the inspectorate and the Ministry of Environment etc.
- ■ Information on the regulations on the items of inspection
- ■ Background information (addresses of other inspectors or of companies to inspect oil tanks etc.)
- ■ Laptop computer
- ■ Inquiry forms
- ■ The licence of the facility and details of the application procedure
- ■ Technical drawings of the premises and the plant
- ■ Process diagrams
- ■ Reports and letters, etc. from previous inspections
- ■ Notices sent to the factory
- ■ Equipment to take samples of the soil, air-emissions noise-emissions etc.
- ■ Identity card
- ■ Warrant card
- ■ Mobile phone (permission might be needed to take the phone during certain parts of the visit)
- ■ Photo camera
- ■ Personal protection equipment:
  - ◆ safety glasses
  - ◆ safety shoes/boots
  - ◆ special clothing
  - ◆ safety gloves
  - ◆ safety helmet
  - ◆ overall
  - ◆ ear protection
  - ◆ face protection

Extract from EU Network for the Implementation and Enforcement of Environmental Law (IMPEL) Reference Book for Environmental Inspection (Section 8.6 – Checklist) Cont.

INSPECTION PLANNING B: CHECKLIST FOR THE INSPECTORATE

Do you have an overview of all industrial activities?

- ● If so, it was compiled by information collected....
- ■ from the register of the Chambers of Industry and Commerce
- ■ from the yellow pages / business phone book
- ■ from the register of the local government, local business organisationsand local environmental organisations
- ■ by driving through the area and making a street up - street down registration.

Is the information verified?

- ● If so, the date of the last update is noted and the following of the listed methods were used
- ■ a location survey (drive by visit to all the companies registered)
- ■ visiting (actually entering the facility premises) all facilities to match the industrial activities against the registered data
- ■ sending a letter to the facility, in which an overview of the present activities or an upgrade of the details is requested

Is an update required of the available information?

- ● If so, because:
- ■ the owner of the potential polluting facility provided information about changes in processes or equipment
- ■ revision works were completed and a facility starts operating according to a revised licence
- ■ an (environmental) accident happened
- ■ complaints were received or a situation of non compliance is suspected
- ■ a regular visit was carried out by an inspector
- ■ a follow up visit is required

Were priorities for inspection set?

- ● If so, by using the following criteria:
- ■ polluting capability or risk
- ■ emission type (single media inspection)
- ■ recipient type - air, soil, water
- ■ branch or installation type
- ■ geographical area
- ■ number of complaints
- ■ natural resources consuming criteria
- ■ season of the year
- ■ availability of Environmental Management System in relation to quality and/or health and safety management system
- ■ other inspection programmes, agreements / conventions: EC / international / local government, branch, special environmental laws, special subjects (air, soil, water, energy, waste, risks)
- ■ notifications by the polluter
- ■ former non-compliance
- ■ specific / integral
- ■ inspection theme

5.3 INSPECTION PLANNING

The Summary for 'Doing the Right Things 2' - A Step by Step Guidance Book for Environmental Inspection (2007) states:-

Pursuant to the Recommendation providing for minimum criteria for environmental inspections (RMCEI) all inspection activities should be planned in advance. Practitioners have expressed the need for guidance to help the implementation of the minimum criteria on planning in the RMCEI. This guidance book was produced for that purpose. The guidance book takes as starting point the Environmental Inspection Cycle, which for the purpose of this guidance book consists of the following seven steps:

1. Describing the context
2. Setting priorities
3. Defining objectives and strategies
4. Planning and review
5. Execution framework
6. Execution and reporting
7. Performance monitoring

The first 4 steps form the Planning Cycle. The output of the Planning Cycle is the inspection plan. In order to write the inspection plan the inspecting authority first has to identify the relevant activities that should be covered by the inspection plan and gather information on these activities. With this information the inspecting authority can perform an assessment of the risks of the identified activities and assign priorities to these activities. Typical criteria that are taken ▶

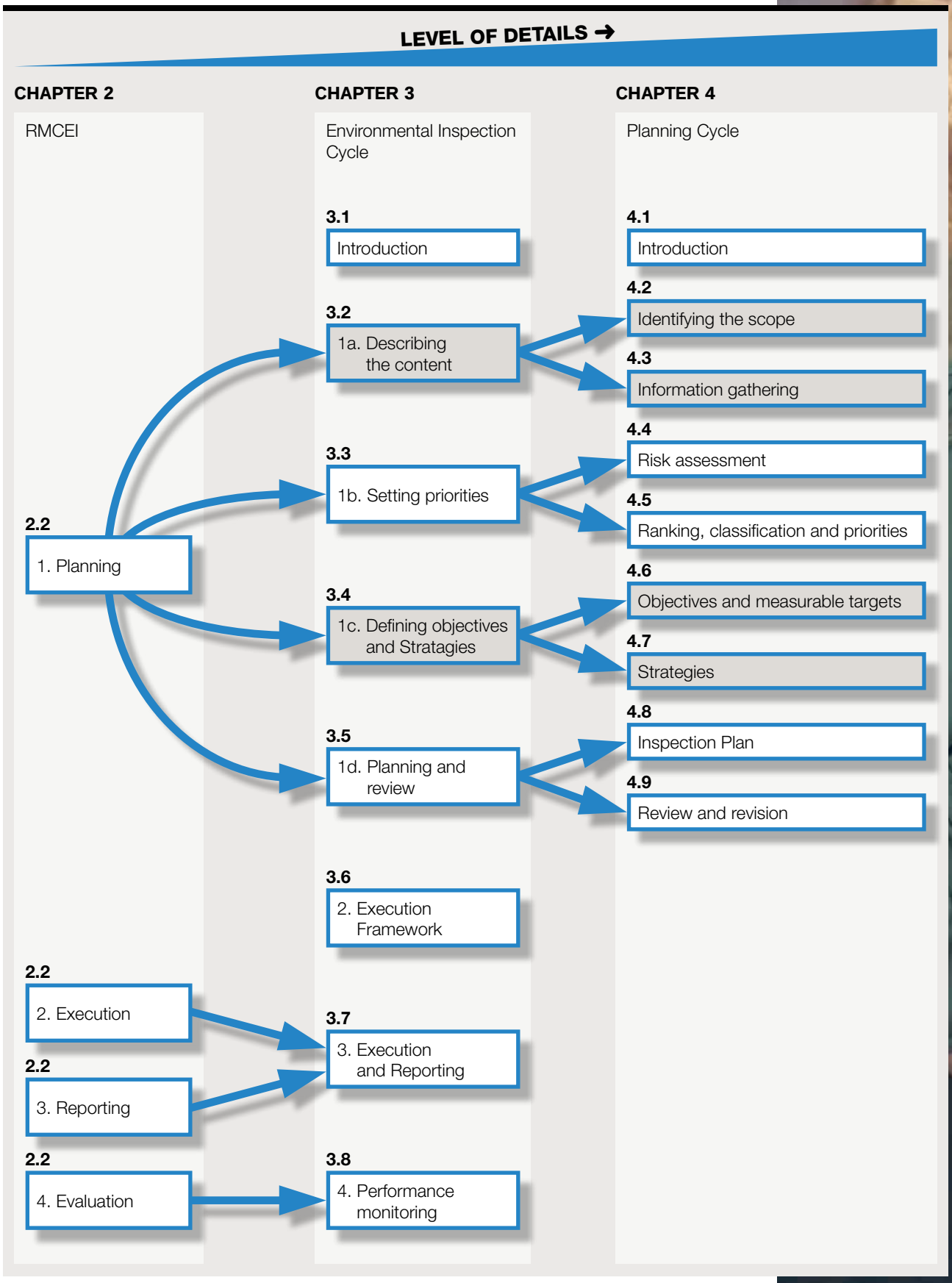


Figure 5.1 Extract from 'Doing the Right Things 2' - Step by Step Guidance Book for Environmental Inspection *(structure of book, page 10)*

into account when setting priorities are environmental impact, compliance record, legal obligations to inspect, (national) policies and objectives and available resources. The priorities indicate what activities should get (the highest) attention. A following step is to define (measurable) inspection objectives and targets for the activities to be inspected and to choose the best inspection strategy to accomplish these targets.

All these steps contribute to the inspection plan. The inspection plan clearly indicates the time period and area it covers. An inspection plan outlines the context in which the inspecting authority performs its inspections. It describes the mission and objectives of the inspecting authority, its statutory tasks and inspection obligations and (national) policies to be implemented. An inspection plan furthermore gives an overview of the priorities that have been assigned and explains why and how these priorities were set. The plan also gives general information on inspection targets, strategies, procedures and the planned inspection activities themselves. The inspection schedule describes what, where, when and by whom the different types of inspection activities will be executed. The inspection plan and the inspection schedule need to be reviewed and – when appropriate - revised periodically. ■

6 PUBLIC INFORMATION

Apart from obligatory public information such as the Register of Environmental Permits, etc., it is in environmental regulators' interests to raise awareness of environmental issues, problems and successes.

6.1 REGULATORY COMMUNICATION

Regulators need to engage as widely as possible with the general public, regulated and unregulated sectors, and with other regulatory bodies and tiers of government, in order to both identify their needs, and to communicate regulatory requirements.

Europe has moved quite rapidly from quasi-secrecy about environmental regulation to almost full disclosure of environmental and other information.

6.2 AARHUS CONVENTION

The United Nations Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, (the Aarhus Convention) came into force in 2001.

It provides for:-

- the right of everyone to receive environmental information that is held by public authorities ('**access to environmental information**').
- the right to participate in environmental decision-making. ('**public participation in environmental decision-making**').
- the right to review procedures to challenge public decisions that have been made without respecting the two aforementioned rights or environmental law in general ('**access to justice**').

The Convention has been implemented at the European Commission level via the EU Regulation 1367/2006 on the application of the provisions of the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters to Community institutions and bodies.

At Member State level the first pillar

('**access to environmental information**') has been implemented in EU legislation Directive 2003/4/EC on Public Access to Environmental Information. This was transposed into UK legislation through the Environmental Information Regulations (EIR) 2004, with separate but similar arrangements for Scotland.

Directive 2003/35/EC transposed the second pillar of the Aarhus Convention ('**public participation in environmental decision-making**') into Community legislation. First, it amends existing EU legislation by improving public participation provisions in the Environmental Impact Assessment (EIA) and the Integrated Pollution Prevention and Control (IPPC) Directives. Second, it introduces provisions for public participation in the preparation of environmental plans and programmes to six existing Directives on waste, air pollution and protection of waters against nitrate pollution. UK legislation translated the amendments to the EIA and IPPC Directives into the draft Town and Country Planning (2005) and the Pollution Prevention and Control (England and Wales, 2005) Regulations, respectively.

The Third pillar of the Aarhus Convention ('**Access to Justice**') remains at a 2003 EU Proposal level. This proposal establishes a set of minimum requirements on access to administrative and judicial procedures in environmental matters. It is intended to transpose the third pillar of the Aarhus Convention into Community law and the law of the Member States.

6.3 ENFORCEMENT BY THE PUBLIC

For acts and omissions by private persons it is proposed that the Member States guarantee that members of the public (natural or legal persons and their associations, organisations or groups) may initiate administrative or judicial procedures against acts or omissions of private persons that do not respect environmental law.

For acts and omissions by public authorities it is proposed that Member States will ensure that members of the public have access to administrative or judicial proceedings against administrative acts or omissions which infringe environmental law if they have a sufficient interest or if they show that their rights have been affected.

It is proposed that Member States guarantee that qualified entities (associations, groups or organisations recognised by a Member State whose objective is protecting the environment) may initiate administrative or judicial proceedings against violations of environmental law, without showing a sufficient interest or impairment of a right if the subject of the procedure is within the scope of their statutory and geographically relevant activities. Qualified entities recognised in a Member State may have recourse to such proceedings in another Member State.

Progress at EU level has stalled although most Member States have amended or interpreted national legislation to give effect to the 'access to justice' pillar of the Convention.

6.4 UK IMPLEMENTATION

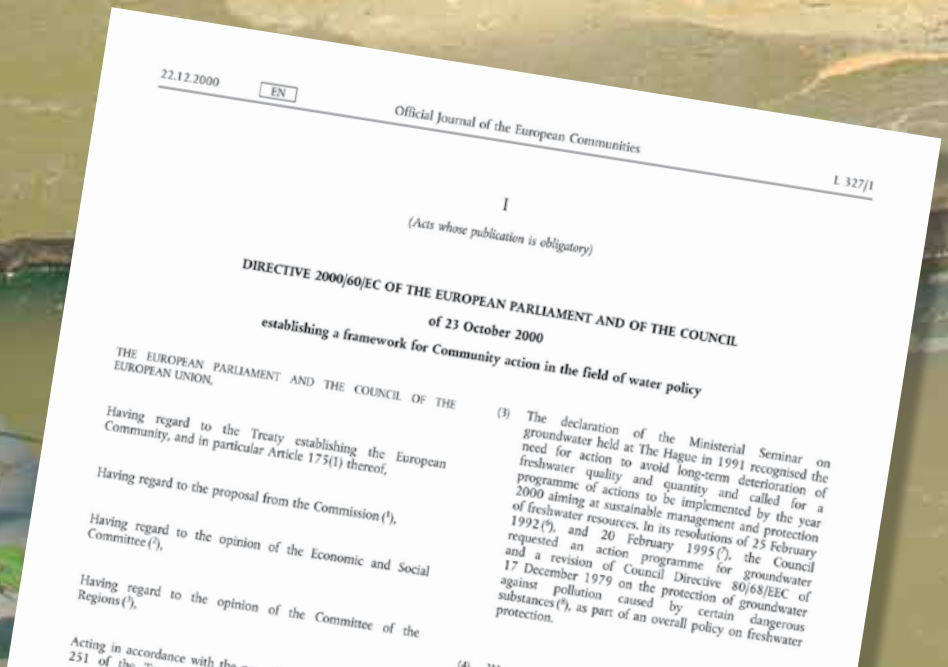
In the UK the Freedom of Information Act 2000, the Environmental Information Regulations 2004 and the establishment of the Information Commissioner (web site: http://www.ico.gov.uk/for_organisations/environmental_information.aspx) have all been moves towards ensuring that the public have access to environmental information, and are empowered to act upon it.

All the UK Environmental Regulators have invested considerable resources into developing their business activities and information management to make their public face as open as possible to their customers. Web sites are under constant development, with the aim of making as much environmental information as is practicable readily available to enquirers.

The Environment Agency has an interactive GIS system 'What's in Your Back Yard?' (WIYBY) http://apps.environment-agency.gov.uk/wiyby/default.aspx that allows users to locate and download a wide range of environmental information including permitted discharges, emissions records and water quality information, down to site level. ■

7 DEFINITIONS OF POLLUTION

Given man's ability to interact with the environment in so many ways, formulating a comprehensive definition of 'pollution' is quite difficult.



22.12.2000 EN Official Journal of the European Communities L 327/1

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(Acts whose publication is obligatory)

DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 23 October 2000

establishing a framework for Community action in the field of water policy

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 175(1) thereof,

Having regard to the proposal from the Commission (1),

Having regard to the opinion of the Economic and Social Committee (2),

Having regard to the opinion of the Committee of the Regions (3),

(3) The declaration of the Ministerial Seminar on groundwater held at The Hague in 1991 recognised the need for action to avoid long-term deterioration of freshwater quality and quantity and called for a programme of actions to be implemented by the year 2000 aiming at sustainable management and protection of freshwater resources. In its resolutions of 25 February 1992 (4), and 20 February 1995 (5), the Council requested an action programme for groundwater and a revision of Council Directive 80/68/EEC of 17 December 1979 on the protection of groundwater against pollution caused by certain dangerous substances (6), as part of an overall policy on freshwater protection.

7.1 THE EU IPPC DIRECTIVE

The EU IPPC Directive (and now the Industrial Emissions Directive) provide a wide definition:

'**Pollution** is defined as the direct or indirect **introduction as a result of human activity**, of substances, vibration, heat or noise **into the air, water or land which may be harmful to human health or the quality of the environment**, or result in **damage** to material property, or **impair** or interfere with **amenities** and other **legitimate uses** of the environment'.

7.2 THE EU WATER FRAMEWORK DIRECTIVE

The EU Water Framework Directive uses a slightly narrower definition focused on water:

'**Pollution** means the direct or indirect **introduction, as a result of human activity, of substances or heat into the air, water or land which may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems**, which result in damage to material property, or which impair or interfere with **amenities** and other **legitimate uses** of the environment'.

The Water Framework Directive also contains the following definitions for Hazardous Substances, Priority Substances and Pollutant:

- **'Hazardous substances'** means substances or groups of substances that are toxic, persistent and liable to bio-accumulate, and other substances or groups of which give rise to an equivalent level of concern.
- **'Priority substances'** means substances identified in accordance with Article 16(2) i.e. identified by the European Commission as being of concern because of toxicity, environmental contamination, widespread use, etc.) and listed in Annex 10 (a List subsequently provided by the EQS Directive /2008/105/EC, see below).
- Among these substances there are **'priority hazardous substances'** which means substances identified in accordance with Article 16(3) and (6) for which measures have to be taken in accordance with Article 16(1) and (8).
- **'Pollutant'** means any substance liable to cause pollution, in particular those listed in Annex VIII. (i.e. essentially chemicals, but does not specifically include organisms or micro-organisms)

7.3 EU 'DAUGHTER' DIRECTIVE ON PRIORITY SUBSTANCES - ENVIRONMENTAL QUALITY STANDARDS IN THE FIELD OF WATER POLICY (THE EQS DIRECTIVE)

The EQS Directive sets out environmental quality standards concerning the presence in surface water of certain pollutants and substances or groups of substances identified as priority on account of the substantial risk they pose to, or via, the aquatic environment.

The priority substances are defined by Directive 2000/60/EC (the Water Framework Directive) which establishes a list of 33 priority substances including cadmium, lead, mercury, nickel and its compounds, benzene, polyaromatic hydrocarbons (PAH) and DDT total. Twenty priority substances are classed as hazardous.

In 2013 a revision was made to the EQS and Water Framework Directives, adding 12 new substances to the list of priority substances, with stricter standards for 7 substances already on the list. The background to the decision is on the Europa web site.

The planned environmental quality standards are limits to the degree of concentration, i.e. the quantity in water of the substances concerned must not exceed certain thresholds. Two types of standard are proposed:

- the average value or concentration ▶

- of the substance concerned calculated over a one-year period – the Annual Average Environmental Quality standard (AA-EQS). The purpose of this standard is to ensure the long-term quality of the aquatic environment.
- the maximum allowable concentration (MAC) of the substance measured specifically – the MAC-EQS. The purpose of this second standard is to limit short-term pollution peaks.

The quality standards are differentiated for inland surface waters (rivers and lakes) and other surface waters (transitional, coastal and territorial waters). Specific standards are also set for metals and certain other substances.

Member States must ensure compliance with these standards. They must also verify that the concentration of substances concerned does not increase significantly in sediments and/or the relevant biota.

The Directive also provides for Member States to establish transitional mixing areas, where the quality standards may be exceeded provided that the rest of the surface water body complies with those standards. These areas must be clearly identified in the river basin management plans established in accordance with the Water Framework Directive. (The Commission has subsequently published guidance on Mixing Zones. This is referenced in Chapter 25.)

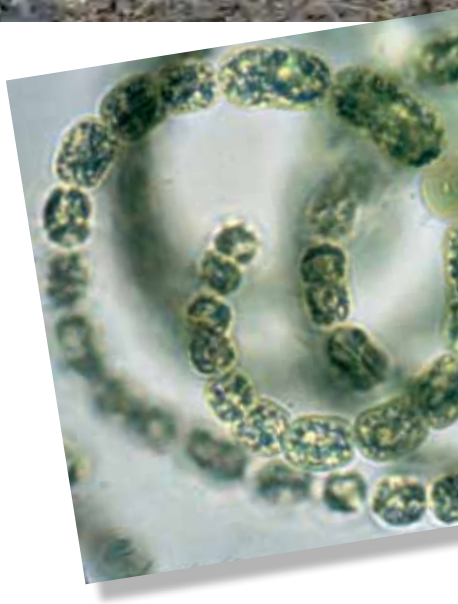
For each river basin, Member States must establish an inventory of emissions, discharges and losses of all substances identified in this Directive. On the basis of this inventory, the Commission must verify whether, by 2018, the objectives of gradually reducing pollution from priority substances and of ceasing or phasing out emissions, discharges and losses of priority hazardous substances have been reached.

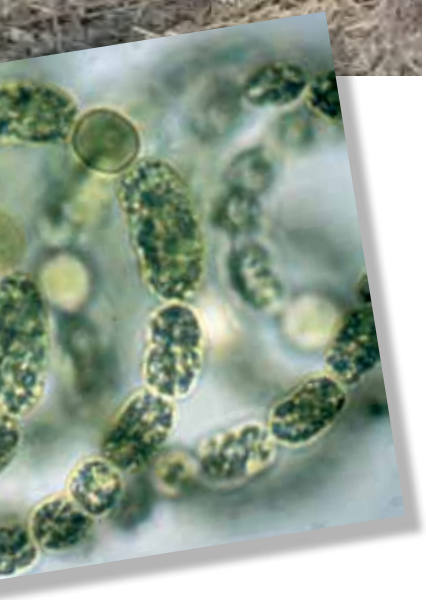
7.4 POLLUTION DEFINITION - ISSUES AND EXCEPTIONS

The pollution definition could be improved in several areas:

7.4.1 'ORGANISMS' OR 'MICROORGANISMS'

Neither definition specifically includes 'organisms' or 'microorganisms' within the term 'substances'. This is surprising given that both Directives are aimed at the protection of human and ecological health and amenity, and human activity





results in introductions of pathogenic microorganisms and alien species to the environment. Note that the Scottish Government includes 'bacteria and other pathogens' as 'substances' in its definition of 'pollutant' for the CAR Regulations. (Reg. 2, The Water Environment (Controlled Activities) (Scotland) Regulations 2011).

7.4.2 OVER-ABSTRACTION OF WATER

There are also some other anomalies. Many substances are only harmful in high concentration. Over-abstraction of water is the reverse of introduction of substances, yet has the same effect by reducing the amount of dilution, potentially causing legitimate discharges downstream of the abstraction to have an unacceptable impact because the expected dilution is not available. Arguably, over-abstraction causes pollution. Integrated water management requires a close liaison between those involved in licensing abstractions from river basins and those engaged in permitting discharges to them. Whilst the Water Framework Directive provides adequate cover to ensure this, it would be helpful for the explicit linkage to be made in the definition of 'pollution'.

7.4.3 INTRODUCTION OF SUBSTANCES OR HEAT

Another issue relates to the 'introduction of substances or heat'.

Industrial cooling systems, especially for power stations, may take large quantities of water from the river, pass through pumps and heat exchangers and then return it all but with the addition of heat. Excess heat may be regarded as a pollutant and the mechanical processing of the water and high temperature gradients in the heat exchangers will affect the biota in the water. Considerable effort is often required to ensure that intake systems have positive measures to prevent fish being drawn into the intake, and to protect and return those that do enter the intake. Also the water must be cooled sufficiently so that the thermal shock of the discharged water does not adversely affect the biota in the receiving water.

Hydro-electric schemes often release cold water from the bottom of reservoirs to the headwaters of a much warmer catchment. Conversely, they may add warm water from the surface of a lake to a cold upland river. Open loop surface water heat pumps may also discharge very cold water. The thermal shock of the cold water on receiving water organisms may be fatal or impair feeding or reproductive behaviours. In either case there is a removal rather than introduction of heat yet there is undoubtedly a harmful effect.

The definition might be better worded '... introduction of substances, or introduction or removal of heat…'

7.4.4 DIFFUSE POLLUTION

Another issue associated with the definition of pollution relates to '…direct or indirect introduction…' and concerns land activities such as agriculture, forestry and urbanisation. Deforestation and poor land management practice, particularly in uplands, can result in rapid erosion of soil and nutrients into watercourses, radically altering the aquatic ecology. Similarly, urban rainfall runoff can be rapid, causing flooding and bank erosion and may be highly contaminated. It is important to consider the need for regulation of such activities that traditionally have shown little cognisance of their wider environmental impact. ■

UK APPROACH TO REGULATION

The general principles adopted by the UK are that regulatory activities should be carried out in a way which is

- TRANSPARENT
- ACCOUNTABLE
- PROPORTIONATE
- CONSISTENT
- TARGETED ONLY AT CASES IN WHICH ACTION IS NEEDED

8 UK REGULATORY PRINCIPLES

The UK has done extensive work to analyse how to make regulatory activity work better, and some important principles are highlighted here. This work can be important to other countries as a best practice framework.

The UK Government has produced a **Regulators Compliance Code**. The principles and requirements of the Code are applicable to a wide range of regulators, not just environmental. The Environment Agency has included on its web site links to the Code, and Government Code of Practice on Guidance on Regulation:

These general principles adopted by the UK are that regulatory activities should be carried out in a way which is

- transparent
- accountable
- proportionate
- consistent
- targeted only at cases in which action is needed.

The Regulators Compliance Code was introduced in 2007 in response to concerns from business and within government that inflexible or bureaucratic regulatory activity might be contradictory to economic growth, social wellbeing and environmental protection.

The Code at first glance appears to significantly restrict the ability of regulators to do the job they have been set up to do. But in fact the Code provides an excellent business planning template for regulators to ensure that a balanced and proportionate approach is taken in securing essential regulatory outcomes.

The government expects that as regulators integrate the Code's standards into their regulatory culture and processes, they will become more efficient and effective in their work. They will be able to use their resources in a way that gets the most value out of the effort that they make, whilst delivering significant benefits to low risk and compliant businesses through better-focused inspection activity, increased use of advice for businesses, and lower compliance costs.

Further information is provided in the Code of Practice on Guidance on Regulation.

There is also an Environment Agency Position Statement on providing advice and guidance to business.

8.1 BACKGROUND TO THE REGULATORS COMPLIANCE CODE

The UK has a long history of regulation, and business interests have persistently raised concerns about what they see as unnecessary 'red tape', or 'administrative burden' that impedes innovation and profitability, particularly for the majority of businesses that comply with their regulatory requirements. There was concern that regulators were too inflexible in their approach and that much regulatory effort was either unnecessary or untargeted, and that regulators were too remote from, and provided insufficient advice to, the businesses that they regulated.

In 2005 the UK Treasury published a report it had commissioned on the scope for reducing administrative burdens by promoting more efficient approaches to regulatory inspection ▶

THE HAMPTON PRINCIPLES

The Hampton Review set out some key principles that should be consistently applied throughout the regulatory system:

- **regulators, and the regulatory system as a whole, should use comprehensive risk assessment to concentrate resources on the areas that need them most**
- **regulators should be accountable for the efficiency and effectiveness of their activities, while remaining independent in the decisions they take**
- **no inspection should take place without a reason**
- **businesses should not have to give unnecessary information, nor give the same piece of information twice**
- **the few businesses that persistently break regulations should be identified quickly and face proportionate and meaningful sanctions**
- **regulators should provide authoritative, accessible advice easily and cheaply**
- **regulators should be of the right size and scope, and no new regulator should be created where an existing one can do the work**
- **regulators should recognize that a key element of their activity will be to allow, or even encourage, economic progress and only to intervene when there is a clear case for protection.**

and enforcement, without compromising the UK's excellent regulatory standards or outcomes (the Hampton Review).

The review covered all areas of regulation, not just environment. The aim of the review was to reduce administrative burdens on businesses (the cost of being regulated) whilst ensuring that the outcomes of regulation continue to be delivered. A fundamental recommendation was that risk assessment should be at the heart of all regulatory activity. Thus compliant businesses should receive light touch regulation, whilst regulators could pay more attention to poor performers.

The UK Government accepted the review and subsequently introduced a Statutory Code for Regulators – The Regulators Compliance Code, which applies, in full or in part, to all UK regulators, and codifies the principles of good regulation set out in the Hampton Report.

The review found that the current regulatory system imposed too many forms, duplicate information requests and multiple inspections on businesses. Hampton recommended that introducing risk assessment could:

- reduce inspections by up to a third – meaning around one million fewer inspections
- cut the number of forms sent by regulators by almost 25 per cent

The report also stated that risk assessment would help regulators target non-compliant businesses more effectively, and reduce the burden on those businesses that do comply.

8.2 HAMPTON REVIEW

In his final report, Hampton proposed:

- reducing inspections where risks are low, but increasing them where necessary
- making much more use of advice, applying the principle of risk assessment
- substantially reducing the need for form-filling and other regulatory information requirements
- applying tougher and more consistent penalties where necessary
- reducing the number of regulators that businesses deal with from thirty-one to seven
- entrenching reform by requiring all new policies and regulations to consider enforcement, using existing structures wherever possible
- creating a business-led body at the centre of government to drive implementation of the recommendations and challenge departments on their regulatory performance

As a result of this final recommendation, the government created a Better Regulation Executive (BRE) to oversee the reduction of regulatory burdens on business, and hold government departments and regulators to account. The government's response to the recommendations can be seen in 'Implementing Hampton: from enforcement to compliance'.

The UK Government and BRE continue to implement the Hampton principles through the work of the Improving Regulatory Delivery Team. Updates on progress are published on the Department for Business, Innovation and Skills (BIS) web site at http://www.bis.gov.uk/policies/bre/improving-regulatory-delivery

8.3 REGULATORY SANCTIONS AND ENFORCEMENT

In parallel with the Hampton Review the UK government was also looking at the effectiveness of regulatory sanctions and commissioned Prof. Richard Macrory to prepare a report on Regulatory Justice: Making Sanctions Effective (The Macrory Review). See http://www.bis.gov.uk/files/file44593.pdf

The Macrory Review made several wide-ranging recommendations for legislative and policy reform, many of which the UK Government accepted, in particular the introduction of Civil Penalties in the Regulatory Enforcement and Sanctions Act 2008. A web link to the Act is provided at: http://www.legislation.gov.uk/ukpga/2008/13/contents

Key recommendations from the Macrory Review, which are largely included in the Regulators Compliance Code, were that in designing the appropriate sanctioning regimes for regulatory non-compliance, regulators should have regard to the following six Penalties Principles and seven characteristics:

MACRORY REVIEW – ENFORCEMENT AND SANCTIONS

Six Penalties Principles

A sanction should:

1. **Aim to change the behaviour of the offender.**
2. **Aim to eliminate any financial gain or benefit from non-compliance.**
3. **Be responsive and consider what is appropriate for the particular offender and regulatory issue, which can include punishment and the public stigma that should be associated with a criminal conviction.**
4. **Be proportionate to the nature of the offence and the harm caused.**
5. **Aim to restore the harm caused by regulatory non-compliance, where appropriate.**
6. **Aim to deter future non-compliance.**

Seven characteristics

Regulators should:

1. **Publish an enforcement policy.**
2. **Measure outcomes not just outputs.**
3. **Justify their choice of enforcement actions year on year to stakeholders, Ministers and Parliament.**
4. **Follow-up enforcement actions where appropriate.**
5. **Enforce in a transparent manner.**
6. **Be transparent in the way in which they apply and determine administrative penalties.**
7. **Avoid perverse incentives that might influence the choice of sanctioning response.**

Details of the civil sanctions currently available to the Environment Agency are discussed in Chapter 25.

9 REGULATORY APPROACHES AND OPTIONS – THE TOOLBOX

The focus of regulatory interventions of whatever form should be to achieve a desired environmental outcome, generally that all the Principles of environmental legislation are fulfilled.

This can be summarised for water as achieving the target Status or Class for the water body. The options available are summarised in Figure 9.1.

Traditionally, point source industrial and sewage discharges to water, ie via a pipe or channel, have been dealt with by Direct Regulation. A risk-based approach is used focussing on the hazard that the activity presents to the environment, the likelihood of it happening and the consequences should it happen.

For the highest risk, or most complex discharges, bespoke permits are required, tailored to the individual circumstances of the discharge and receiving water.

For less risky discharges, typically those with high dilution available and low complexity, such as small < 20 m³ / day sewage works, standard permits

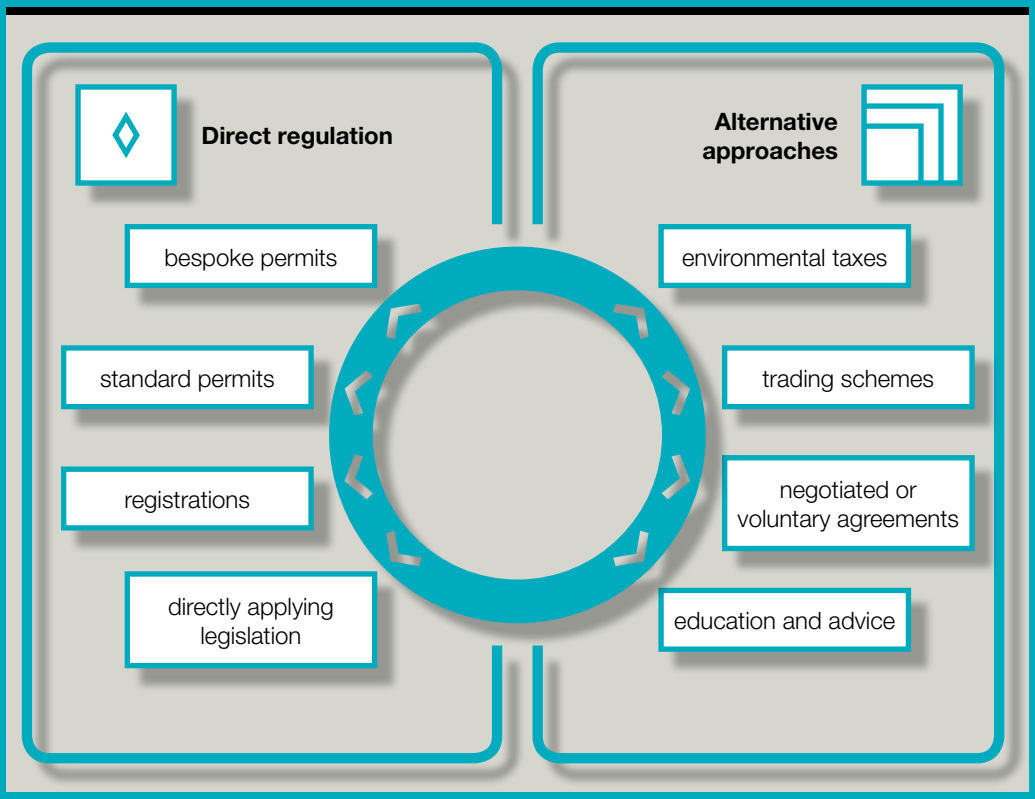


Figure 9.1 Regulatory approaches to achieve desired environmental outcomes

From Delivering for the Environment, EA 2005

can be produced where the regulator establishes a generic risk assessment, and similar permit conditions apply to all qualifying discharges, which then attract a lower charge than a bespoke permit.

For small discharges that require ongoing maintenance, e.g small domestic sewage works serving only one or a few properties, registration may be used, where the operator notifies the regulator of the discharge and in so doing agrees to comply with a set of standard obligations set out in the registration requirements. There may be a one-off administrative charge or registrations may be renewable.

Finally the law may apply directly. Typically this is either via prohibitions in primary legislation, e.g. prohibition on discharging inflammable liquids to sewer, or by generally binding rules set out in Regulations, e.g. requirements in the Scottish Controlled Activities Regulations for sustainable drainage systems (SuDS) at all new development sites.

Diffuse polluting inputs from these and other sources have been largely unregulated, and addressing them requires alternative approaches such as environmental taxation, education and voluntary initiatives. A threat of financial sanction, or, more positively, a financial inducement to move in the right direction for environmental protection and improvement, generally stimulates innovation towards securing the desired outcome. Public awareness and participation in addressing local diffuse pollution problems can be very effective in securing good environmental behaviours from land users. This issue is discussed further in Chapters 22 and 26.

The Environment Agency has addressed much of the above in its booklet 'Delivering for the Environment – A 21st Century Approach to Regulation'. It is available on request from the Publications section of the Environment Agency Web Site. ■

10 DIRECTIVE GUIDANCE

For complex legislation such as the Water Framework Directive (WFD) or the Integrated Pollution Prevention and Control Directive (IPPC) and the Industrial Emissions Directive (IED), the European Commission and Member States have recognised that centralised guidance is needed to help Member States interpret their obligations and to deliver the intended outcomes.

The following sections outline the nature of EU–level guidance that is available in the public domain, mostly via the internet. Key web sites and documents are also signposted as embedded links to relevant web sites. Important references are included as hyperlinks to .pdf files.

10.1 COMMON IMPLEMENTATION STRATEGY FOR WATER FRAMEWORK DIRECTIVE

For the Water Framework Directive, the Member States and European Commission established a Common Implementation Strategy, (CIS) in 2001, addressing some of the issues where a common approach across Member States is essential in order to prevent market distortion, or where the legal obligation or scientific definitions need further development or clarification. The initiating Common Implementation Strategy document can be found at the following link: http://ec.europa.eu/environment/water/water-framework/objectives/implementation_en.htm

The aim of the CIS was, and is, to allow, as far as possible, a coherent and harmonious implementation of the Water Framework Directive. Most of the challenges and difficulties arising were recognised to be common to all Member States. Many of the European river basins are shared, crossing administrative and territorial borders, where a common understanding and approach is crucial to successful and effective implementation. A Common Strategy was recognised as limiting the risks of bad application of the Directive and subsequent disputes.

The focus is on methodological questions related to a common understanding of the technical and scientific implications of the Water Framework Directive. The aim has been to clarify and develop, where appropriate, supporting technical and scientific information to assist in the practical implementation of the Directive. Guidance documents, providing advice on operational methods, have been developed for this purpose. However, such documents have an informal and non-legally binding character and are placed at the disposal of Member States who wish to use them on a voluntary basis.

The guidance documents produced in the frame of the joint Strategy were seen as forming the basis for guidelines, which could be adopted under the Committee procedure for amendment to the Directive. The process established within the joint Strategy could therefore partly be seen as an informal preparation for the Committee procedure for some specific areas. ▶

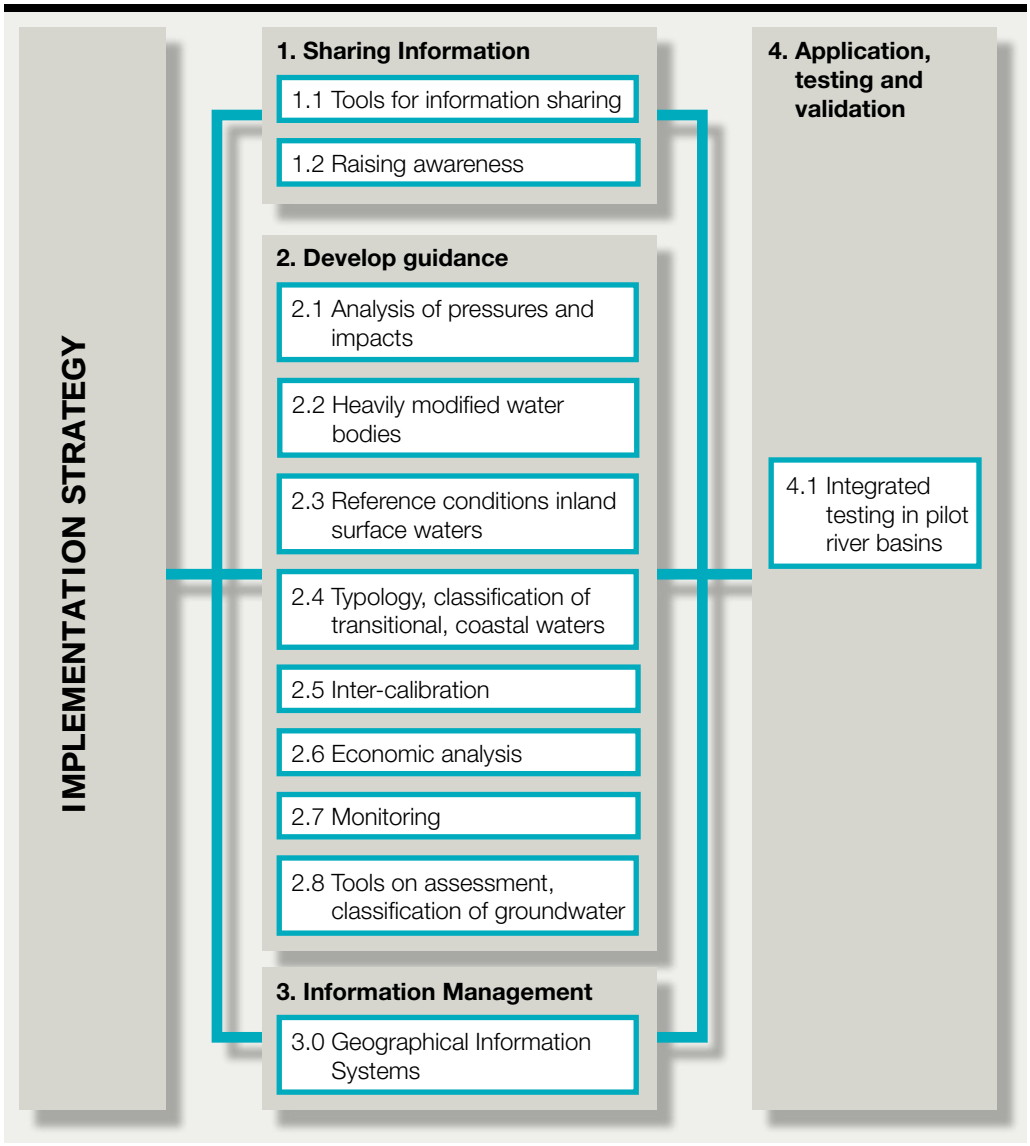


Figure 10.1 Common Implementation Strategy

The following elements were identified for a Common Strategy for the implementation of the Water Framework Directive:

- The necessity to **share information** between Member States and the European Commission. The need to inform and involve **the public and promote public awareness of** the key elements of the WFD and issues linked to its implementation.
- The need to ensure **coherence** between the implementation of the WFD and **other sectoral and structural policies**.
- The need to ensure **coherence** between the implementation of the WFD, other water Directives and process and product oriented Directives.
- The need to **integrate activities** on different horizontal issues for the effective development of river basin management plans and implementation of the WFD.
- The need for **capacity building** in Member States for an effective implementation of the WFD.
- The need to involve **stakeholders and the civil society** in the implementation of the WFD.
- The need to promote a **common attitude** towards Candidate Countries of Central and Eastern Europe regarding their possible involvement in activities (this is key for shared international river basin districts).

- The need to establish **working groups** and develop **informal guiding and supporting documents** on key aspects of the WFD.

Working groups were established on different issues for which common activities were deemed to be necessary. These include groundwater, reference conditions, heavily modified water bodies, economics, limits and definition of river basins, methods for the development of river basins management plans, public and stakeholder participation, 'significance' levels/thresholds, monitoring and the development of a shared structure for Geographic Information Systems (GIS).

Figure 10.1 shows the links between the horizontal and vertical activities and outlines the guidance documents developed to assist in the implementation of the WFD.

10.2 IPPC & IED DIRECTIVE GUIDANCE

Industrial production processes account for a considerable share of the overall pollution in Europe (pollutants such as greenhouse gases, acidifying substances, wastewater emissions and waste). The EU has a set of common rules for licensing and controlling industrial installations in the IPPC Directive of 1996.

In essence this Directive is about preventing, and when this is not ▶

Completed, draft and planned BREF Notes and Executive Summaries of BREF Notes are currently available on the European IPPC Bureau web site for the following Sectors:

Best Available Techniques Reference Document (BREFs)	Code	Adopted Document	Formal draft (*)	Meeting report	Estimated review start
Ceramic Manufacturing Industry	CER	BREF (08.2007)			
Common Waste Water and Waste Gas Treatment / Management Systems in the Chemical Sector	CWW	BREF (02.2003)	D2 (07.2011)	MR (06.2008)	
Emissions from Storage	EFS	BREF (07.2006)			
Energy Efficiency	ENE	BREF (02.2009)			
Ferrous Metals Processing Industry	FMP	BREF (12.2001)			Review on hold
Food, Drink and Milk Industries	FDM	BREF (08.2006)			2014
Industrial Cooling Systems	ICS	BREF (12.2001)			
Intensive Rearing of Poultry and Pigs	IRPP	BREF (07.2003)	D2 (08.2013)	MR (06.2009)	
Iron and Steel Production	IS	BATC (03.2012) BREF (03.2012)			
Large Combustion Plants	LCP	BREF (07.2006)	D1 (06.2013)	MR (10.2011)	
Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilisers Industries	LVIC-AAF	BREF (08.2007)			
Large Volume Inorganic Chemicals – Solids and Others Industry	LVIC-S	BREF (08.2007)			
Large Volume Organic Chemical Industry	LVOC	BREF (02.2003)		MR (12.2010)	
Management of Tailings and Waste-rock in Mining Activities	MTWR	BREF (01.2009)			
Manufacture of Glass	GLS	BATC (03.2012) BREF (03.2012)			
Manufacture of Organic Fine Chemicals	OFC	BREF (08.2006)			
Non-ferrous Metals Industries	NFM	BREF (12.2001)	D3 (02.2013)	MR (09.2007)	
Production of Cement, Lime and Magnesium Oxide	CLM	BATC (04.2013) BREF (04.2013)			
Production of Chlor-alkali	CAK	BREF (12.2001)	FD (04.2013)	MR (09.2009)	
Production of Polymers	POL	BREF (08.2007)			
Pulp and Paper Industry	PP	BREF (12.2001)	FD (07.2013)	MR (11.2006)	
Production of Speciality Inorganic Chemicals	SIC	BREF (08.2007)			
Refining of Mineral Oil and Gas	REF	BREF (02.2003)	FD (07.2013)	MR (09.2008)	
Slaughterhouses and Animals By-products Industries	SA	BREF (05.2005)			
Smitheries and Foundries Industry	SF	BREF (05.2005)			
Surface Treatment of Metals and Plastics	STM	BREF (08.2006)			
Surface Treatment Using Organic Solvents	STS	BREF (08.2007)			2014
Tanning of Hides and Skins	TAN	BATC (02.2013) BREF (02.2013)			
Textiles Industry	TXT	BREF (07.2003)			
Waste Incineration	WI	BREF (08.2006)			2014
Waste Treatments Industries	WT	BREF (08.2006)			Review started
Wood-based Panels Production	WBP	-	D1 (07.2013)	MR (11.2011)	
Wood and Wood Products Preservation with Chemicals	WPC	-			2014
Reference Document (REFs)	**Code**	**Adopted Document**	**Formal draft (*)**	**Meeting report**	**Estimated review start**
Economics and Cross-media Effects	ECM	REF (07.2006)			
Monitoring of emissions from IED-installations	ROM	REF (07.2003)	FD (10.2013)		

possible, minimising pollution from various industrial sources throughout the European Union, and achieving integrated control of their emissions, consumption of energy, water and raw materials. About 50,000 installations in the EU are involved and their operators have to obtain an authorisation (environmental permit).

The IPPC Directive (Directive 2008/1/EC) which limits pollution to all media (land, water and air) from major industries has been updated by the Directive on industrial emissions 2010/75/EU (IED). Transposition into Member State law was scheduled to have been completed by January 2013. There is currently a transition phase between the requirements of IPPC and IED. Details of both Directives, and the development of guidance for IED, are available on the European Commission's web site: http://ec.europa.eu/environment/air/pollutants/stationary/index.htm

For IPPC and IED the Commission has established BAT Reference Notes (BREF Notes) which describe the techniques and technologies likely to be acceptable to regulators as indicative Best Available Techniques (BAT) for the reduction of pollution from the industrial sectors subject to the Directive. These serve as a reference for EU Member States' authorities to ensure that permits for the industrial processes concerned include emission limit values based on best available techniques that have been determined by working groups encompassing experts from industry and national administrations.

The IPPC BREF Notes are continually being revised to include developments in knowledge and techniques. Additionally, the requirements of the IED are being incorporated. The European Commission has issued a Commission Implementing Decision (2012/119/EU) specifying the requirements for drawing up and reviewing BAT Reference Documents (BREFs).

The BREF Notes and reviews are coordinated and, after sanction by the Commission, published by the European IPPC Bureau. The European Integrated Pollution Prevention and Control (IPPC) Bureau is located in the Institute for Prospective Technological Studies (IPTS). ■

11 RIVER BASIN PLANNING AND DEVELOPMENT OF THE EU WATER FRAMEWORK DIRECTIVE PROGRAMMES OF MEASURES

The Water Framework Directive (WFD) provides the strategic planning framework for water management across Europe. Regulation in all forms is the key mechanism for implementing the Directive and is brought into force in accordance with the river basin plans and the integral programmes of measures.

11.1 WFD PLANNING CYCLE

The interaction of the planning cycle with the programmes of measures is shown in Figure 11.1 and follows a six year cycle, repeated over three cycles. The timetable for action is included in Table 11.1.

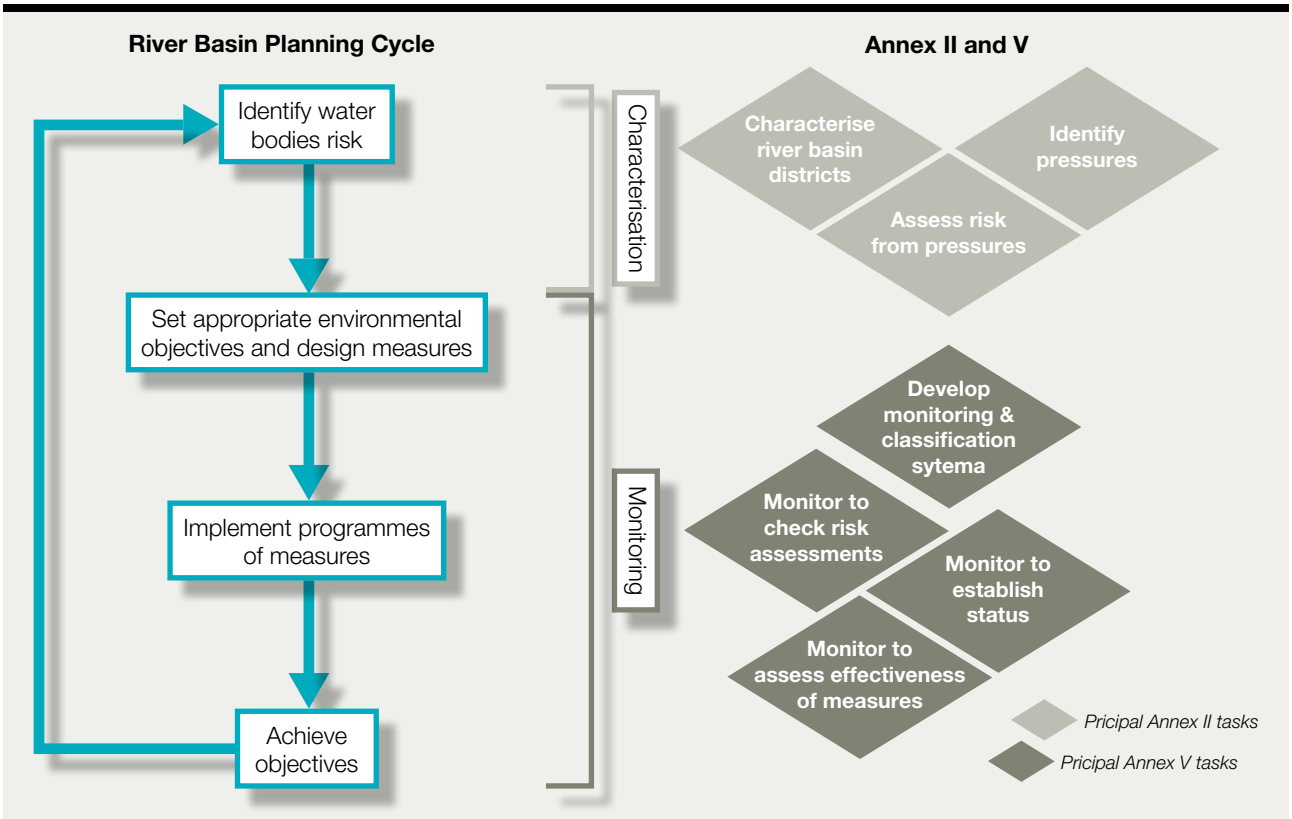


Figure 11.1 Relationship between river basin planning, monitoring and the programmes of measures

Source - Scottish Environmental Protection Agency (SEPA), 2002, Future for Scotland's Waters

TABLE 11.1 WATER FRAMEWORK DIRECTIVE TIMETABLE
(ADAPTED FROM FOUNDATION FOR WATER RESEARCH)

Complete action by year end	Action Required	EU Directive Articles	Overview
2000	**Water Framework Directive entered into force**	**Article 22 Article 25**	**3 years for Member States to prepare**
2003	• **Transpose requirements to national legislation** • Define River Basin Districts and Authorities	**Article 23** Article 3	
2004	Characterise river basins: pressures, impact and economic analysis	Article 5	**6 years to analyse issues and prepare the River Basin Management Plans**
2005	**Identify significant trends in groundwater pollution**	**Article 17**	
2006	• **Establish environmental monitoring programmes** • **Publish and consult on a work programme for the production of the first River Basin Management Plans** (RBMPs) • **Establish environmental quality standards** (EQSs) for surface water	**Article 8** **Article 14** **Article 16**	
2007	• Report monitoring programmes to the EC • **Publish and consult on summary of significant water management issues** (SWMI) for each River Basin District	Article 14	
2008	Publish and consult on drafts of the RBMPs	Article 14	
2009	• Publish the first RBMP for each River Basin District • **Establish programmes of measures** (PoMs) in each River Basin District in order to deliver environmental objectives	Article 13 **Article 11**	
2010	• Report RBMPs, including PoMs to the EC • **Introduce water pricing policies**	Article 9	**3 years to put programmes of measures in place**
2012	• **Ensure all POMs are fully operational** • Report progress in implementing the first RBMPs	**Article 11** Article 15	
2013	**Review progress of the first RBMP cycle**		**3 years to achieve specified objectives**
2015	Main environmental objectives specified in the first RBMPs met?	Article 4	
2015	**Review and update first RBMPs**	**Articles 13, 14 and 15**	**Further 6 years' planning, consultation and implementation cycles**
2021	• Main environmental objectives specified in the second RBMPs met? • **Review and update second RBMPs**	Article 4 **Articles 13, 14 and 15**	**Further 6 years' planning, consultation and implementation cycles**
2027	• Main environmental objectives specified in the third RBMPs met? • **Review and update third RBMPs**	Article 4 **Articles 13, 14 and 15**	

The aim of the Water Framework Directive is that over time the status of no water body shall deteriorate, and that all natural surface water bodies shall meet at least Good Status and artificial water bodies shall meet Good Potential.

11.2 WFD TIMETABLE

The EU WFD set a clear timetable for action across Europe which is given in Table 11.1.

The key elements relating to planning and evaluation of regulatory options are in the green area of the table. Implementing improvements through regulatory actions are generally in the orange area and form the programme of measures. The WFD allows for three planning rounds based upon six year cycles; the review and planning for the second and third rounds is shown in blue. This allows for a pragmatic approach with stepwise improvement to meet the agreed objectives.

11.3 WFD PROGRAMME OF MEASURES

Having carried out monitoring to determine the status of the water bodies within a River Basin District, Member States must then use this information to develop an integrated Programme of Measures (or improvement programme) to meet the environmental objectives, in particular that of 'good water status' within the river basin.

These options are developed as part of the River Basin Management Planning process and the final plan sets out the Programme of Measures and the regulatory interventions that will take place to achieve the agreed objectives for each waterbody.

The Water Framework Directive allows for a combination of regulatory options to achieve the agreed objectives. Note this is a similar approach to the UK Regulatory Options – The Toolbox which was presented in Chapter 9 and summarised in Figure 9.1.

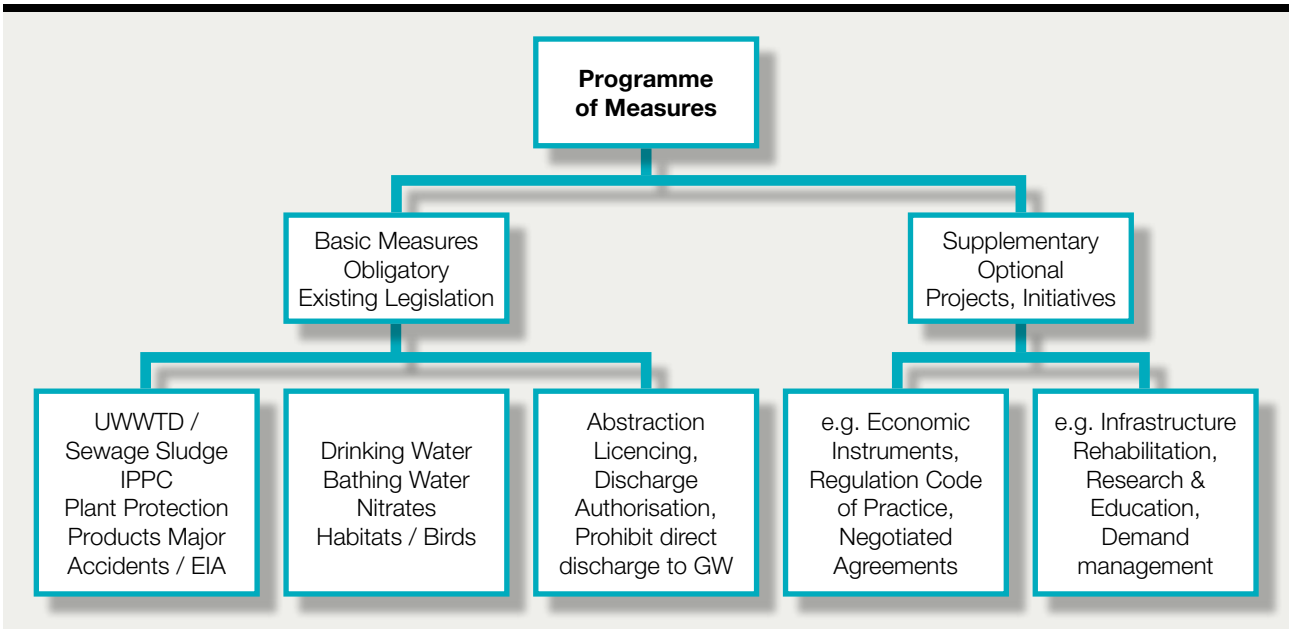


Figure 11.2 Structure of Programme of Measures

The EU WFD separates these into basic and supplementary measures.

The compulsory **basic measures** include meeting the requirements of other relevant Directives and the licensing of discharges and abstraction. Where necessary these are complemented by **supplementary measures**, if the basic measures are not sufficient to meet the environmental objectives. Supplementary measures are set out in an Annex to the Directive as a non-exhaustive list of potential initiatives for improving water status, ranging from economic instruments to negotiated agreements to rehabilitation projects and Research and Development. Figure 11.2 sets out the requirements of the Programme of Measures in diagrammatic form.

Member States are assessed against implementation of the agreed programme of measures.

A good understanding of the availability of regulatory options (permits, licences, etc.) and non-regulatory options (voluntary agreements, partnerships, education, taxes, etc.) is essential to ensure the objectives of the WFD are met and maintained. ■

12 NATIONAL MECHANISMS FOR ACHIEVING WATER QUALITY OUTCOMES

To achieve desired water quality outcomes the following approaches are needed:

- good strategic planning;
- good design and detail planning;
- good construction;
- good operation;
- good maintenance;
- good management;
- and a high level of transparency throughout;.

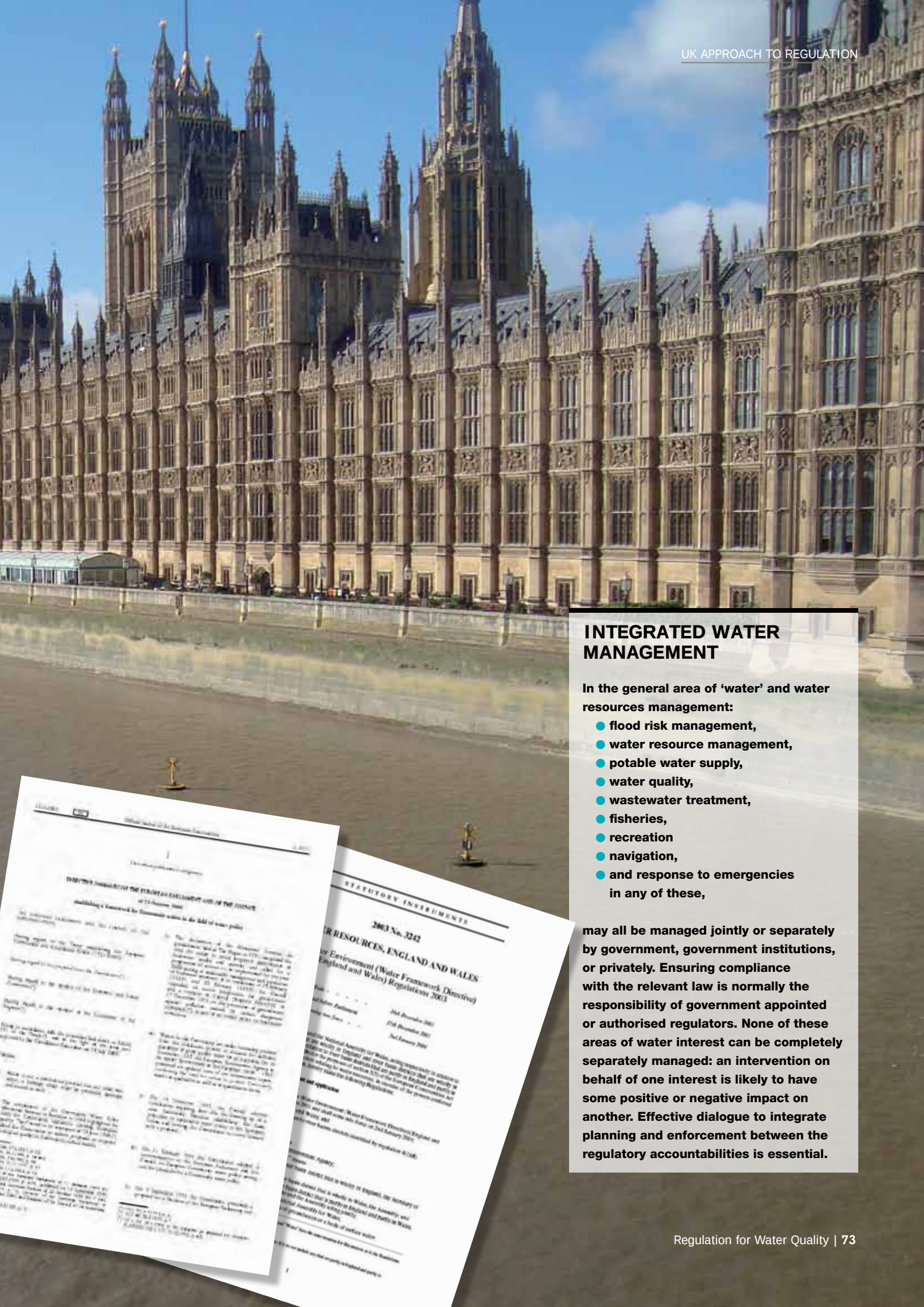
They all contribute to reducing the amount of prescriptive regulation needed to control the impact of potentially harmful activities.

It is essential to communicate clearly the need, and benefits of these good practices to all stakeholders so that interventive regulation can be minimised.

12.1 TRANSPOSITION AND IMPLEMENTATION INTO MEMBER STATE LAW

Member States have to transpose EU law into national law, but the detailed mechanisms for delivery of the water quality outcomes required by the EU law can legitimately vary from Member State to Member State. However, there are a few common principles:

- Serious environmental offences must be subject to national criminal law and sanctions, - a requirement of the 2008 Directive on Protection of the Environment through Criminal Law.
- Environmental information shall be generally made available to the public, in accordance with the 2003 Directive on Public Access to Information.
- Transposition and implementation information shall be reported by Member States to the Commission and the Commission reports in summary to the European Parliament and Council.



INTEGRATED WATER MANAGEMENT

In the general area of 'water' and water resources management:

- **flood risk management,**
- **water resource management,**
- **potable water supply,**
- **water quality,**
- **wastewater treatment,**
- **fisheries,**
- **recreation**
- **navigation,**
- **and response to emergencies in any of these,**

may all be managed jointly or separately by government, government institutions, or privately. Ensuring compliance with the relevant law is normally the responsibility of government appointed or authorised regulators. None of these areas of water interest can be completely separately managed: an intervention on behalf of one interest is likely to have some positive or negative impact on another. Effective dialogue to integrate planning and enforcement between the regulatory accountabilities is essential.

In general the European Commission focuses attention initially on transposition of Directive requirements into national law, and then on implementation activity and reporting progress. It does not analyse and report the details of delivery mechanisms adopted by Member States. Additionally there is a mechanism via the European Ombudsman for individual citizens to register a complaint with the Commission if they believe that a Directive is not being implemented properly by their government. Although the ability of citizens to engage is a fundamental principle, experience shows that the number and type of interventions is manageable, and becomes more manageable as trust develops.

Member States can decide on the extent to which delivery of effective regulation can be centrally controlled, i.e. directly by central government ministries, or devolved from central government to executive agencies or to regional or local government offices, or by a combination of any of these. Given the diversity of size, geographies, legal systems and institutional mechanisms in Member States there is no 'one size fits all' approach to EU Directive implementation. For individual outcomes specified in EU law, Member States may have a variety of criminal and civil law mechanisms and delivery bodies to ensure the intended Directive outcome is achieved.

Details of Member State governance systems for water are not generally available in English, so this book focuses on UK approaches. Limited analysis of some Member States' environmental law and governance systems have been included in IMPEL and OECD publications: IMPEL – Reference Book on Inspections 1999; IMPEL - Doing the Right Thing – Step By Step Guidance Book for Planning of Environmental Inspection; and OECD – Water Governance in OECD Countries a Multi-Level Approach.

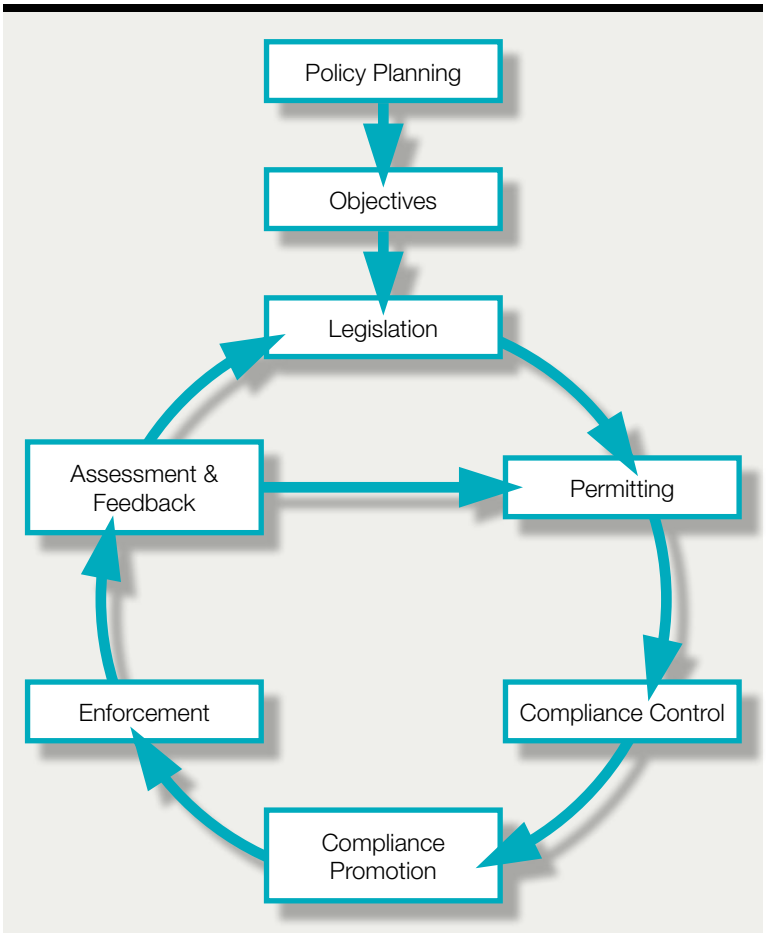


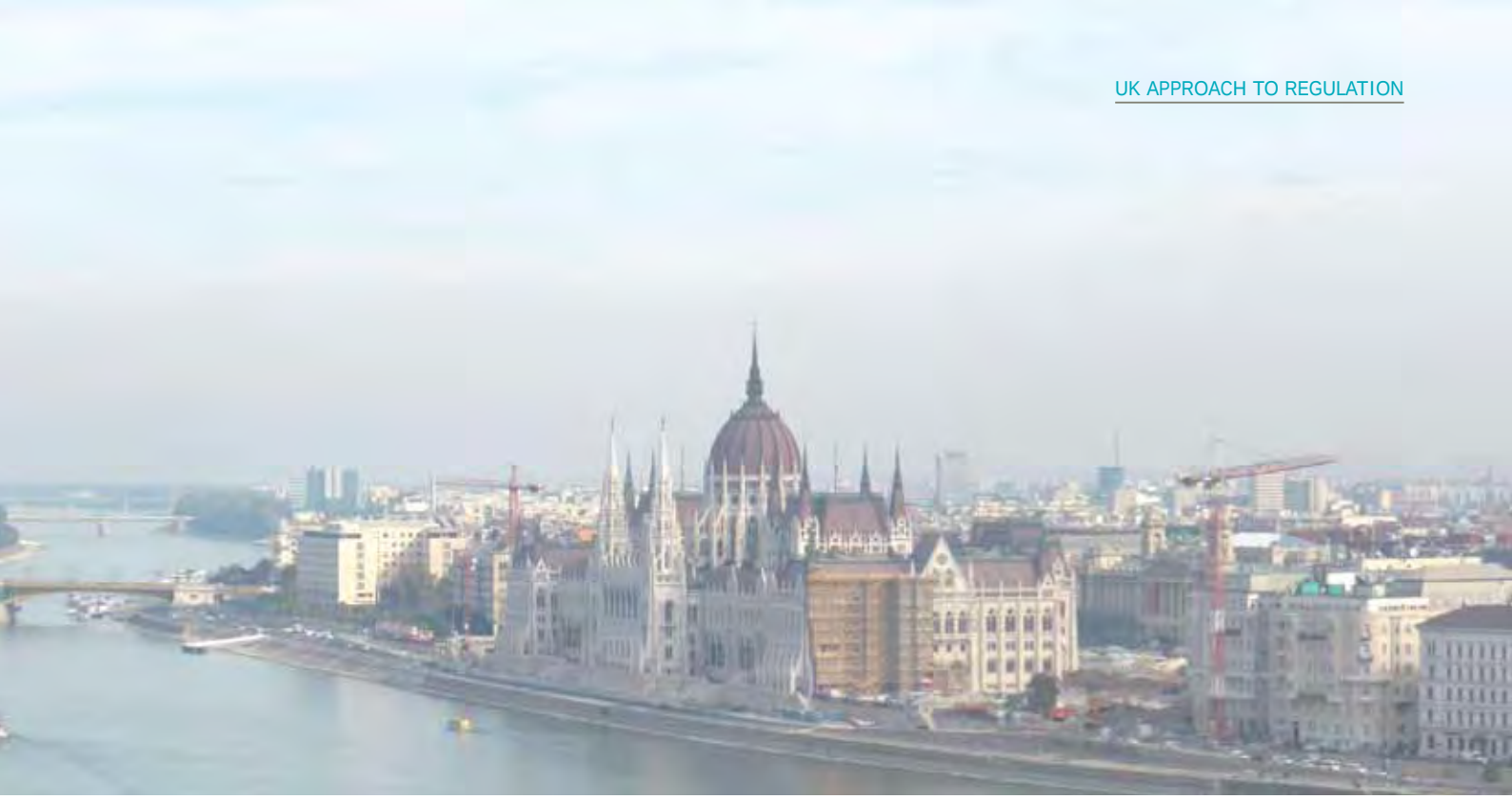
Figure 12.1 The Regulatory Cycle *(from IMPEL Environmental Inspectors Handbook 1999)*

12.2 EU-LEVEL REGULATORY GUIDANCE FROM IMPEL

The IMPEL Environmental Inspectors Reference Book describes a 'Regulatory Cycle' identifying the key steps from policy to implementation. This includes the political policy and objective setting process, development of legislation, permitting, compliance control, compliance promotion, enforcement, and assessment and feedback. The Regulatory cycle is shown in Figure 12.1.

12.3 THE INSPECTION CYCLE

The Inspection cycle is shown in Figure 12.2 below, and is a variant or element of the Planning cycle described in Chapter 2. Full details of the stages of the cycle are provided in: IMPEL - Doing it right 2 –



step by step Guidance for Planning of Environmental Inspection).

Both of the IMPEL reports (referred to in this and an earlier sub-section) contain a wealth of information on the strategic planning and tactical delivery of environmental inspection, which although focused on effective techniques for inspection staff, provide an excellent reference base for policy makers and administrators.

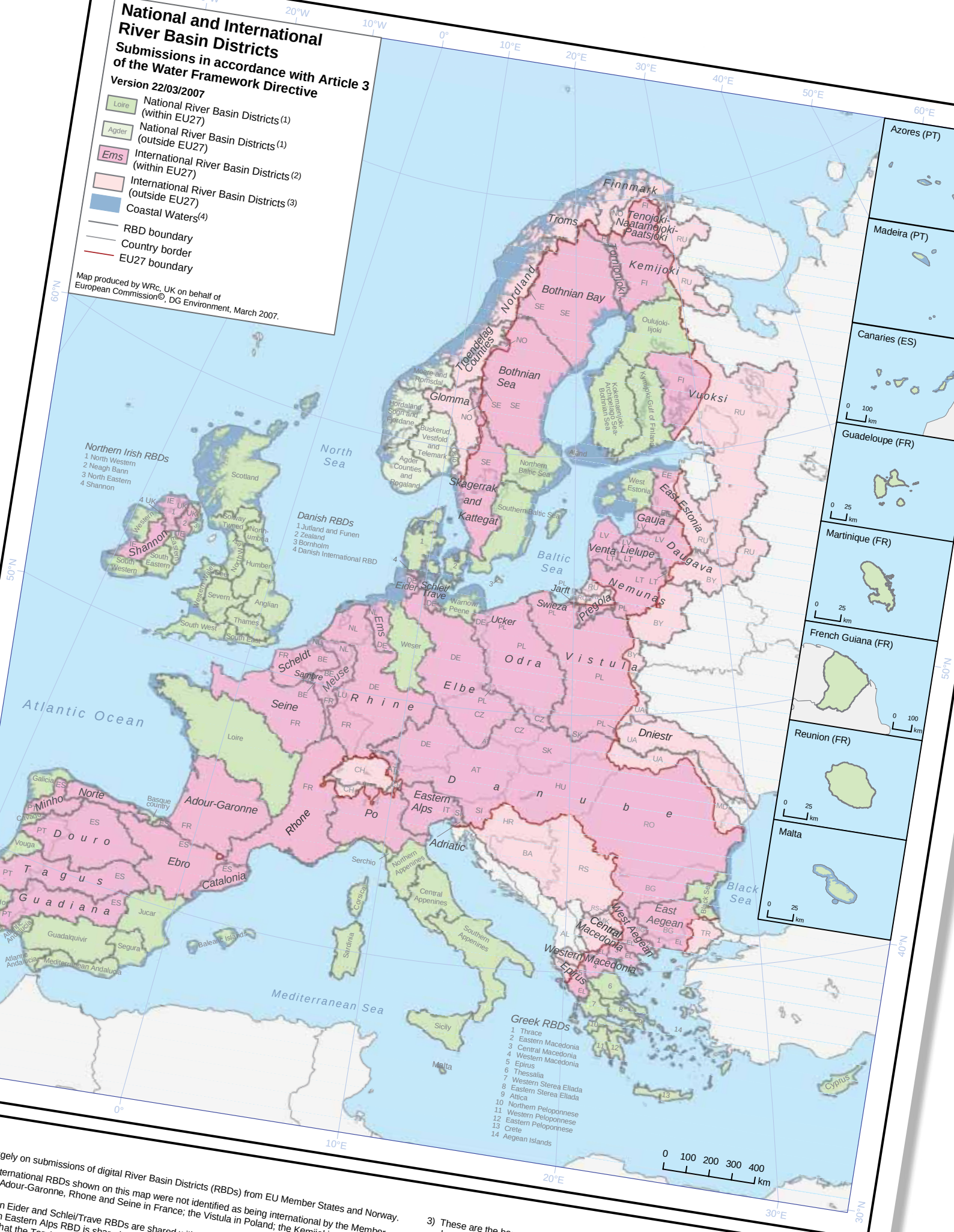
Figure 12.2 The Inspection Cycle *(from IMPEL - Doing It Right 2 – Step by Step Guidance for Planning of Environmental Inspection*

12.4 ACHIEVING DIRECTIVE OUTCOMES

Implementation of Directives by Member States requires not only transposition of legal requirements into national law, but also an effective delivery system to ensure that the objectives of the Directive are demonstrably met. The strategic and detail planning of delivery is an essential responsibility of governments and their delivery agents.

It is at this early stage of implementation that options for achievement of objectives in the most timely and cost effective way can best be considered. Policy decisions may be broad-brush or focused on individual activities. They may involve taxation, levies, charges, permits, registrations or prohibitions, all of which may be underpinned by criminal and/or civil sanctions. And education, research, public awareness and special interest groups all have a part to play.

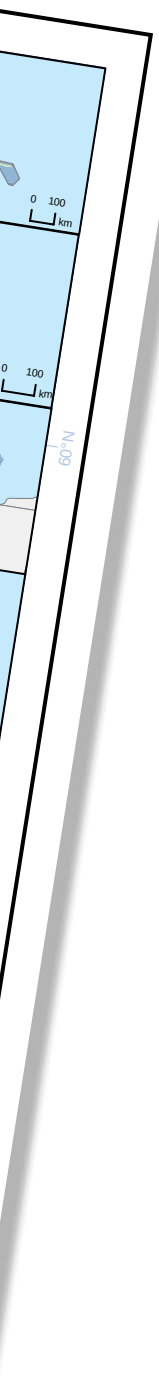
As an example, where the Directive obligation affects new development, a broad-brush policy decision may be made inserting a simple rule in the development planning framework, affecting all development – placing the obligation to comply with the Directive firmly on all developers. Alternatively a more focussed and cost-effective approach may be necessary, requiring individual developers meeting specified criteria, to apply for, receive and comply with a permit for the lifetime of the development.



gely on submissions of digital River Basin Districts (RBDs) from EU Member States and Norway.
ternational RBDs shown on this map were not identified as being international by the Member
Adour-Garonne, Rhone and Seine in France; the Vistula in Poland; the Kemijoki and Vuoksi in
n Eider and Schlei/Trave RBDs are shared with the Danish International RBD.
n Eastern Alps RBD is shared with the Slovenian Adriatic RBD.
hat the Tornionjoki international RBD in Finland is shared with Sweden, most likely with part
ay international RBD. As the Bothnian Bay covers several river catchments, the Tornionjoki
have been kept separate in this map.
the Finnmark RBD between Norway and Finland is currently under review.

3) These are the boundaries of the river catchments extending beyond the EU27 border. They have been derived from the Catchment Characterisation and Modelling (CCM) database, developed by the Joint Research Centre (JRC), except the boundaries for the Danube international RBD which were supplied by the International Commission for the Protection of the Danube River (ICPDR).

4) Coastal waters are defined in the Water Framework Directive (WFD) as extending 1 nautical mile from the coastline. However, some Member States have included a larger part of coastal waters within the RBD boundaries.



13 OVERVIEW OF ENVIRONMENTAL DIRECTIVE TRANSPOSITION AND IMPLEMENTATION IN EUROPE AND THE UK

EU national governments are always accountable to the European Commission for transposition and implementation of Directive requirements, and resulting national policy.

Executive and regulatory decisions as the 'competent authority' within a national government policy framework may be devolved from central government to regional or local government, or to government agencies. Operational delivery of the regulatory requirements may also be delivered by government or government owned utility businesses (typically water supply and urban wastewater treatment), or by private business.

Somewhat surprisingly neither the European Commission, IMPEL or the European Network of Heads of Environmental Protection Agencies (NEPA) have produced a collation at EU level of the institutional and administrative arrangements for implementation in each Member State. A limited suite of national descriptions, focused on regulatory inspection and enforcement, is provided in the IMPEL Environmental Inspectors Reference Book 1999, but it can hardly be described as up-to-date or representative of the expanded EU.

13.1 UNITED KINGDOM - ENVIRONMENTAL REGULATORY FRAMEWORK

The UK government is responsible for policy and strategic direction for transposition and implementation of all Directives, working closely with devolved administrations in Scotland, Wales and Northern Ireland. In England the Department for Environment Food and Rural Affairs (Defra) is the lead Ministry. Defra also liaises with other UK government departments where interests overlap. Other EU states have similar types of arrangements.

In the UK national government policy is formulated into primary legislation – Acts of Parliament that are subject to public consultation and detailed scrutiny, and amendment by Parliament as they pass from draft proposals into law. For the most part, primary UK legislation is high level, identifying accountabilities for delivery, structure, duties and powers of delivery bodies, and specification of offences and sanctions. Acts of Parliament give ministers powers, subject to Parliamentary scrutiny, and public consultation, to make regulations which specify detailed requirements for implementation of the primary law.

Thus the Environment Act 1995 established the Environment Agency as a Non-Departmental Public Body (NDPB), independent of direct ministerial control, and specified the extent of its duties and powers as environmental regulator for England and Wales, and rights of appeal against its decisions. Regulations from the Minister for the Environment, Food and Rural Affairs, who is responsible for the Environment Agency, then specified detailed requirements. For example, these regulations included EU Directive specified statutory quality objectives, and national administratively consistent permit application and appeals procedures. The Environment Agency implements these procedures while affected parties must comply or risk sanction. ▶

13.2 UNITED KINGDOM WATER REGULATORY SYSTEM

In England Defra provides high level guidance to the regulated water businesses and regulators in a Statement of Obligations. The chief regulator for the water environment is the Environment Agency, dealing with all water environmental issues, while Ofwat (Office of Water Services), the Water Industry Regulator, deals with control of the privatised monopoly businesses – the Water Service Utilities (WSUs), that provide public potable water supply, and conveyance and treatment of sewage.

The devolved governments of Scotland, Wales and Northern Ireland have similar arrangements, each with a separate environmental protection agency, and financial regulator of the Water Service Utility.

The UK regulatory environment has a significant impact on the behaviour and development of the privatised water industry that provides potable water, and sewerage and sewage treatment systems for UK citizens. The regulatory approach aims to do this through enabling dialogue, partnership, joint development and consultation. However, regulatory instruments are available should the need arise. The ability to use regulatory sanctions is important and is recognised by the water industry, bill payers and the general public as a necessary safety net.

The government and regulators have developed clear and complementary roles to provide a framework within which the water industry operates. The government is obliged to make arrangements to ensure compliance with European Directives. Box 13.1 shows the key components of the system:

BOX 13.1 UK WATER INDUSTRY REGULATORY FRAMEWORK

- **The government, through Defra, sets the strategic direction and determines appeals. Defra provides high level guidance to regulated businesses and regulators in a Statement of Obligations. The water industry economic regulator, Ofwat, sets water prices in accordance with the government's Social and Environmental Guidance to ensure that companies have sufficient resources to undertake their duties and customers are protected from excessive price rises.**
- **The Environment Agency, as the environmental regulator, determines the environmental standards, sets permits for abstraction and discharge, and assesses compliance.**
- **The Drinking Water Inspectorate sets and monitors the quality of water provided at customers' taps.**
- **The Consumer Council for Water represents the views of customers.**
- **The Water Service Utilities provide drinking water and treat sewage, maintain and develop infrastructure, and operate their businesses within the terms of their operating licence. They must also deliver financial returns to shareholders and meet debt obligations to banks, who take a keen interest in their asset values, revenues, and management performance.**

The economic regulator, Ofwat, is assisted in gaining accurate information about water company activities by independent reporters appointed to each company. These relationships are illustrated in Figure 13.1.

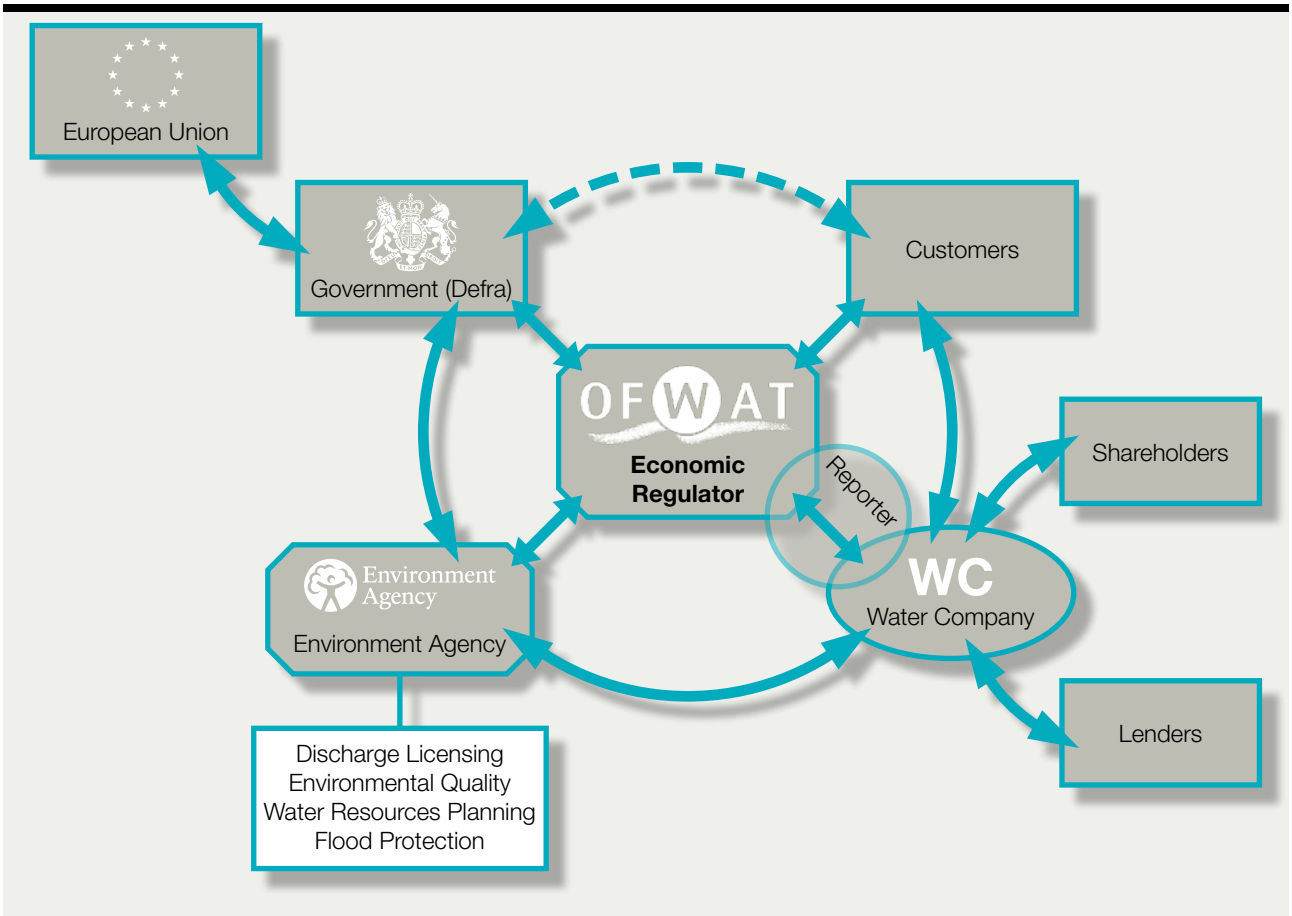


Figure 13.1 UK Water and Environment regulatory model

The roles of the regulators and the water industry have been determined by primary legislation, including the Water Industry Act, the Water Resources Act and the Environment Acts. These provide the statutory framework which is supplemented by regulations and guidance from Defra. In addition, each regulatory organisation has developed strategies and guidance, setting aims and objectives and providing clarity on specific technical issues. These guidance documents form the basis of the day-to-day relationships between the organisations, and in many respects drive the behaviour of the water industry in meeting regulatory requirements.

The strategy documents of each regulatory organisation chart the key outcomes, activities and costs over a five to twenty-five year period. Each will be subject to public consultation and discussion with other key organisations, including government departments. This is especially important, as each requires co-ordination with the other regulators and the water industry. At a strategic level these policy statements influence the costs and actions of the water companies and ultimately the cost to customers.

The technical guidance produced by each regulator provides the detailed framework under which the water industry operates. This guidance is developed in order to introduce new requirements or changes to operational practice or reporting. This will cover climate change, the supply-demand balance, drinking water quality, the water environment and other miscellaneous provisions. Whenever possible, guidance is drafted in close association with the water industry to ensure that it is workable and that it will result in the correct outcome. Policy and technical staff from each organisation work together within an agreed framework to draft and test this guidance. It is essential that good working relationships are maintained and that individuals have a good understanding of each other's needs and technical capability.

Agreement on guidance will be sought whenever possible before it is ratified by the sponsoring regulator. However, on some ▶

occasions the responsible regulator will need to determine the guidance unilaterally. Significant guidance documents may be subject to public consultation, especially if there are cost implications or impacts on the public. Once ratified, all guidance is in the public domain and is made available on request and much is freely accessible via web sites.

The UK regulators each have slightly different ways of determining national guidance and informing the water companies and the public about this. Ofwat produces a sequence of numbered Managing Director (MD) or Regulatory Director (RD) formal letters. In this way new requirements or guidance is sent directly via prearranged communication routes into each water company and other regulators and interested parties. These letters aggregate into a comprehensive suite of guidance upon which the water companies interact with Ofwat.

The Environment Agency produces an equivalent quality-controlled sequence of guidance notes covering its area of responsibility. These are assembled into environmental permitting (including discharges) guidance and abstraction licence guidance. The guidance is publicly available via the Agency's web site. Any changes to the manuals are sent to the water companies and to operational officers within the Environment Agency. Ultimately this guidance is imposed through changes to permit conditions, and enforced by monitoring and compliance assessments undertaken by the Environment Agency. Prosecutions are taken when necessary in the courts. The Drinking Water Inspectorate issues similar Information Letters which are available on their web site. Compliance with this guidance is assessed by a self-monitoring and reporting regime, with Drinking Water Inspectors taking regulatory action if required.

Each water company needs to take this guidance into account in the way that it operates. Companies have some latitude in the way that they comply with guidance and achieve permit conditions. However, they must meet the outcomes and satisfy the legal requirements of their permits.

With this regulatory framework occasions arise when there are conflicting requirements or where the water industry believes that the guidance is being disproportionately or unfairly applied in determining environmental permits. On these occasions the industry or individual companies can appeal, informally or formally. These appeals are determined by an independent inspectorate acting for the Secretary of State, the Planning Inspectorate. In important cases the Secretary of State has the right to 'call in' an issue and determine it directly, or to require a public inquiry prior to determination.

A feature of the UK water industry – and water industries in most other European countries – is the involvement of consultants at every level of the system, from regulatory planning to programme delivery (though they are not normally directly involved in the operational side of the business). These experts and specialists, working mostly for independent private companies, provide a pool of expertise that is constantly moving between the different organisations involved and greatly increasing the capacity of the industry to perform effectively. Individual consultants will move seamlessly among projects for different water companies and may work for Ofwat, the Environment Agency, and other organisations, including academic institutions, within the space of months and so there is a transfer of knowledge and expertise, whilst maintaining commercial and regulatory confidentiality.

BOX 13.2 HOW PRICES ARE DETERMINED IN THE UK REGULATORY MODEL

Economic regulation is achieved by controlling the prices each company is allowed to charge customers, rather than by control of rate of return on investment as is the case in some other countries.

Ofwat uses company comparisons as a surrogate to mimic market competition. The objective is delivery of service, not infrastructure.

Some key terms:

RCV – Regulatory Capital Value. This is the main reference for the market value of the company and its assets under the scrutiny of Ofwat. It works out at about 10% of the replacement cost of the assets. The company is seeking to generate a return on this value.

K – How much a company may raise or must cut its price each year.

This is controlled by the price limit formula

rpi ± k + u

RPI ± K + U

K is a number determined by Ofwat at a price review every five years for each company, for each year, to reflect what it needs above inflation in order to finance the provision of services to consumers. It may be changed at an interim adjustment between price reviews. RPI is expressed as the percentage increase in the Retail Price Index in the year and U is the amount of unused K not taken up in previous years.

Many factors are taken into account in the calculation of K, including the past performance of the company as reported to Ofwat, the cost of capital, the investment obligations placed on the company by regulators, efficiency improvements of the company, and the prevailing cost of infrastructure construction. The determination of K is negotiated through the Periodic Review Process by submission and review of detailed company business plans.

There is a need to balance and take an overview of the current and future requirements for the water industry, and this is undertaken on an ongoing basis by the regulators in a series of formal and informal quarterly meetings. Ongoing and frequent dialogue is important for all parties.

13.2.1 WATER PRICING

The objective of the economic regulatory process is to ensure financeability: the ability of appointed water companies to finance their functions through debt, equity or retained earnings. Companies being able to finance the proper performance of their functions is interpreted to mean two things. First, the companies should receive a return on investment at least equal to the cost of capital. Second, companies' revenues, profits and cash flows should be such that they can borrow as necessary in the debt markets and provide shareholders with sufficient incentives to produce additional funds through equity injections or retained earnings.

The Periodic Review Process (PR) is a five-yearly review of all the obligations and requirements of the water industry; it provides a formal and structured opportunity for dialogue and consultation. Following this, water prices are set for the next five-year period. These prices seek to balance the financeability of the companies with the need for maintained or improved service to customers and the environment, and affordability to customers. Box 13.2 describes the price setting mechanism.

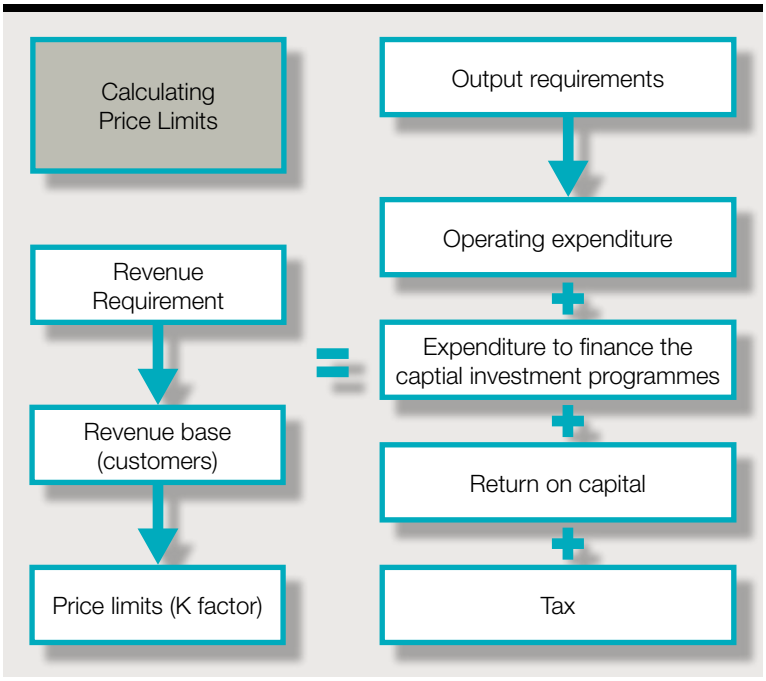


Figure 13.2 Calculating Price Limits

13.3 PERMITTING SUMMARY & PRINCIPLES

Each abstraction above a minimum threshold from surface or groundwater will have an individual licence with conditions. In addition, discharge permits are set for all discharges to surface and groundwaters from industrial and urban wastewater treatment works, intermittent discharges from sewers and contaminated surface waters. Trade effluent permits are set for discharges of trade effluent to sewers. The permits reflect local conditions and environmental need, and will greatly influence the level of treatment, maintenance and operational costs. These are set and maintained at a local level.

The fine detail of the permitting calculation, and the mechanism for determination of permit conditions, is left to the competency of the environmental regulator, subject to appeal by aggrieved applicants. The environmental regulator publishes Guidance to Applicants for Permits, and provides a limited amount of free advice, charging thereafter according to the complexity of the proposed discharge. Applicants submit an application, which the environmental regulator checks to see if 'duly made' i.e. whether there is sufficient information to proceed with determination. (If insufficient information is received, consideration stops until the necessary information is provided).

The environmental regulator then determines the application, normally issuing a permit that specifies conditions that must be met for the discharge to be

legal (covered in more detail in Chapter 15 and 16). Typically the permit will limit the nature and location of the discharge and will include volumetric and concentration limits for effluent constituents, and may include operator monitoring and reporting requirements.

The applicant can challenge the regulator's decision via an appeal mechanism to an independent inspector appointed by the lead government department, or accept the regulator's conditions. If the conditions are accepted the permit holder may then commence the discharge in accordance with the permit, and provides such discharge monitoring and compliance information as the regulator has specified.

The environmental regulator may then monitor the receiving water to confirm that design assumptions regarding the permit calculations for the discharge are correct, and to determine whether the intended receiving water quality has been delivered at the controlled point of discharge. This is usually at, or equivalent to, the boundary of the permit holder's property, or at the boundary of the mixing zone if one has been determined for the discharge. Mixing zones are discussed in more detail in Chapter 21.

The environmental regulator monitors the quality in the receiving waters against the specific targets for that water body. The regulator may, from time to time, review the permit, making permit conditions more stringent if the discharge is having an unacceptable impact, or relaxing them if design assumptions prove to be over-precautionary. The regulator may also contribute to government or EU reviews of water quality standards.

All this process is in the public domain, with key documents and information placed on the Public Register held by the regulator, e.g. applications, advertisements, consultation responses, permits, monitoring results, and information about appeals and enforcement activity. The Register is open for access by the public at the regulator's offices, and is increasingly becoming web based to widen its availability.

The environmental regulators collate the water quality compliance information, in accordance with Directive requirements and report to their lead departments and thence to Defra where UK-wide information is collated. Defra then submits the collated UK information to the European Environment Agency, who in turn collate the Member State information and report to the Commission. The Commission then reports to European Parliament and Council, and publishes a report on Directive compliance within the European Community.

The whole regulatory process is rather like the layers of an onion, each of which represents an 'Issue Management' or 'plan, do, check, review,' cycle for each of the players, from European Parliament and Council, down to operator, and back again. (See Chapter 2, Fig. 2.3)

At the national level the regulatory cycle focuses on defining the obligations and ensuring there is a system in place to deliver them as effectively and efficiently as possible, and to demonstrate that this is being done. At regulator level the focus is on defining the scale of the regulatory effort and resources required, ensuring that the obligations are publicised to target audiences, issuing and monitoring permits as needed, and reporting progress to government and stakeholders. From an operator perspective the focus is on understanding what the regulatory obligations are and how to fit them into business practice at least cost and maximum benefit. This is considered in more detail in Chapter 15 and 16.

14 ACHIEVING WATER FRAMEWORK DIRECTIVE AND IPPC DIRECTIVE COMPLIANCE

The Water Framework Directive (WFD) is an umbrella under which the historic and single issue Directives can be optimised in a co-ordinated manner, focusing on water resource outcomes.

When the WFD is fully implemented a number of the existing Directives will be unnecessary and can be repealed, simplifying the regulatory environment. This 'Framework Directive' approach is being used for a number of similar environmental challenges including waste management.

Achieving and maintaining compliance with WFD objectives can be via a number of mechanisms, of which discharge regulation and permitting is just one. Many activities are not amenable to a specific discharge control regime or permits, and 'softer' more business-focused measures are needed to ensure that the activity does not result in deterioration of status, e.g. rules for new developments requiring sustainable drainage systems (SuDS) for surface water runoff management; sediment management requirements for activities in water bodies such as construction; specified good agricultural practice upon which subsidy payment depends.

In England the government is promoting a 'Catchment–Based Approach' to achieving reductions in diffuse pollution, encouraging local stakeholders and interest groups to work with regulators and local government. More details are given in Chapter 22.

14.1 COMBINED APPROACH

The Water Framework Directive adopts the 'combined approach' to securing compliance with Directive objectives.

The combined approach seeks to optimise the use of the following mechanisms:

- Environmental Quality Objectives (EQS)
- Emission Control, usually based on IPPC and centred on Best Available Technology (BAT)
- No Deterioration

The Directive and its daughter Directives establish water quality standards for surface and groundwater which must be met within a timescale. The EQS approach is usually used to determine the optimum permit limits necessary to ensure that the standards in the receiving environment are met. Modelling methods are used to calculate permit limits and to optimise between sources of pollution that may cause failure (see Chapter 20).

Emission Control mechanisms can also be used to meet or exceed these environmental standards. These are set by the application of production process based BAT standards to the emissions. If these controls alone will not achieve compliance with environmental standards then EQS mechanisms are used to further tighten controls to ensure compliance in the receiving waters.

The No Deterioration element adds a further safety mechanism to ensure that current water quality is not allowed to get worse, or that regulatory actions do not have negative consequences on water quality.

In this way the regulatory mechanisms can be used in combination to ▶

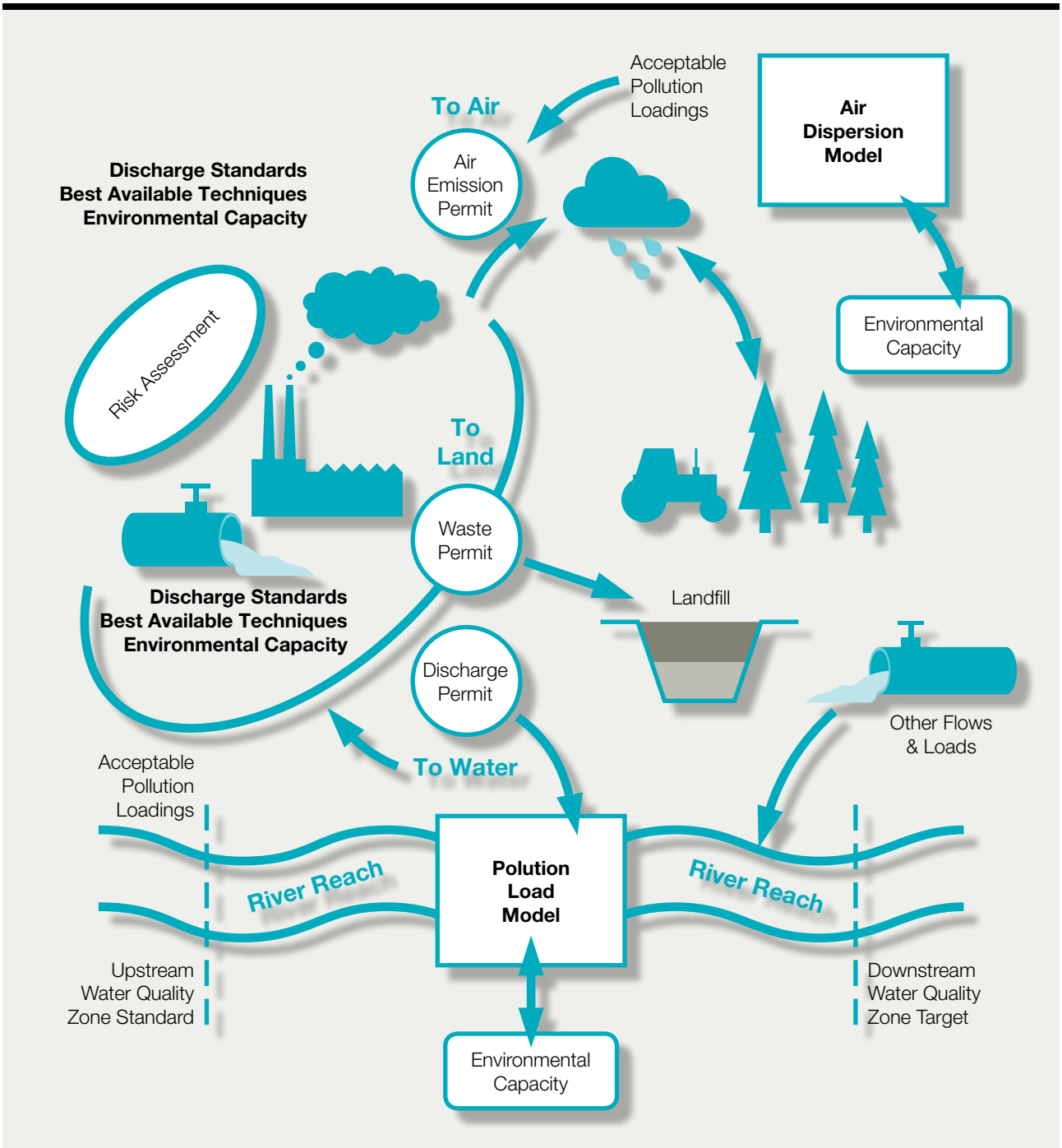
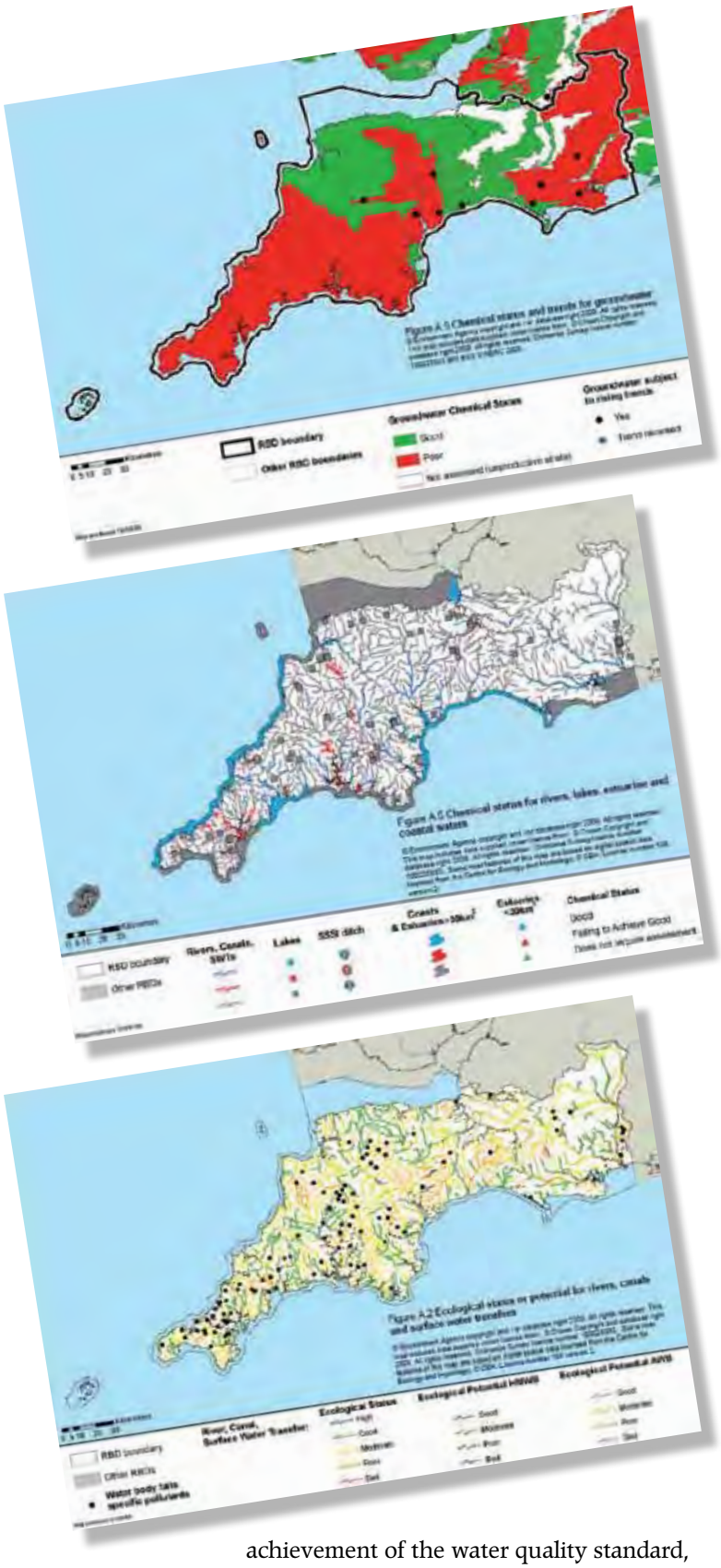


Figure 14.1 Overview - Combined approaches to environmental protection

ensure achievement of standards in the receiving waters.

There are provisions under the Integrated Pollution Prevention and Control (IPPC) Directive for emission control mechanisms based on Best Available Techniques (BAT) to be used in specified industrial sectors. (This is currently being subsumed into the Industrial Emissions Directive 2011 which is in the process of transposition (by 2013) by Member States.) Indicative BAT is defined for each relevant industrial sector in European Commission approved BAT Reference Notes, - BREF Notes and draft guidance.

Normally use of BAT will result in effluent and surface water discharges to receiving waters that do not threaten compliance with water quality standards. In situations where use of BAT alone will not deliver



achievement of the water quality standard, (e.g. low dilution available), treatment to a standard better than BAT is required, so that the relevant receiving water can comply with the water quality standards. In this case the environmental capacity needs to be calculated, usually by the application of modelling techniques, and the acceptable pollution loadings calculated to be incorporated to the discharge permits. This can, of course be a material consideration for companies in deciding where to locate new plant or to improve existing plant.

A diagrammatic overview of the combined approach, including IPPC for air, land and water emissions is given in Figure 14.1.

14.2 BEST AVAILABLE TECHNIQUES (BAT)

The simple operational definition can be best described as:

'**Best**' – the most effective techniques for achieving a high level of protection of the environment as a whole.

'**Available**' – techniques developed on a scale which allows them to be used in the relevant industrial sector, under economically and technically viable conditions, taking into account the costs and advantages.

'**Techniques**' – includes both the technology and the way the installation is designed, built, maintained, operated and decommissioned.

Technically, BAT is defined in Article 2.11 of the IPPC Directive as 'the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing, in principle, the basis for emission limit values designed to prevent, and where that is not practicable, generally to reduce emissions and the impact on the environment as a whole'.

14.3 BAT IMPLEMENTATION UNDER IPPC

Edited extract from Defra IPPC Guidance:

The system of Integrated Pollution Prevention and Control (IPPC) set out in the IPPC Directive applies an integrated environmental approach to the regulation of certain industrial activities. This means ▶

that emissions to air, water (including discharges to sewer) and land, plus a range of other environmental effects, must be considered together. It also means that regulators must set permit conditions so as to achieve a high level of protection for the environment as a whole.

These conditions are based on the use of the 'Best Available Techniques' (BAT), which balances the costs to the operator against the benefits to the environment. IPPC aims to prevent emissions and waste production and where that is not practicable, reduce them to acceptable levels. IPPC also takes the integrated approach beyond the initial task of permitting through to the restoration of sites when industrial activities cease.

The web site of the European Commission contains general background information on the IPPC Directive and its successor, the Industrial Emissions Directive (Directive 2010/75/EU).

Guidance on the interpretation and implementation of the IPPC Directive can also be found on the Commission's web site. The Commission's IPPC Bureau web site contains links to IPPC conference proceedings as well as to the European guidance documents on best available techniques.

More details on the IPPC permitting process and examples of permits are given in Chapter 18. ■

PERMITTING

Permits legalise discharges, and require compliance with conditions which are intended to ensure that water quality objectives are met. Failure to comply can lead to criminal or civil sanctions.

WHATEVER THE COMPLEXITY OF THE SYSTEM, IT IS ADVISABLE TO KEEP THE PERMIT REQUIREMENTS AS CLEAR AND SIMPLE AS PRACTICABLE.

15 PERMITTING OVERVIEW AND PRACTICE

Where point source emissions of potentially polluting material to water cannot be avoided, it is essential to control their polluting impact.

Permits from the relevant government office or agency legalise such discharges. Conditions in the permit must be adhered to otherwise the discharge is illegal, rendering the operator liable to criminal and civil sanction.

◀ The regulator needs to have a good understanding both of the potentially polluting activity and of the receiving water environment to avoid under- or over-prescriptive conditions. It helps if the operator shares this knowledge.

15.1 SUMMARY OF THE PERMITTING AND COMPLIANCE PROCESS

This sub-section summarises the key components of successful permitting and monitoring. Following subsections amplify the following key points and logic:

- The permitting of discharges is one of the tools available for securing desired water quality and quantity.
- The desired water quality (WQ) and quantity is specified in River Basin Management Plans in terms of water standards that must be met by a certain timescale.
- Normally it is the concentration of substances in a discharge, rather than the volume of the discharge, that is the limiting factor.
- Effluent discharges may be permitted only if there is a reasonable prospect that they will deliver the intended WQ or will contribute to meeting it.
- Applicants need to know what is required of them to obtain and comply with a permit.
- Regulators must provide advice and timely information to prospective applicants for discharges.
- The applicant should have early dialogue with the regulator to identify the regulator's requirements, and to avoid any potentially costly re-design of the business or development proposal that will generate the effluent.
- Pre-application discussions help define what the regulator wants and the options available to the applicant.
- The applicant undertakes the detailed discharge planning. This may require specialist modelling of options. The regulator may do this, or may audit the results of models commissioned by the applicant.
- The applicant applies for a permit, submitting all the information required by the regulator, plus an appropriate determination fee.
- The regulator puts the application on the Public Register, and its web site, and informs external consultees of the application so that they can make representations if their interests may be affected by the proposed discharge, and commences internal consultation with other sections of the regulator's portfolio (e.g. flood risk, water resources, navigation, fisheries, conservation, etc.)
- The regulator collates all responses to the consultation and considers them, along with the application, and determines whether or not to grant the permit, and if so what conditions to apply.
- The regulator informs the applicant of the decision and places the permit or refusal on the Register.

- The applicant may either accept the decision or appeal to a third party Inspector, whose decision is binding.
- If the applicant accepts the decision to grant a permit subject to conditions, the discharge may commence in accordance with the conditions from the date(s) specified in the permit, and subject to payment of the relevant discharge fee.
- If the applicant for a stand-alone discharge appeals against the permit decision or conditions, the permit is normally held in abeyance pending the Inspector's decision.
- If the application is for a discharge from a PPC installation or waste plant, then the permit condition applies pending the Inspector's decision.

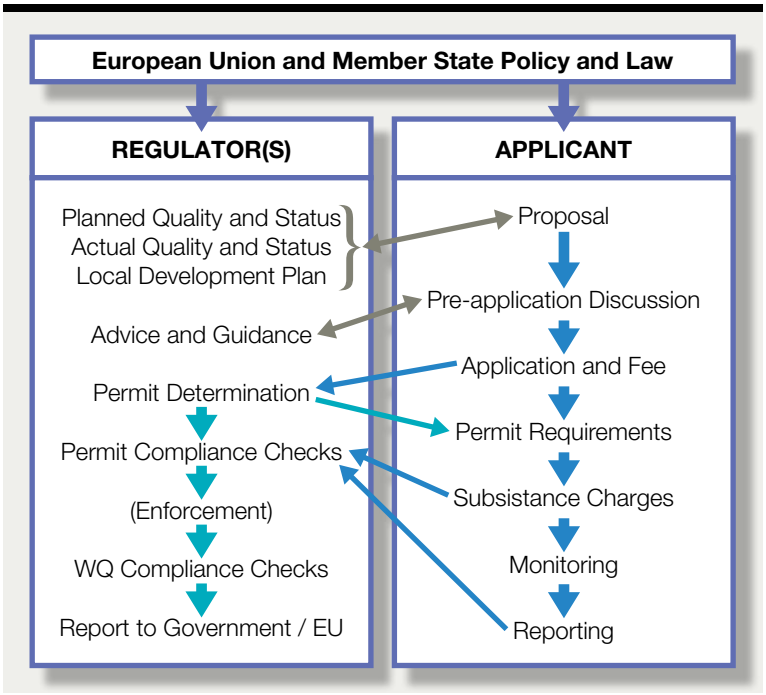


Figure 15.1 Permitting & Compliance Overview

- The discharger monitors the discharge in accordance with the monitoring plan specified by the regulator and provides relevant data and information to the regulator.
- The data and information is placed on the Register.
- The regulator assesses compliance with permit conditions and records it on the Register.
- The regulator assesses whether the receiving water quality matches the intended Classification and Status, and if not, the extent to which the discharge contributes to non-compliance.
- If there is non-compliance the regulator investigates and discusses reasons for non-compliance with the discharger, with a view to speedy improvement to meet permit requirements, or to review permit conditions to achieve the required Classification and Status.
- Depending on environmental impact of non-compliance with permit, the regulator may take criminal or civil enforcement action against the discharger.
- The results of enforcement are recorded on the Register by the regulator.
- The regulator periodically reports specified regulatory performance information to its lead government department, and thence to the European Commission.

The overall process is summarised in Figure 15.1.

15.2 PERSPECTIVE ON PERMITTING

Permits for potentially polluting discharges are legitimate where it can be demonstrated that all reasonable measures have been taken by the operator to eliminate the need for the discharge, and that the risks to the environment can be controlled and minimised. Granting of discharge permits should precede and be a necessary requirement for development to go ahead, rather than being retrospectively applied for. It is recognised that introducing an effective permitting regime for the first time will inevitably initially involve a substantial proportion of retrospective applications from dischargers, and some form of prioritisation of determination of applications may be needed.

The water environment is very much affected by what happens on land and in the air. The water cycle involves all three media. Historically, control of activities that impact on these media have been separately regulated, with a variety of different permits and requirements, in some cases overlapping, or worse, creating a gap in regulatory effectiveness, and generating a lot of bureaucracy to the detriment of businesses with multiple environmental emissions.

Environmental regulation can be expensive and can be seen as a burden on business, particularly where that business does not receive any direct benefit for protecting the environment. It is important that regulatory effort is targeted at points of highest risk, either because of the inherent risk of the materials used in the activity, or because of the previous and/or current performance of the operator.

Unscrupulous operators may attempt to avoid regulatory obligations, relying on lack of communication and/or regulatory rigour between separate regulatory regimes, e.g. discharging more pollutants to atmosphere via a stack rather than washing out and treating them in a trade effluent treatment plant that discharges cleaned water to a watercourse and produces sludge for disposal or recycling.

It is generally recognised that sustainable development is most likely to be achieved by encouraging the right behaviours rather than having to compel them. However, a firm but fair regulatory regime, backed up by stringent enforcement, is a recognised incentive for businesses to rapidly adopt the right behaviour.

15.3 THE LEGAL BASIS OF PERMITS

In England and Wales the Environment Act 1995 delegates much primary executive authority from the Minister (central government) to the Environment Agency (a non-departmental public body). The Environment Agency is the responsible agency, established by government but independent of direct government control, for delivery of a range of, but not all, EU and national environmental obligations. This independence reduces the potential for political interference in environmental decisions.

The Environmental Permitting Regulations, Directives and national policy that they implement identify activities or types of discharge that require either permits or registration as being exempt from permitting. (Registration is for activities or discharges of standard type that can be subject to general binding rules because of lower environmental risk. The requirements are less onerous than permits and are therefore cheaper for operator and regulator to administer.) It is illegal to undertake such discharges or activities without permit or registration. It is an offence not to comply with the

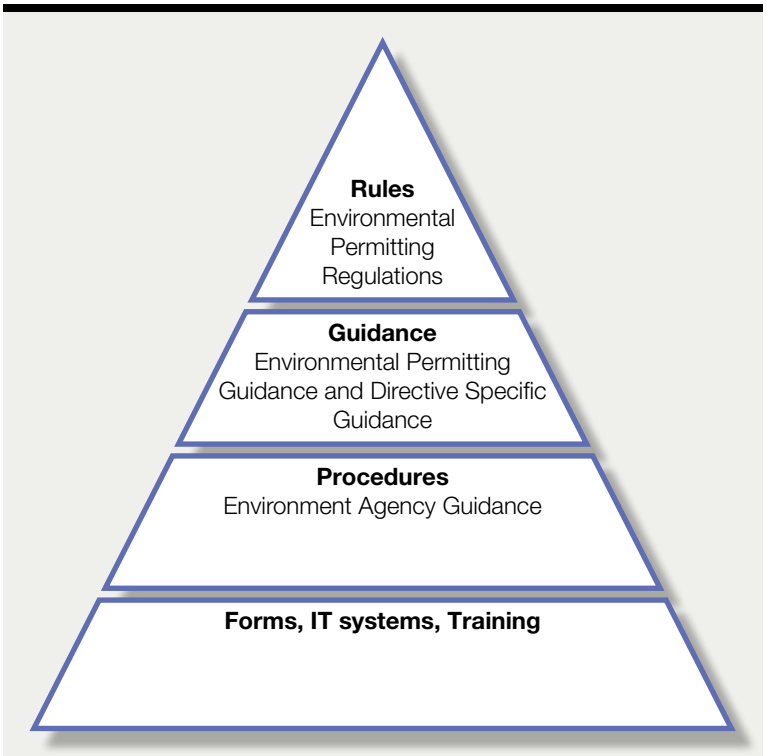


Figure 15.2 Environmental Permitting Heirarchy

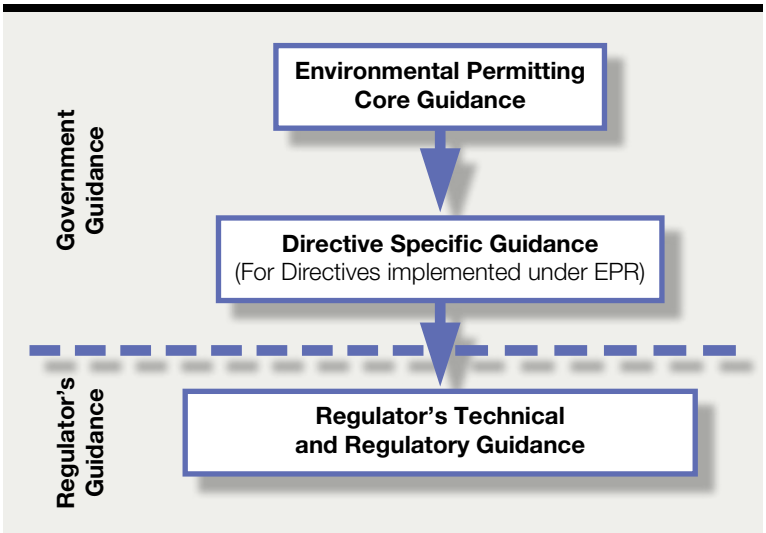


Figure 15.3 Environmental Permitting Guidance Hierarchy

requirements of a permit or registration. It is an offence to cause or knowingly permit pollution of water.

See the web link to the Environmental Permitting Regulations 2010.
An embedded .pdf copy is provided here.

The legal requirements are outlined in the Environmental Permitting Core Guidance
An embedded .pdf copy is provided here.

15.4 THE ENVIRONMENTAL PERMITTING REGIME

In England and Wales the IPPC, Waste and Water regulatory regimes have been integrated under the Environmental Permitting Regulations which provide a common, risk-based flexible permitting and compliance platform for all environmental permits, whilst accommodating all the specific requirements of each legal regime. It is thus possible for a large and complex operation to have a single environmental permit that covers its emissions to all media and is consistent with the most stringent components of all the environmental regulatory regimes that apply to its operation. At the other end of the regulatory scale, the integration of regulatory methods has allowed low-risk water discharge activities to receive a much lighter level of regulation via registrations.

The Environmental Permitting Regulations provide a robust framework for the regulation of emissions to the environment, under which sits high level and detailed guidance and procedures for regulators and businesses. The hierarchy is shown in Figures 15.2 and 15.3 taken from Defra consultation material.

The government's guidance provides help for those operating, regulating or interested in activities that are covered by the Environmental Permitting (England and Wales) Regulations (EPR). The purpose of the Environmental Permitting Core Guidance is to have a simple, single reference point explaining how the Environmental Permitting Regulations work and how they are implemented. It replaces previous lengthy guidance for the former water, waste and IPPC systems with an easy-to-read, concise piece of guidance.

The main government EPR guidance document is the Environmental

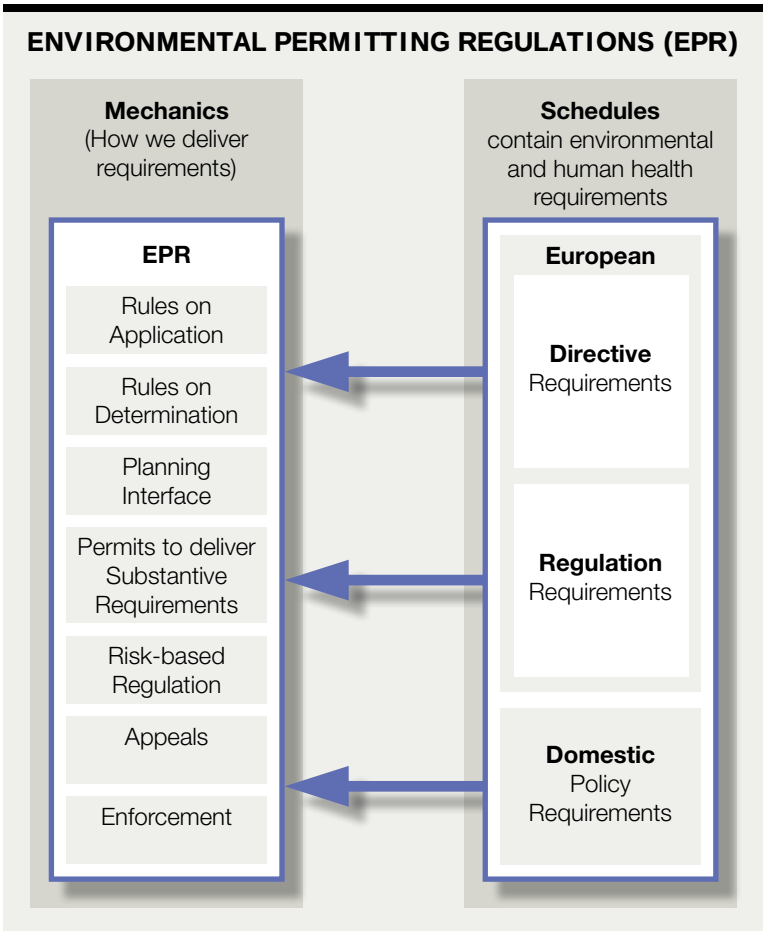


Figure 15.4 Conceptual Structure of Environmental Permitting Regulations 2010

Permitting Core Guidance and is supported by further guidance on each of the various EU Directives delivered by the EPR.

The following web links provide access to the government guidance for EPR generally: Environmental permitting Regulations Core Guidance (March 2013)

Introductory booklet on Environmental Permitting Regulations (2010)

The government has also provided Guidance for regulation of stand-alone water discharge activities (i.e. discharges that are not PPC or Waste related discharges), and for Regulation of groundwater activities.

Click on the hyperlinks below for embedded copies of the government guidance documents:

EPR Core Guidance
EPR Booklet
EPR Water Discharge Activities
EPR Groundwater Activities

Figure 15.4 provides a conceptual diagram of the structure of the Environmental Permitting Regulations 2010.

15.5 BESPOKE PERMIT, STANDARD RULES PERMIT, REGISTERED EXEMPTION, GENERAL BINDING RULES

There are basically four types of regulatory controls available under EPR for potentially polluting discharges, and the choice of which regime to apply depends on risk to the local environment.

The most demanding regime is the **bespoke permit**, where the conditions of permit may be tailored to the nature of the activity, including its inputs and operation; nature, volume and composition of discharge; and receiving water requirements. Most large industrial plant with process effluent discharges to water will fall under this regime, the precise scope of regulation depending on which Directives apply to the sector of business. Detailed risk assessments of several aspects of the business and receiving environment may be required. These will be used by the regulator to produce a comprehensive permit containing conditions that limit the risk of pollution occurring, or receiving waters failing to meet their prescribed Class. If the regulator refuses a valid application, or if the regulator imposes conditions that are unacceptable to the operator, the operator may appeal to the Minister or Minister's appointee. Both parties are bound by the appeal decision. It is an offence to undertake a prescribed activity without a permit. It is an offence not to comply with a condition of a permit.

The overall scope and requirements for bespoke permits is outlined in the Defra Environmental Permitting Core Guidance, Chapters 2 to 7: Introduction; What Facilities require an Environmental Permit?; The Regulator; Environmental Permit Applications; Application Procedures and

Determining Applications; and Chapters 9 to 14: Operator Competence; Consultation and Public Participation; Compliance Assessment, Enforcement and Review; Charging; Appeals; and Public Registers and information.

Standard rules permits are allowed for common types of discharge that are of lower environmental risk, but which nevertheless require a permit, and for which a national-scale risk assessment can be undertaken to generate rules applicable to an entire class of discharge. In most cases the regulator determines the standard rules following public consultation. These rules then form the standard permit. Operators may choose to apply for a standard rule permit if they can demonstrate compliance. Because the risk assessment is only undertaken once, the administrative costs are lower for standard rules permits, so charges are lower. Standard rules permits cannot be appealed as applying for them is voluntary. The national risk assessment may preclude certain standard rules permits where the receiving water is identified as being particularly sensitive to pollution. If a standard permit application has been accepted by the regulator, it is an offence for the operator not to comply with the requirements of the standard rules. More detail on the requirements for standard rule permits is given in Chapter 8 of the Defra Environmental Permitting Core Guidance.

Registered exemptions may apply to activities with low risk of pollution when undertaken in accordance with a national risk assessment and sector good practice, but which pose a risk if good practice is not adhered to. Classes of activity that are eligible for registration are determined nationally and specified in Regulations. Registration amounts to a notification by the operator to the regulator that an activity is taking place or is going to take place at a location, and that the operator agrees to comply with sector good practice. Registrations may be one-off, or renewable on a periodic basis, and are subject to a charge. Registrations may be precluded where the receiving water is identified as being sensitive to pollution. It is an offence not to have a registered exemption where one is required. It is an offence not to comply with a registered exemption. More detail on the requirements for registered exemptions is given in Chapter 15 of the Defra Environmental Permitting Core Guidance.

Generally binding rules apply through direct application to the operator of primary or secondary law (Regulations). They may apply for classes of lower risk activities than registered exemptions, but which nevertheless need to be properly constructed, managed and maintained. They have not (yet) been used in England and Wales, but in Scotland the Controlled Activities Regulations (CAR) administered by the Scottish Environmental Protection Agency (SEPA) allow them for small sewage treatment plant and for surface water drainage systems, for example. Such activities are legal provided they comply ▶

with the rules set in the Regulations and do not cause pollution. There is no need for the regulator to be notified.

The SEPA web site has information on the Controlled Activity Regulations (CAR) and a Practical Guide to the Controlled Activity Regulations.

An embedded copy of the Practical Guide to CAR is provided here.

15.6 TRADE EFFLUENT CONSENTS

There is a further tranche of permits issued by sewerage operators for trade effluent discharges made into the public sewerage system. Discharges of treated urban waste water or storm sewage overflows from the sewerage system are subject to environmental permits. The sewerage operator therefore needs to ensure that trade discharges to sewer do not threaten compliance with the environmental permit. Trade Effluent Consents are discussed further in Chapter 17.

15.7 ENVIRONMENTAL PERMITTING REGIME – ADVANTAGES & DISADVANTAGES.

The history of environmental regulation is that it has almost invariably been developed piecemeal and reactively, following recognition by government that environmental or public harm had been caused by activities that needed to be controlled. This applies both at national and European level.

In the UK environmental legislation dates back at least 150 years. The result has been an almost bewildering amount of different regulations for businesses to navigate and comply with. Often, different regulatory regimes overlapped, sometimes with contradictory requirements.

As part of the government's approach to simplifying environmental governance, and in recognition of the fact that the majority of environmental permits can operate to a common framework, Defra established the Environmental Permitting Programme (EPP) in 2003 as one of several Better Regulation Initiatives.

The aim was to reduce regulatory administrative burden and increase business and regulatory efficiency by creating a common framework for all environmental permits for England and Wales. The immediate priority was to merge the IPPC and waste regulatory permitting regimes, as the regulatory overlaps were causing problems – both for local authorities and the Environment Agency, who between them shared regulatory responsibilities, and for the businesses that they regulated.

The resulting Environmental Permitting Regulations 2007 (EPR) addressed waste and IPPC regimes only. It introduced a common permitting platform for both regimes, fully compliant with the Waste Framework and IPPC Directive requirements, and in so doing considerably reduced the amount of regulatory administrative burden on industry whilst ensuring effective environmental protection.

The next phase was to bring together under the environmental permitting framework permitted discharges to surface water (discharge consents) and to groundwater (groundwater authorisations), together with non-nuclear radioactive substances regulation.
The Environmental Permitting Regulations 2010 successfully did so.

Further consideration is being given to bringing the water abstraction regulatory regime under the EPR framework. The Defra Better Regulation web page provides more detail on the aim, scope and content

of the Better Regulation Initiative and on the specifics of EPR development.

Much of the earlier material on the Defra Environmental Permitting Programme has now been archived, and can be accessed here.

The key benefits of EPR are:

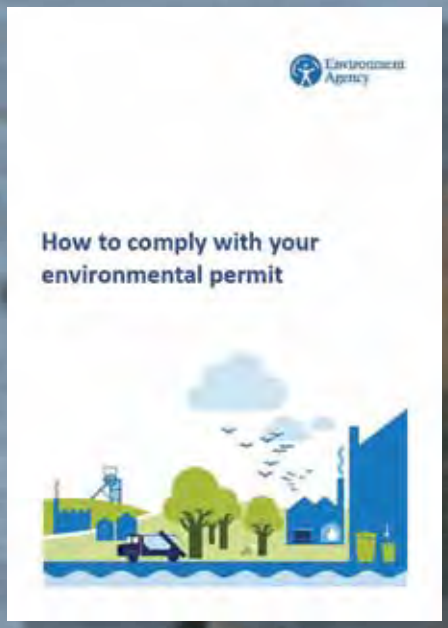
- Common application and permit templates.
- Standardised guidance and methodology.
- Less risk of regional variance in determination and enforcement of permits.
- Platform is not limited to a single regulator and can be expanded for use by other regulators.
- Encourages development of common data systems by regulators, increasing efficiency.
- Migration of subsistence charges to a common charges framework.

Disbenefits or outstanding deficiencies of EPR implementation include:-

- Permits issued under previous regulatory regimes (legacy permits) need to be updated to EPR template. It is not clear that regulators have sufficient resources to do this one-off exercise quickly.
- From an individual operator's viewpoint the common application process can appear complex, as the standard forms necessarily include all regulatory options, only a few of which are likely to be relevant to their specific case.
- The current application process can be seen as unwieldy, although planned menu-driven electronic forms are likely to make the application process much easier.
- The complex legal wording and composite structure of the Environmental Permitting Regulations makes it difficult for the non-legal professional to readily read and understand exactly what is required. There is heavy reliance on guidance to interpret the legal requirements. ■

16 ENVIRONMENT AGENCY GUIDANCE

We use the Environment Agency Environmental Permitting Guidance as an example of good practice, demonstrating the principles and need for a logical and transparent approach to water regulation. The examples that follow represent the situation at the time of writing, and can be used to demonstrate potential approaches and principles. Note that regulatory guidance is continually updated, so for current material consult the official Environment Agency Guidance.



16.1 ENVIRONMENTAL PERMITTING GUIDANCE

The Environment Agency has published an extensive suite of regulatory advice and guidance, to aid its staff and for the benefit of applicants for permits and the general public. This is available from the Business and Industry pages of the Environment Agency web site. The advice and guidance is periodically updated, and so for the most up to date information it is best to consult the Environment Agency web site. Much of the Environmental Permitting advice and guidance relates to installations regulated under IPPC and IE Directives, and to Waste Management activities, where the focus is on minimising environmental risk and minimising releases to the environment. Specific water quality regulatory guidance makes up a relatively small proportion of the total information. One over-riding principle is that discharges to water under any Directive regime shall not cause a breach of the relevant water quality objectives for the receiving water. ▶

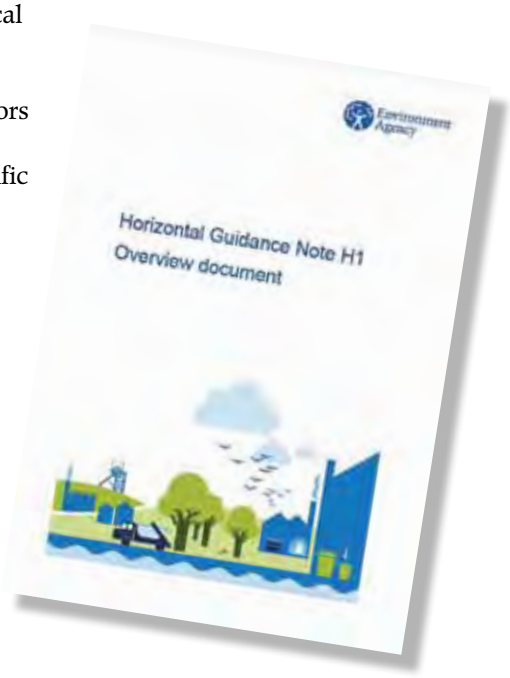
For convenience some web pages and documents that are particularly relevant to water quality regulation have been downloaded and links embedded in this book. These reflect the Environment Agency web site content in November 2013.

The sub-sections that follow highlight some of the more important aspects of the guidance.

The Environment Agency has published a series of general and sector-specific regulatory guidance to facilitate the permitting process under EPR. Successive levels of this guidance can be accessed via the Environment Agency web page on Environmental Permitting Guidance.

The guidance is tiered and comprises:-

- A general introduction for applicants for permits - 'How to Comply With Your Environmental Permit'
- Sector specific technical guidance
- 'Horizontal' guidance applicable across sectors
- Regulatory guidance notes (RGNs) on specific aspects of policy and interpretation issues associated with EPR,
- Application guidance,
- Charges guidance
- Assessing the environmental risk of an activity – Operational Risk Appraisal (OPRA).



The lead document is 'How To Comply With Your Environmental Permit'.

An embedded copy is provided here.

It contains guidance on management systems and permit conditions, and describes the basic standards that standard permit holders will need to understand. Applicants for bespoke permits will find the basic information they need here but they should also use other relevant technical guidance.
The guidance is split into seven parts:

Part 1: guidance for all activities;
Part 2: waste operations
Part 3: installations
Part 4: mining waste operations
Part 5: discharge of sewage or trade effluent
Part 6: groundwater activities (landspreading)
Part 7: where to find more information

The Environment Agency has also provided information on environmental management systems aimed at Small and Medium-sized Enterprises (SMEs) in various sectors. This includes the general business sector and specific information for operators of small sewage treatment works (less than 20m^3 per day), and for common discharges onto land that may affect groundwater.

Sector-specific technical guidance (mostly for PPC and Waste Installations, but with separate documents covering 'Discharges to Surface Water and Groundwater', and 'Groundwater') is listed on the Environment Agency web site. Further, more detailed guidance on the requirements for water quality planning and discharge permits is also given, and is referred to elsewhere in this Chapter.

The sectors and web-links to their sector specific Guidance, are listed below:-

- Cement and lime activities,
- Chemicals,
- Clinical waste,
- Combustion plants, including power stations,
- Discharges to surface water and groundwater,
- Food and drink,
- Groundwater,
- Intensive farming (pigs and poultry),
- IPPC Waste treatment and storage,
- Landfill,
- Mining waste,
- Paper, pulp and cardboard manufacturing,
- Printing and textiles - coating activities,
- Production and processing of metals,
- Radioactive substances activities – radioactive substances users,
- Radioactive substance – nuclear,
- Refineries,
- Spreading waste on land,
- Waste: incineration and energy recovery.

Click the following links for copies of the web pages for Discharges to Surface water and Groundwater, and for Groundwater.

Horizontal Guidance covers aspects of environmental protection information that are relevant to all sectors regulated under the Environmental Permitting Regulations.

These include:-

- Environmental Risk Assessment
- Energy Efficiency
- Noise
- Odour
- Site Condition Report Guidance ▶

The Horizontal Guidance on Environmental Risk Assessment(H1) is particularly important regarding the determination of discharge limits on pollutants discharged to water. H1, and H1 Annexes D and E provide discharge limit determination tools for 'basic' and 'complex' activities.

Regulatory Guidance Notes (RGNs) provide Environment Agency guidance on policy and legal interpretation issues associated with implementing the Environmental Permitting Regulations. They are high level guidance notes on the Agency's approach to implementing the Regulations. They sit below government guidance.

Web links for current RGNs are provided below and cover:-

- Understanding the meaning of Operator
- Understanding the meaning of regulated facility
- Deciding applications are duly made and requests for further information
- Setting standards for environmental protection
- Operator competence
- Determinations involving sites of high public interest
- Appeals to Secretary of State or Welsh Ministers
- Substantial changes in operation at installations, mining waste facilities and other facilities involving solvents and combustion
- Surrender
- Dealing with the death, financial difficulties or striking off of an operator
  Enforcement powers
- Statutory Periodic Permit Reviews
- Defining Waste Recovery: Permanent Deposit of Waste on Land
- Understanding the Landfill Directive

Regulation of intensive farming of pigs and poultry has proven to be contentious in the UK, as the sector had previously been virtually unregulated, with operators having a poor understanding of environmental requirements. Given the generally low levels of experience of regulation and technical skills within the sector, the Environment Agency has put considerable effort into making the guidance and instructions as clear as possible for farmers. Nevertheless, the problems faced by this sector are relatively straightforward, so the sector guidance and worked examples may prove to be a useful introduction to some of the complexities of IPPC control.

16.2 WATER DISCHARGE ACTIVITY GUIDANCE

The Environment Agency used to provide on its web site public copies of its detailed internal WQ guidance to its staff under the heading 'Water Quality Documents'. The page contained links to detailed guidance on WQ Planning, Permitting, and Monitoring and Compliance. As part of the rationalisation of the Environment Agency's web site

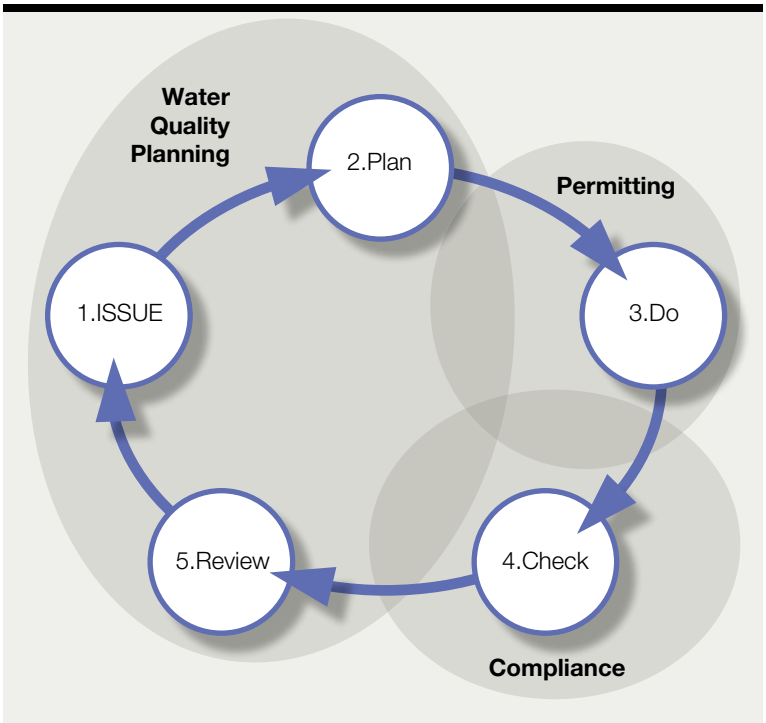


Figure 16.1 Relationship between Water Quality Planning, Permitting and Compliance

prior to much of its information moving to the government web site in April 2014, these documents are no longer readily accessible, although they are currently available on request. Downloaded copies of the documents available in November 2013 can be accessed here. **Note that these documents are subject to continual review, so for current information always consult the Environment Agency.**

The guidance covers three distinct but linked processes –Water Quality Planning, Permitting Discharges, and Monitoring and Compliance Assessment. For each there was a process map, identifying the sequence or suite of regulatory activities and tasks, and the specific guidance relating to them. The process maps contained embedded web links to documents on the Environment Agency web site, making reference to them very easy. Screen captures and downloaded copies of the process maps are provided in the following sections.

The three components of water discharge activity guidance apply whether or not the discharge is 'stand alone', although the often more prescriptive requirements for PPC installations and waste facilities frequently deliver tighter discharge standards than needed simply to achieve EQS. Each component has its own Plan-Do-Check-Review cycle whilst interacting with the other components and also contributing to the overall regulatory delivery part of the larger scale 'Environmental Protection' Plan-Do-Check-Review cycle.

16.3 WATER QUALITY PLANNING PROCESS

Water Quality planning comprises several steps, which ideally would be run sequentially, but in practice often run to some extent in parallel and in co-ordination with Permitting and Compliance processes:

- Identify Uses, Objectives and Targets for water body (see below).
- Identify substances or attributes of interest and monitor water body for them.
- Assess and report compliance of water body with Class and Status, including any permit non-compliance.
- Determine and report any reason for failure to meet Class or Status.
- Formulate and appraise options for solutions.
- Create and implement action plans.
- Audit delivery of planned outputs and outcomes and report on findings.

The identification of Uses, Objectives and Targets (UOT) is the first and most important part of the WQ planning process as all action flows from this. In order to plan the maintenance of current Good Status, or remediation if current Status is not good, regulators need to identify the current legitimate uses made of the water environment in a catchment, and the measures necessary to facilitate their continued sustainable use in a way that contributes to Good Status. This may involve limiting ▶

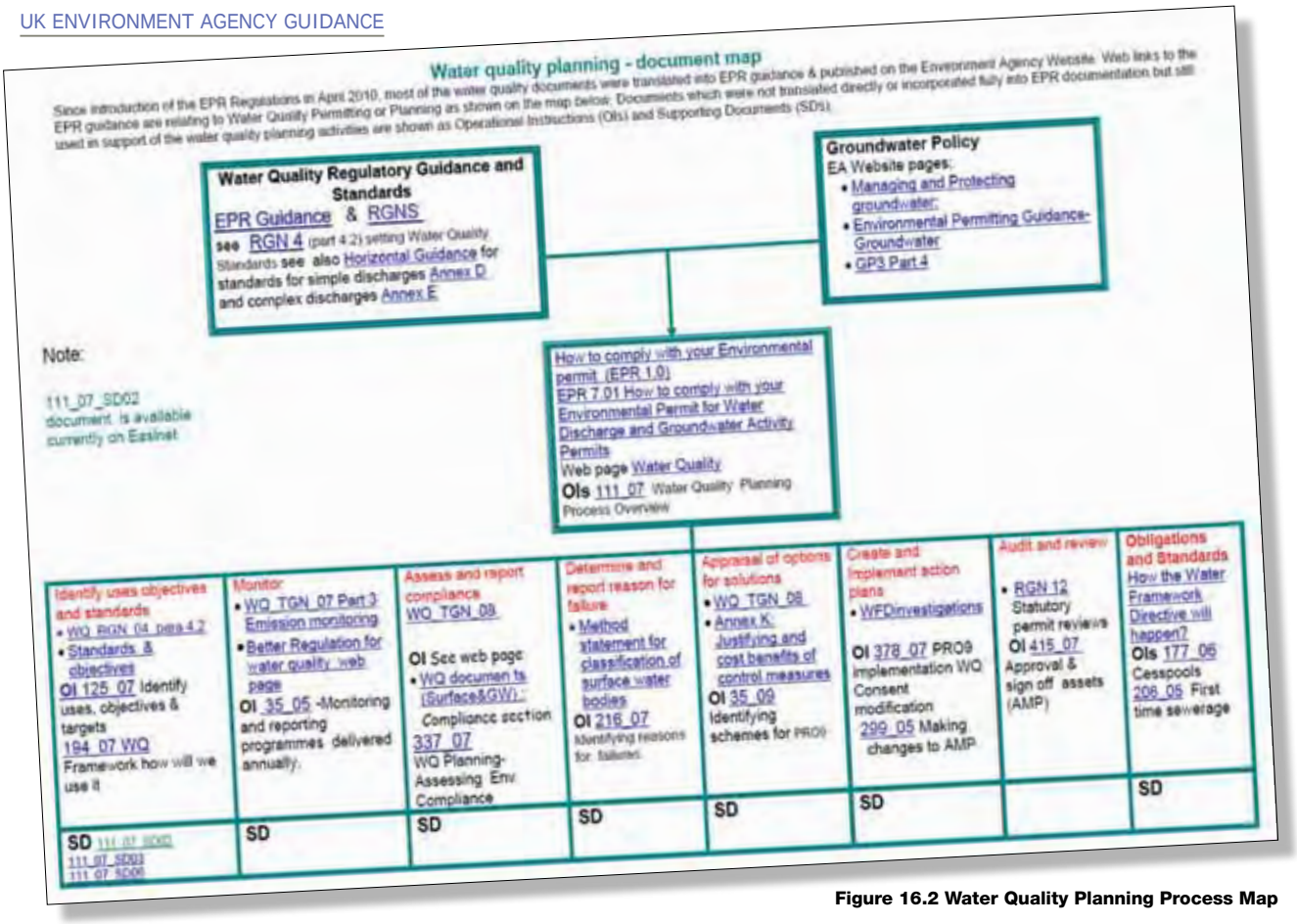


Figure 16.2 Water Quality Planning Process Map

the use or modifying the activities of others that threaten that use.

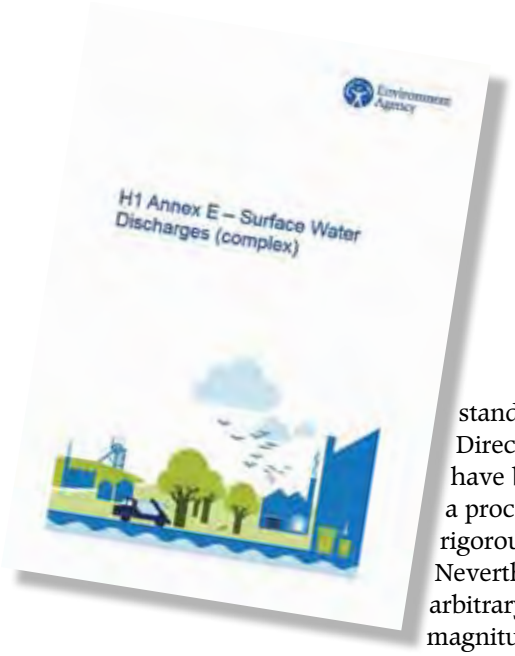
This means linking the use made of the water environment (e.g. designated as needing protection for economically important species under the Freshwater Fish Directive) to Directive outcomes (e.g. sustainable fish populations), and setting water quality targets as incremental steps towards that, to be achieved over the plan timescale. The outcome for a plan cycle might be 'achieving Good Status', or 'improving towards Good Status', depending on the difficulty in getting from current quality to desired quality within the six years of a Water Framework cycle. The WQ target would be expressed in terms of meeting specified quality standards set out in the relevant Directive (e.g. the concentration limits required within Freshwater Fish protected areas.)

The overall process is depicted in the Water Quality Planning Process Map(Figure 16.2), which can be accessed as a downloaded file here. This is no longer maintained on the EA's web site. It contains some functional web links to detailed guidance documents that are referenced in it, but several are no longer working. These documents may be obtained from the Environment Agency directly.

16.3.1 EVIDENCE BASED ENVIRONMENTAL TARGETS

There is reasonably good scientific knowledge of the biological impact and effects of many common polluting chemicals, but relatively little for the majority of synthesised chemicals. For regulators' Water Quality Planning and Permitting purposes, setting local water quality standards requires a good understanding of acute and chronic toxicity mechanisms for the whole range of aquatic and aquatic-dependent organisms. Where this knowledge does not currently exist, precautionary water quality standards may be derived, based on multiple dilutions of concentrations that have been demonstrated in the laboratory to either kill or have an adverse effect on certain organisms. So a newly synthesised substance that in laboratory tests kills fish at a concentration of 1 mg/l may have a precautionary one thousand dilutions applied to derive a prospective water quality standard of 0.001mg/l. More investigation and data may show this to be over-precautionary (or under-precautionary) and subsequently a revision to the standard, and any permits relying on it, may be made.

The majority of statutory water quality



standards (i.e. Directive standards) have been through a process of rigorous peer review. Nevertheless, quite arbitrary orders of magnitude (x10, x100, etc.) safety factors still apply to many of the substances limited by statutory quality standards. Their virtue is that they probably provide a high degree of protection to the receiving water and stimulate technical innovation if it is currently difficult for dischargers to achieve the required discharge limits. On the down side, if the standard is too strict, it may impede economic development and result in excessive energy consumption in manufacturing and effluent treatment processes.

It is therefore worthwhile ensuring that the effectiveness of standards is reviewed from time to time, looking at discharge data and the environmental monitoring data collected downstream of discharges (both water quality and ecology) to verify that the standard is set at the appropriate level. Strict adherence to the Water Quality Planning cycle described in Chapter 2 and above should ensure that this occurs. As a generalisation, the 'review' part of the cycle is the least well developed.

Most Directives have an implementation timescale by which the Member State must meet the required standards in its waters. The European Commission has necessarily focused most attention on late or non-compliance with Directive standards. Seemingly little has been done to review compliant waters to check whether the standards are in fact set at the right level.

The starting point for the regulator in considering an application for permit, or pre-application discussion, is to establish the temporal distribution of current water quantity (flow) and quality at the proposed discharge point, such as annual maxima and minima, mean, median, mean and 95 percentiles, together with the impacts of any current or permitted but not yet operating discharges or abstractions. For major watercourses (and their first and second order tributaries) statutory quality standards or requirements are likely to apply, in accordance with Directive requirements. If the water already meets those requirements, the regulator's job is to ensure that the permit does not threaten future compliance. If the receiving water does not currently meet the required standards, the regulator will need to assess the likely reasons for failure, intended remediation and timescale for completion, and the contribution that the new discharge may make to downstream compliance.

16.4 WATER DISCHARGE PERMITTING PROCESS

The Water Discharge Permitting Process is sequential with inputs from Water Quality Planning and Compliance at certain stages. The following steps can be identified:

- Developer identifies need for discharge.
- Pre-application discussions identify any environmental constraints on developer's proposal, and allow developer to assess options for discharge control.
- The developer makes a formal application, which is accepted as being valid after checking for completeness and payment of the correct fee. Details of the application are entered on the Register.
- The application is advertised and specified consultees are notified by the regulator.

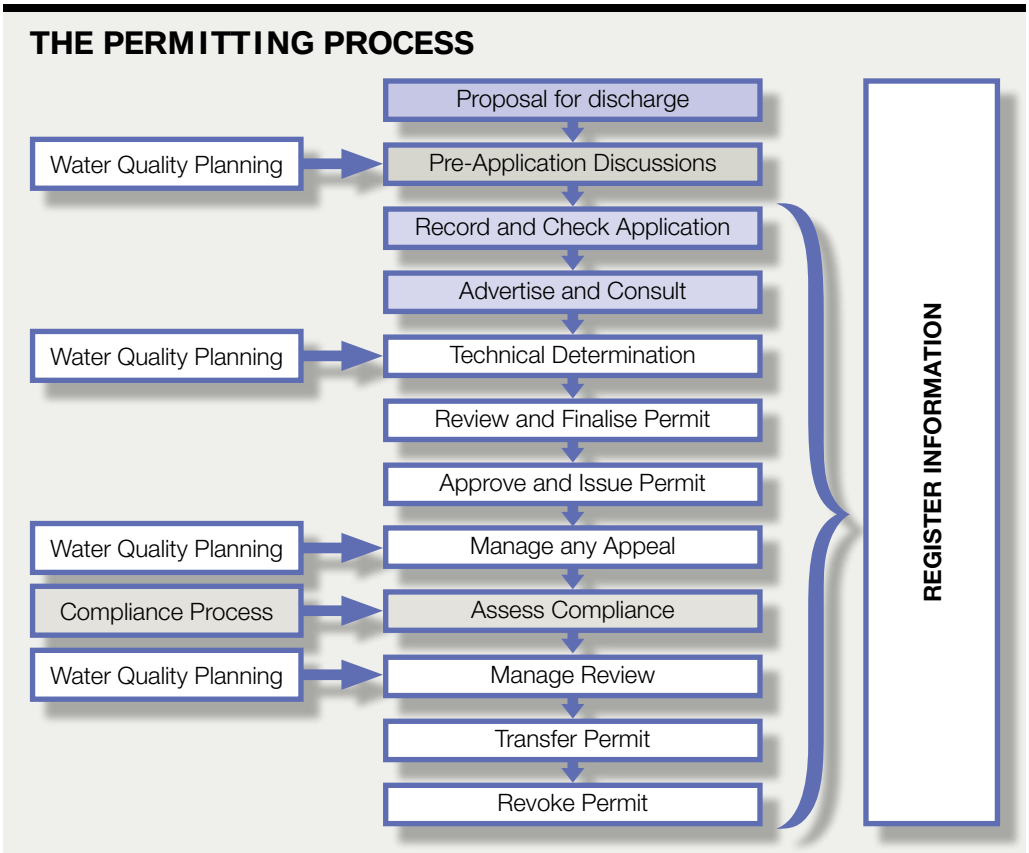


Figure 16.3 Water Discharge Activity Permitting Process

- Technical determination of the permit conditions is undertaken by the regulator, taking into account representations made in response to advertisement and consultation. Further information may be sought from the applicant.
- The technical analysis is reviewed and final permit conditions are determined.
- The permit is then issued to the applicant, and details of the permit and decision documents are entered on the Register.
- If the applicant does not agree with the permit they may appeal to an independent inspector for the permit to be altered.
- If the applicant accepts the permit the discharge may begin, in accordance with the conditions in the permit, which will include such monitoring and reporting of the discharge quality and quantity as the regulator deems necessary for compliance to be assessed.
- Periodically, in conjunction with water quality planning cycle timescales, the permit may be reviewed, checking on discharge performance and on achievement of expected receiving water quality. The review may result in alteration of permit conditions, which may be appealed.
- In the event of a change of ownership of a discharge it may be transferred to the new owner.
- In the event of cessation of discharge the permit will be revoked.

The process is summarised in Figure 16.3 Water Discharge Activity Permitting Process.

The components of permitting are depicted in Figure 16.4 Permitting Process Map, which can be accessed as a downloaded file here. The Process Map is no longer maintained on the EA's web site. It contains some functional web links to detailed guidance documents that are referenced in it, but several are no longer working. These documents may be obtained from the Environment Agency directly.

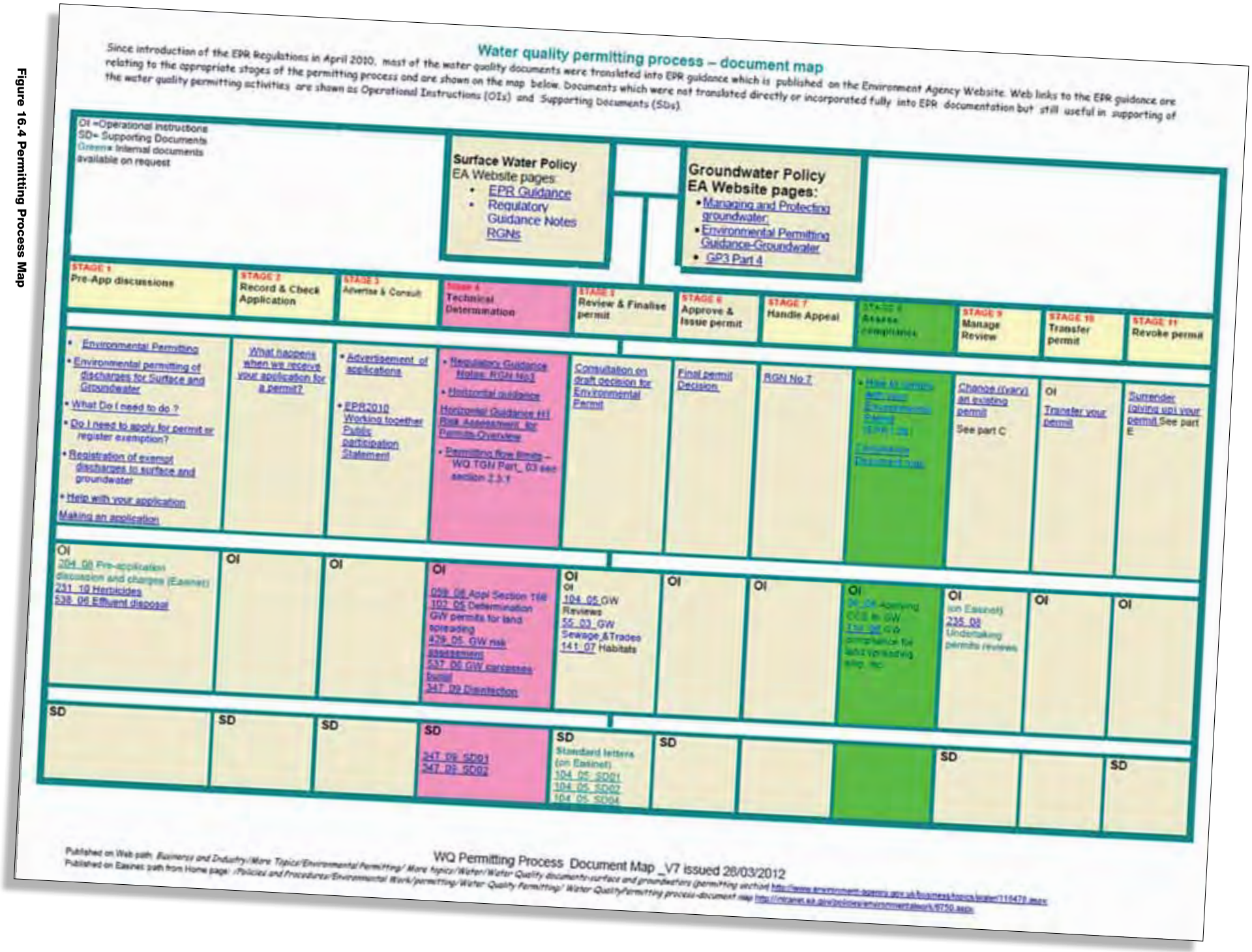


Figure 16.4 Permitting Process Map

16.5 COMPLIANCE PROCESS

Most water discharge compliance activities are addressed in EPR Guidance – How to Comply with Your Environmental Permit and in How to Comply with your Environmental Permit for Water Discharge and Groundwater Activity Permits, both of which can be accessed via the web links or as downloaded documents here and here.

Specific guidance on stand-alone water discharge activity permit compliance includes:

- Compliance assessment for descriptive permits
- Compliance assessment for numeric permits
- Urban Waste Water Treatment Directive requirements
- UV Disinfection Compliance assessment
- Flow Measurement
- Groundwater discharge compliance assessment
- Operator Self-monitoring
- Operator Performance Risk Appraisal (OPRA)
- Compliance Assessment Plans
- Compliance Classification Scheme (CCS).

The Environment Agency web site formerly provided a web link of detailed internal guidance to staff on aspects of compliance in Figure 16.5 Compliance Process Document Map which could be accessed as a downloaded file here. The map is no longer maintained on the EA's web site. It contains some functional web links to detailed guidance documents that are referenced in it, but several are no longer working. These documents may be obtained from the Environment Agency directly.

Compliance assessment may identify non-compliance, in which case some form of enforcement may be required. Enforcement is discussed in Chapter 25.

16.6 MAKING AN APPLICATION FOR A PERMIT

The Environment Agency uses a common format for all environmental permit applications, which must be used to apply for a new bespoke or standard permit or to vary, transfer or surrender a permit. The form is quite complex, and can run to many pages as it has to cover all types of permittable activities. It is broken down into a series of parts, only some of which will be required for a particular sector, location or discharge type.

The Making an Application web page provides links to the relevant forms and guidance on how to complete them. The guidance includes specific

Water quality compliance - document map

Since introduction of the EPR Regulations in April 2010, most of the water quality documents were translated into EPR guidance which is published on the Environment Agency Website. Web links to the EPR guidance are relating to the appropriate topics of permits conditions and are shown on the map below. Documents which were not translated directly or incorporated fully into EPR documentation but still useful in supporting of the water quality compliance permitting activities are shown as Operational Instructions (OIs) and Supporting Documents (SDs).

Water Quality Regulatory Guidance and Standards
EPR Guidance & RGNS
see RGN 4 (part 4.2) setting Water Quality Standards see also Horizontal Guidance for standards for simple discharges Annex D
and complex discharges Annex E

Groundwater Policy EA Website pages:
- Managing and Protecting groundwater
- Environmental Permitting Guidance-Groundwater
- GP3 Part 4

How to comply with your Environmental permit (EPR 1.0)

EPR 7.01 How to comply with your Environmental Permit for Water Discharge and Groundwater Activity Permits

OIs
91_09 Compliance Umbrella Doc
337_07 (Quick guide to Assessing Environmental Compliance –Reporting Requirements)
35_05 (Monitoring & Reporting Programmes)

OI = Operational Instructions
SD = Supporting Documents
Green = Internal documents available on request

Descriptive Permits	Numeric permits (LUT)	Urban Waste Water Treatment Directive (UWWTD)	Operator Self Monitoring (OSM)	UV Disinfection	Flow	Groundwater	Compliance Classification Scheme (CCS)	Operator Risk Performance Appraisal (OPRA)	Compliance Assessment Plans (CAPs)
• WQ_TGN_08 para 4.1 **OI** 1155_08	• WQ_TGN_08 para 4.2 **OI** 74_07	• WQ_TGN_08 para 4.3 • OMA guidance for OSM and UWWTD **OI** 06_09	• EPR 7.01 • WQ_TGN_07 Part 3 **OI** 97_09	• WQ_TGN_08 para 4.4 **OI** 58_03 085_10 - (Microbial Source Tracking MST)	• WQ_TGN_08 para 4.5 & 4.6 **OI** 472_10	See Horizontal Guidance • Annex J, Ji, Jii, Jiii 114_06 Sheep Dip 221_07 Work Notices	**OIs** 534_10 EPR Internal **26_05** (Applying CCS to GW)		(to be drafted)
SD 1155_08_SD01	**SD**	**SD**	**SD**	**SD**	**SD**			**SD**	**SD**

Figure 16.5 Compliance Process Document Map

information for discharges to surface water and to groundwater and provides examples of different application types. A downloaded example of a simple water discharge activity permit application for a small sewage treatment works is provided here.

16.7 THE PERMITTING PROCESS - PRE-APPLICATION DISCUSSIONS ON ENVIRONMENTAL IMPACTS AND OPTIONS FOR MINIMISING THEM

It is in developers' and operators' best interests to contact the regulator as early as possible in the development planning process, and well before any significant decisions have been made. Regulators should make accessible as much environmental information as is readily available to prospective permit applicants, and freely provide advice as to the sort of information a successful application should provide. A fine line has to be drawn between the regulator providing regulatory advice and providing environmental or design consultancy services to the prospective applicant. Failure to undertake pre-application discussions has led in the past to unpleasant and costly surprises for businesses, and an unwanted workload for regulators. Normally regulators will provide advice and information free of charge for a limited initial period, but if substantial work is involved in addressing the prospective discharge requirements, or in providing environmental information, then a charge may be made to the applicant to recover costs.

The UK environmental regulators provide extensive support and information for small and medium sized businesses that may have environmental impacts. Their information is included on the government's business support web sites for England and Wales and for the devolved Regions. As these are entirely web based resources it is not feasible to append documents from them to this report. They provide an excellent introduction for non-specialists to the range of environmental regulation that a small or medium sized business may experience, and point to where advice may be found.

The UK regional governments and environmental regulators collaborated to establish Netregs – a web site providing access to a wide range of environmental regulatory information for small and medium sized enterprises (SMEs). A major concern for SMEs has been the difficulty of finding out what environmental obligations apply in their business sectors. Netregs provided this information in a readily accessible way. Unfortunately a government rationalisation of web sites in 2011 resulted in most of the Netregs information for England becoming less available in England, whilst similar information reflecting regional priorities and legislation remains available in Wales, Scotland and Northern Ireland.

Some of the English Netregs information can be accessed on the Gov.uk web site under the heading Waste and Environmental Impact. The Environment Agency web site has a wide range of

information under the general heading Business and Industry, with subsections on environmental topics and sector–specific information, plus a monthly e-bulletin – Business Environmental Update. Neither web site reproduces the user-friendly features of Netregs. In Wales the Welsh government's Business Wales web site has a lot of information presented in a manner similar to the former Netregs under the heading Environment – Efficiency Waste and Pollution Prevention.

Fortunately Scotland and Northern Ireland have maintained and continue to develop Netregs, focused on the nuances of their own legislation. As international and EU obligations apply to the whole UK, the vast majority of the Netregs environmental regulation information on the Scotland and Northern Ireland Netregs web site remains relevant to England and Wales.

The Environment Agency provides a substantial amount of advice for prospective environmental permit applicants on its web-site. The downloaded Environmental Permitting web pages and documents accessed via hyperlinks in this book provide a major resource on 'how to do environmental permitting,' focusing on discharges to water.

For the most part the hyperlinks in this Chapter use the now archived EA Website to access web pages and documents available at the time of drafting.

Note that they are a snapshot in time, and may be subject to change, so prospective applicants should always consult the authoritative website for the most up-to-date information.

In 2014 the Environment Agency web site will become part of the gov.uk web site. It is not yet clear exactly what content will change, remain the same or be lost, so this book, provides a useful repository of how at least some of the water environmental regulatory business was presented to the public in late 2013.

The Making an Application web page and associated guidance documents relevant to Applications for Environmental Permits for discharges to water are particularly useful. They include information on applications for various types of permits, variations, transfer and surrender of permits; and a useful document – Getting it right first time – hints and tips on making a successful application for a permit. It also includes links to example applications for discharges to surface waters and to groundwater.

16.8 RISK ASSESSMENTS

Environmental risk assessment is an absolutely fundamental component of permitting and regulatory delivery. It underpins all regulatory decision making and, if undertaken properly, ensures that the level of regulation of an activity or discharge is cost effective and proportionate to the long-, medium-, and short-term risks posed to the water environment.

A cyclical framework for environmental risk management is required to offer structure in what would otherwise be a complex array of considerations for the decision-maker. The framework also offers a mechanism through which the process of environmental risk assessment and management can be explained to stakeholders, and acts as a valuable aide-mémoire to multidisciplinary teams conducting risk assessment. This framework identifies four main components of risk assessment: (1) formulating the problem; (2) carrying out an assessment of the risk; (3) identifying and appraising the management options available; and (4) addressing the risk with the chosen risk management strategy.

Essential components of environmental risk assessment and management can be summarised as follows:

- Risk questions are best informed by a range of stakeholders.
- When a risk problem is highlighted, the source, pathways and receptors under potential threat should be recognised.
- An assessment plan is then needed to outline the data requirements for assessment and the methods needed for data collection and synthesis.
- Resources for the assessment can be allocated following initial risk screening and prioritisation. Identifying the hazard at the beginning of the assessment should clearly define the harm to the environment that is of concern.
- An estimation of the potential consequences of the hazard being realised and an evaluation of the probability of impact can then be carried out.
- This evidence is then used to provide judgement as to the significance of the risk.

Detailed guidance on environmental risk assessment is provided in Green Leaves 3, Guidelines for Environmental Risk Assessment and Management, published by Defra in November 2011.

A .pdf copy is provided here.

16.9 APPLICATION AND SUBSISTENCE CHARGING

It is a fundamental principle that the polluter pays for pollution. It is therefore appropriate for the operator of a regulated activity to pay a contribution towards the costs of regulation, both at the time of application and decision by the regulator, and for the work undertaken by the regulator for subsistence of the permitted discharge. These charges are additional to those incurred by the operator in monitoring activities and emissions and in providing information to the regulator.

Nevertheless the public/society also obtains value from the operator by way of goods and services provided as a result of the regulated activity, so there is also a 'public good' component or contribution to the cost of regulation. Not all the regulatory burden falls on the operator.

The permit in effect allocates a proportion of environmental assimilative capacity to the discharger. Without it the operator cannot legally continue business, so it has

a high value to the business, of equivalent importance to success as the raw materials and energy used by the process, although it is not in itself tradeable. Note that when a business is sold, the permit can be transferred with it.

Principles for Regulators' Charging schemes, which have to be approved by the lead Minister, are set out in Chapter 12 of Defra Environmental Permitting Regulations Core Guidance.

Details of the current (2014/2015) Environment Agency Environmental Permitting charging scheme are on the web together with the charges for discharges of effluent to surface waters and groundwaters.

16.10 MONITORING AND INSPECTION

Most production processes benefit from monitoring to ensure that the quality of finished products is up to the customer's specification, and that input materials are not unduly wasted. Businesses are familiar with management and monitoring techniques directed towards this end. The same principles apply to discharges from process-effluent treatment plant. Here the 'customer' is the receiving water environment. Typically the finished products are:

- the effluent complying with permit specification, and therefore the customer's (that is, the environment's) requirements
- waste sludge for further treatment, recycling or disposal.

The waste stream(s) feeding the effluent treatment plant need to be monitored by the operator to ensure that no off-specification releases of pollutants are made that might exceed the plant's treatment capacity or otherwise cause non-compliance with the permit. The effluent treatment system process(es) need to be monitored by the operator to ensure they are operating within design parameters and to maximum efficiency. The regulator may, in addition, specify that specific components of the effluent discharge have to be monitored and recorded by the operator on a continuous or episodic basis. Typically these might include flow rate, pH, temperature, turbidity, conductivity, Dissolved Organic Carbon, Chemical Oxygen Demand, Dissolved Oxygen and Ammonia on a continuous or relatively high frequency sampling basis. Components that are less readily monitored directly, such as metals, pharmaceuticals and pesticides, will be subject to a less frequent sampling programme.

In connection with the subsistence of the permit, the regulator's role is to check that the required information on process and discharge has been provided, that the discharge complies with the permit, and, if not, to ensure that steps (including legal enforcement) are taken to secure compliance as quickly as practicable. In addition, to ensure that information provided by the operator pursuant to the permit, and any action by the regulator in policing the permit is entered on the Public Register.

For a well-run business, interaction with the regulator will be largely pre-planned on the basis of the regulator's risk assessment of the discharge, with effort concentrated on performance audit and routine inspection, and review of the risk assessment. Poorly performing businesses may require a disproportionate amount of reactive effort to investigate pollution incidents and to respond to public complaint. This may divert regulator's effort away from the planned programme. ▶

In such a case there may be a strong incentive for the regulator to move quickly to legal enforcement in order to get performance on track.

16.11 OPERATIONAL RISK APPRAISAL

The Environment Agency has introduced a formal risk assessment process, Operational Risk Appraisal (Opra), for certain activities that it regulates to enable it to focus resources where most needed, and to charge operators according to the amount of effort needed to regulate them. It does not yet apply to stand-alone water discharge activities (e.g. most sewage and trade effluent discharges that are not included in other regimes, which have recently been included under the EPR umbrella) as there is an environmental risk element embedded in the current charges for discharges scheme. The Opra scheme is briefly outlined on the Environment Agency web page which links to several Opra explanatory documents and the Agency's charging schemes.

The following sections have been extracted and paraphrased from the Environment Agency document Environmental Permitting Regulations Operational Risk Assessment (Opra for EPR) version 3.9, a downloaded copy of which can be viewed here.

To look after the environment regulators need to be able to put more of their effort into the higher-risk activities and poor performers. Operational risk appraisal (Opra) is a way of assessing risk that helps them do this. They use it to:

- help them plan how to use their resources
- report on how the activities they regulate are performing
- work out charges

Opra assesses five attributes of an activity and generates a score which defines the amount of regulatory effort needed and translates this into a charging band.

The attributes assessed are:

- complexity
- emissions and inputs
- location
- operator performance
- compliance rating.

These are explained in more detail below and in Opra for EPR v 3.9.

The Environment Agency web page on Opra contains links to further Opra guidance.

Much of the information feeding into the Opra risk assessment is provided by the permit holder. The Environment Agency uses a questionnaire, linked to the five attributes, to be completed by the permit holder to generate the Opra profile. The answers to these questions provide an environmental risk assessment for the permitted activities. This then converts to the permit holder's Opra-banded profile.

There are three different types or 'tiers' of environmental permit, subject to Opra. The different types relate to the complexity of the activity under scrutiny.

Tier 1 is for Registrations. There are currently no Tier 1 Opra permits.

- Tier 2 is for fixed charge permit activities. These are permits where the regulator makes a decision whether or not to grant the permit, but where there isn't enough environmental risk to justify using the full Opra scheme.
- Tier 3 is for complex installations

with bespoke permits, waste facilities, and some mining waste operations. Permits are subject to the full Opra scheme.

The five 'attributes' are:

1 Complexity - the type of activities covered by the permit. This attribute looks at:

- what the permit holder does and what hazardous materials are on site.
- what the permit holder releases or could release into the environment.
- the work the regulator needs to do to make sure the permit holder is keeping to the rules of the permit and to keep public confidence.

2 Emissions and inputs - the amounts the permit holder is are allowed to put into and release from an activity. This attribute looks at:

- releases to air.
- releases to water.
- releases to land.
- waste coming onto site.
- waste being transferred off site.

3 Location - the state of the environment around the permit holder's site. This attribute looks at:

1. how far the site is from where people live, work and play.
2. how far the site is from areas that have been given special legal protection, e.g.Sites of Special Scientific Interest.
3. what surface and ground waters occur near to the site and if the site could be flooded.
4. the potential for a direct release to water and what the permit holder has in place to stop it.
5. if the site is in an area the local council is targeting to improve air quality.

4 Operator performance – the permit holder's management systems and enforcement history. This attribute has two parts:

1) the management systems and procedures the permit holder uses to help keep to the rules of the permit.
2) recent formal enforcement action taken at the permit holder's site by regulatory organisations.

5 Compliance rating - how well the permit holder keeps to the conditions of the permit. Using the Environment Agency's compliance classification scheme (CCS), this attribute looks at:

- whether or not the permit holder has kept to the conditions of the permit.
- what could have happened to the environment if the permit holder failed to keep to the conditions of the permit.
- work the regulator needs to do to deal with the permit holder if the permit holder fails to keep to the conditions of the permit.

The Environment Agency works out the compliance rating using the total CCS for each calendar year, January to December. The compliance rating adjusts the yearly subsistence charge for most tier 2 and tier 3 permits. Details of the adjustments for each band are presented in the EP Charging Scheme and Guidance 2013/2014.

The information and answers for each attribute will give the permit holder a band rating from A to E, and A to F for compliance rating. An 'A' rating means the permit holder needs less regulatory effort from the regulator, while 'E' or 'F' means more regulatory effort is needed ▶

because of the increased environmental risk of the permit holder's activities, and to help the permit holder to keep to the conditions in the permit. 'Regulatory effort' means the work the regulator does to assess how well the permit holder meets these conditions. This can include visits to the permit holder's site to give advice or to assess how the permit holder is doing, checking information against the permit or auditing the permit holder's management system.

16.12 PUBLIC REGISTER

The Register is in many ways one of the most important resources of an environmental regulator, and the public that it serves, yet it often has a very low profile in day-to-day regulatory life. The Register is specified by law, and the regulator is obliged to enter and maintain a wide range of specified information on it. It is an important safeguard against over-zealous or indifferent regulatory performance. In the context of regulated activities, it provides a public record of what is required or allowed, individual operator's performance, and the regulator's response to it.

The form of the Register is not specified; it may be paper or electronic or a combination of both. It has to be made available for scrutiny by the general public on demand during normal working hours, and information from it must be provided on request at reasonable cost.

The Register contains, subject to certain exclusions on grounds of national security or commercial confidentiality:

- Notices from Minister to Regulator specifying water quality objectives, e.g. WFD and EQS Directive Standards.
- Directions from Minister to Regulator requiring specified action(s) in relation to any part of the regulatory remit, e.g. monitoring water quality, investigating water quality issues, etc.
- Details of applications for new or varied permits, applications for transfer or surrender of permits, notices requiring further information from applicants, regulator's reports on environmental assessment of an operator's activity, regulator's decisions, appeals and information relating to appeals, permits granted, and information provided in compliance with permit.
- Water and effluent sample results for all samples taken by the regulator in connection with pollution control functions, or that the regulator required to be taken, including action taken, if any, by the regulator on the results.
- Details of convictions of any person for an environmental offence.
- Details of legal cautions of any person.

The regulator has some discretion about whether any civil sanctions for non-compliance with environmental law are entered on the register, but is required to publish 'from time to time' reports on the civil sanctions imposed and their effects.

Information from the regulator's register may also be provided 'up the chain' to local or national government. Directive related data, such as monitoring in compliance with Environmental Directives, and emissions from regulated businesses, is reported to the European Environment Agency for publication in the European Environment Information and Observation Network (Eionet) and the European Pollutant Release and Transfer Register (E-PRTR).

16.13 ENVIRONMENTAL MONITORING FOR DISCHARGE PERMIT COMPLIANCE

It is generally seen as the regulator's job to monitor the receiving water at critical points downstream of the discharge to ensure that the assumptions made in granting the permit have been substantiated, and the water is meeting its target Class and is not unduly affected by the discharge. The regulator has powers of entry on to land to secure samples and information. These powers are not generally granted to operators. In complex situations, for instance where there are several discharges in close proximity, or the discharge has a permitted mixing zone, both monitoring and modelling of discharges and water quality may be necessary in order to demonstrate an individual discharger's compliance with permit and overall compliance with water quality standards.

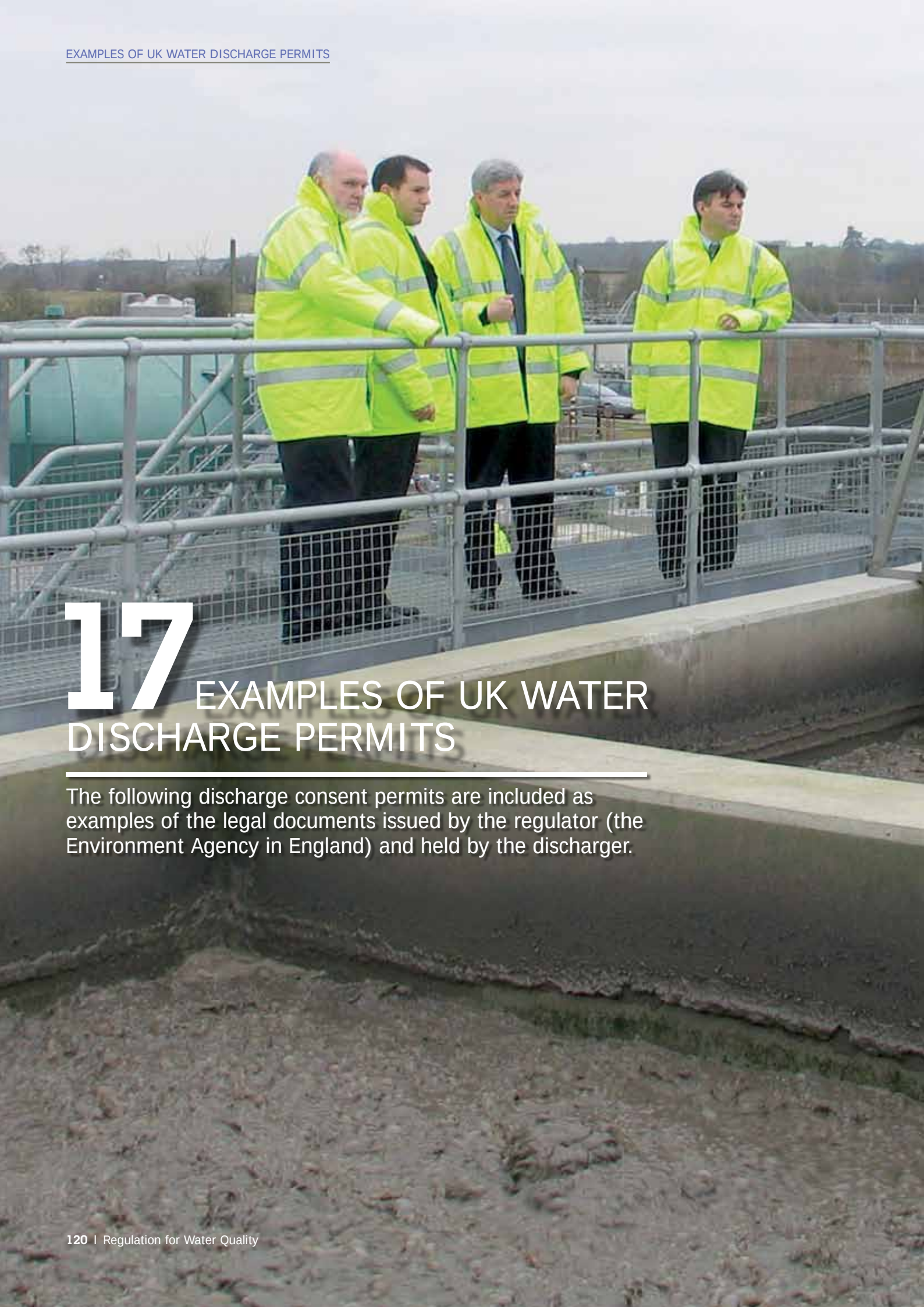
16.14 COMPLIANCE ASSESSMENT, ENFORCEMENT AND REVIEW

The Regulator must take enforcement action if a permit is not complied with. See also Chapter 25. The Regulator should periodically review the terms of a permit to ensure that it is consistent with latest environmental knowledge and technological advancement.

Default frequency of review may be specified in Directives or by national legislation, otherwise it is dependent on the regulator's assessment of risk of the permit not being complied with, or of environmental deterioration. A comprehensive set of reviews of permits was undertaken for the Habitats Directive, and the advent of River Basin Management Plans under the Water Framework Directive implies a six year cycle for all permits for discharges that are made to waters of less than Good Status.

Compliance Assessment, Enforcement and Review principles are set out in Chapter 11 of Defra's Environmental Permitting Regulations Core Guidance. The principles cover:

- Compliance assessment
- Risk-based compliance assessment
- Methods of compliance assessment
- Enforcement
- Enforcement notices
- Suspension notices
- Prosecutions
- Revocation
- Remediation
- Enforcement against the Crown
- Ongoing review
- Variation of conditions by the regulator
- Permit reviews. ■



17 EXAMPLES OF UK WATER DISCHARGE PERMITS

The following discharge consent permits are included as examples of the legal documents issued by the regulator (the Environment Agency in England) and held by the discharger.

17.1 SCOPE OF DISCHARGE CONSENTS / STAND-ALONE WATER DISCHARGE ACTIVITIES.

Permits for effluent discharges to inland waters in the UK, known as 'consents', have been required since the 1950s, under water pollution laws. In England and Wales there are about 60,000 consented discharges. Some, for large industrial discharges, have previously been subsumed into environmental permits issued under the IPPC and Waste Regulations. Since 2010, when the discharge consent regime came under the Environmental Permitting Regulations, all extant discharge consents became 'environmental permits for stand-alone water discharge activities'. The majority have not yet been reviewed to meet the EPR Standard Conditions template for stand-alone water discharge activities.

A 'stand-alone water discharge activity' is the rather curiously inaccurate name adopted by Defra lawyers in describing, for Environmental Permitting Regulations purposes, a discharge to controlled waters of sewage or trade effluent or 'other matter' from an activity that is not otherwise caught by the Regulations ▶

i.e. not an IPPC installation or waste site. 'Stand-alone effluent discharge activity' would more accurately describe the discharge.

This chapter provides a brief summary of some existing discharge consents/ stand-alone water discharge activities.

17.2 SMALL SEWAGE TREATMENT PLANTS, AND COOLING WATER OR HEAT EXCHANGER DISCHARGES TO SURFACE WATERS

The majority of stand-alone water discharge activities (WDA) are for small sewage treatment plants serving small developments in areas where there is no main sewerage provision, generally rural areas. For small treatment plants in the range 5m3 to 20m3 the Environment Agency has undertaken generic risk assessments, and consulted on proposed Standard Rules for such plants. Similarly, generic risk assessments have been undertaken for discharges of certain types of cooling waters and from heat exchangers, and Standard Rules have been formulated for these.

Provided the operator can satisfy certain environmental and operational criteria set out in the Standard Rules they are eligible to have a Standard Permit, attracting a reduced application and subsistence charge. Details of Standard Permits are provided on the Environment Agency web site.

Copies of these downloaded pages and the relevant water discharge activity documents (Standard Rules, Generic Risk Assessment, application forms) are available from the link here.

The generic risk assessment upon which the Standard Rules are based covers human health, chemical and biological water quality, and protected sites and species.

In summary, the Standard Rules require that:

- The Discharge cannot reasonably be made to public sewer.
- The operator may discharge domestic sewage with a maximum daily volume between 5 and 20 cubic metres per day to surface waters.
- The sewage must be domestic sewage containing no trade effluent and it must be treated by a secondary treatment plant that is sized, designed and constructed according to a set standard, and managed, operated and maintained in accordance with the manufacturer's recommendations.
- The discharge must only be made to a watercourse that normally contains water throughout the year.
- The discharge must not be made in close proximity to a designated sensitive water or nature conservation site.

The Standard Rules Permit identifies the operator and the location of the discharge. Its conditions are simply to comply with the relevant set of rules. A copy of the template used by the Environment Agency for Standard Rules Permits can be accessed here.

17.3 TRADE EFFLUENT DISCHARGES TO SEWER

In the UK many industries discharge their trade effluent to a public sewer rather than fully treating on site and discharging to a watercourse under an environmental permit. The public sewer terminates at an urban waste water plant designed to treat all the incoming domestic and trade effluent, regulated under the Urban Waste Water Treatment Directive.

Sewerage and sewage treatment have been privatised in England and Wales. There are

10 privately owned sewerage undertakers providing public sewerage and treatment for approximately 98% of the population.

Under the Water Industry Act 1991 the sewerage undertakers act as regulators, controlling the input of trade effluent from industry to their systems. On application they issue permits known as Trade Effluent Consents to industrial dischargers. These can specify limits on the timing of discharge, content, pH and temperature, and can require flow and other monitoring activities by the discharger. They are analogous in many ways to the environmental permits issued by environmental regulators for discharges to surface and ground waters. The sewerage undertaker proportionately charges the industrial discharger for receiving the effluent into the sewer, and treating the polluting load it represents (in admixture with other urban waste water) at the sewage treatment plant, including resultant sludge treatment. Any disputes regarding trade effluent permits are handled by the water industry regulator OFWAT.

The industry can then decide whether to pay the sewerage undertaker to treat the waste or to construct an on-site facility and treat before discharge, or even better (if possible), to invest in improved production process systems to prevent the generation of waste in the first place. Where the latter option is not feasible it is often in the mutual interest of the sewerage undertaker, industrialist and environmental regulator that the trade effluent is discharged to a sewer for treatment rather than being treated on site. The sewerage undertaker gets a reasonably stable or predictable biodegradation load from the trade discharge which can help mitigate treatment instabilities due to population behaviour or rainfall, and gets a faster rate of return on investment in treatment technology. The business minimises their own treatment costs, and avoids having to install and operate possibly quite complex plant that is well outside the normal suite of skills for that industrial sector. The environmental regulator avoids the risk to the local water environment (often a small watercourse offering low dilution) of trade effluent treatment failure.

On the negative side, poor performance by industrial dischargers can seriously damage sewerage systems and treatment plant. Commercial pressures for income generation through trade effluent charges may tempt some sewerage managers to accept trade effluent loadings that come close to, or exceed, the design capacity of the treatment plant, resulting in non-compliance of the plant with its environmental permit, and possibly a deterioration of water quality. Housing and commercial development may place additional flows into the sewer carrying the trade effluent, the net effect of which is to cause downstream combined sewer overflows to operate early after rainfall, discharging a more concentrated 'storm' sewage to watercourses that have not risen sufficiently in flow to accommodate the transient load.

In the case of PPC installations discharging to sewer, both environmental regulator and sewerage undertaker have a regulatory interest. The environmental regulator limits the emissions to the environment from the installation, taking into consideration the treatment that will be afforded by the urban waste water treatment works. The sewerage undertaker is obliged to include the environmental regulator's limits in the trade effluent consent for the discharge to the sewer, but may make them tighter in order to protect health and safety and operational performance of the sewerage system and treatment processes. The nature and composition of the trade ▶

effluent may also result in limits for specific chemicals being put on the urban waste water treatment works discharge permit and/or sludge treatment emissions. If the water company is found to have breached its consent and polluted the river, it will be prosecuted by the environmental regulator. However, if the sewerage undertaker can prove that the industrial enterprise exceeded its trade effluent consent to the sewer it may avoid prosecution by the environmental regulator, and may itself prosecute the industrial enterprise, even though that enterprise is a customer.

In the UK the majority of industrial discharges are to sewer and so are regulated largely within the context of private company relationships. The balance of these relations is different in different countries in Europe, for example in Italy it is normally the case that each industry discharges direct to the environment and manages its own waste treatment and has its own permit relationship with the environmental regulator. The specific legal framework there is less conducive to commercial relationships between private enterprise and the mostly municipal wastewater departments.

The UK trade effluent discharge consents are not openly published on web sites in the same way as regulated industrial consents. However, the information related to them is available on request from the water companies.

Further information on trade effluent consents is available at the following links:

- Netregs - General information on Trade Effluent Permits

- Ofwat - Trade Effluent Charges
- Water UK - Water UK Revised Guidelines for Trade Effluent Discharges and Charging
- Sewerage Undertakers – access the web link here.

The Water UK Guidelines include example trade effluent applications and consents.

17.4 TRADE EFFLUENT DISCHARGES TO THE WATER ENVIRONMENT

Where a sewer is not available for trade effluent reception, a discharge of trade effluent to surface water or to groundwater may be permitted by the environmental regulator. If the business activity is of sufficient size to qualify for control of emissions under IPPC the discharge will be included under a PPC environmental permit. If the effluent is generated as a result of a waste management activity the discharge will be included under a waste management environmental permit. If the discharge comes from neither of these, the discharge may be permitted as a 'stand-alone water discharge activity'.

The majority of such discharges are likely to require bespoke permits, with conditions assembled from standard wording but with individually determined limits because of the nature of processes used, available receiving water capacity, etc. Trade effluent permits may also be issued for temporary discharges such as for effluents arising during construction.

Certain common types of trade effluent discharge may be eligible for Standard Rules permits. Currently there is a Standard Rules permit available for Cooling Water and Heat Exchangers.

17.5 POSITION STATEMENTS – FOR LOW RISK DISCHARGES

The Environment Agency has decided that for certain low risk discharges no permit or registration is necessary, provided that the operator can ensure that no pollution results from the activity. Such activities are dealt with via Position Statements. These describe the type of discharge and the circumstances under which it will not be treated as a water discharge activity, and therefore not requiring permit or registration.

The Environment Agency has produced a Position Statement for domestic open loop heat pumps discharging to a surface water course. A downloaded copy is provided here. The Environment Agency has also produced a Position Statement on temporary water discharges from excavations. A downloaded copy is provided here.

17.6 URBAN WASTE WATER TREATMENT

The Urban Waste Water Treatment Directive defines 'urban waste water' as domestic waste water from human metabolism and domestic activities which may be mixed with industrial effluent and/or surface water runoff. Urban waste water has a biodegradable load that needs to be reduced prior to discharge to a watercourse. The Directive uses 'Population Equivalent' (p.e.) as the measure of biodegradable load. It requires that where the biodegradable load due to urban waste water, or where, (for certain industrial sectors) the biodegradable load from individual factories exceeds 2000 p.e., a sewerage system (collecting system) shall be provided. This shall connect to an urban waste water treatment works normally providing at least secondary treatment to a defined standard.

EXAMPLES OF UK WATER DISCHARGE PERMITS

The Directive allows that there may be the need for storm overflows of dilute untreated sewage to prevent flooding of properties but that pollution shall be limited.

The majority of settlements, villages, towns and cities in the UK are served by sewerage systems which drain sewage generated by domestic functions and trade effluent generated by industry and commerce, often in admixture with surface water runoff, to an urban waste water treatment works. At the treatment works most of the solid component is separated from the dissolved (primary treatment) and the dissolved and remaining suspended solids then receive aerobic secondary treatment, which significantly reduces the amount of solids, oxygen demand, and ammonia content of the sewage. If the receiving water has been identified as 'sensitive', further layers of treatment (tertiary treatment) may be needed to further reduce oxygen demand, ammonia, nutrients or bacteria. The sludge solids resulting from the treatment stages are subject to further treatment, usually aerobic or anaerobic digestion, to make the resulting biosolids easier to handle and fit for recovery of value as agricultural fertilizer, or as feedstock for incinerators. In some cases the digesters provide the treatment plant with combined heat and power (using the methane generated by the sludge treatment process). The sludge related processes may, if they are of sufficient scale, be regulated under IPPC as waste related activities, but the waste water treatment remains outside IPPC control because of the UWWT Directive requirements.

Sewerage systems and urban sewage treatment works are subject to the requirements of the Urban Wastewater Treatment Directive. In the UK the Directive is implemented by the relevant Urban Waste Water Regulations applicable to England and Wales, Scotland, and Northern Ireland. Downloaded copies of the England and Wales Urban Waste Water Regulations 1994 and as amended in 2003 are provided here.

Defra has produced a booklet on implementation of the UWWT Directive. This was last produced in 2002 and was due for revision in 2012. The European Commission reports biannually on data submitted by Member States pursuant to the UWWT Directive.

The UK Regulations place the burden of providing, operating and maintaining collecting systems and treatment plant on sewerage undertakers. These are private companies in England and Wales, and state-owned in Scotland and Northern Ireland. The environmental regulators are responsible for ensuring that the systems are delivered to time and perform in accordance with the UWWT Regulations.

In England and Wales the government, Ofwat , sewerage undertakers and Environment Agency have agreed a standard wording for the requirements

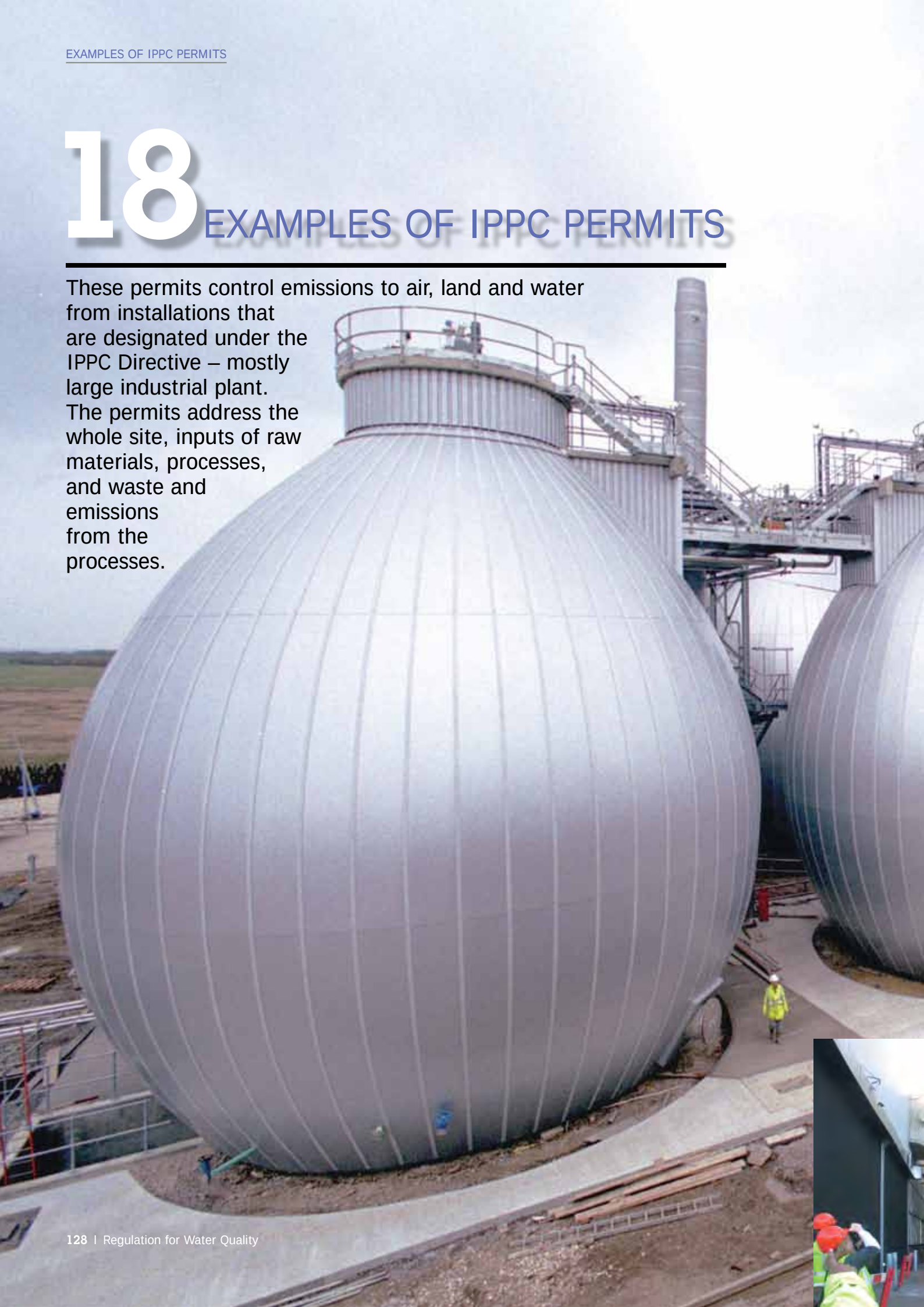
of the UWWT Directive to be set in all relevant consents (now 'stand-alone water discharge permits'). These are separate from the bespoke requirements, e.g. for ammonia, BOD or metals.

A typical consent (now stand-alone water discharge permit) for a major urban waste water treatment plant is provided in the links below.. The town of Swindon is located towards the upper end of the Thames catchment. It has had a sewage treatment works since the early twentieth century. The town has greatly expanded, and the consent was successively modified to reflect the increased load received and the need for tighter standards to protect both the receiving water and downstream uses, including potable water abstraction. The examples include facsimile copies of the consents and modifications, including the standard UWWT wording, going back to 1989,plus the latest (electronic) variation of permit.

Initially for UWWTD purposes only, but now for all sampling requirements, the sewerage undertakers monitor their effluents using composite samplers or continuous instrumentation, and report the data to the Environment Agency. The Environment Agency assesses the data for compliance and posts it on the Public Register. Periodically the data is collated and sent to Defra for onwards transmission to the European Environment Agency as part of the UK data submission on UWWT Directive compliance.

18 EXAMPLES OF IPPC PERMITS

These permits control emissions to air, land and water from installations that are designated under the IPPC Directive – mostly large industrial plant. The permits address the whole site, inputs of raw materials, processes, and waste and emissions from the processes.



18.1 WHAT DO BESPOKE IPPC PERMIT CONDITIONS LOOK LIKE?

For all bespoke permit applications the Environment Agency uses a single permit template. The template has generic conditions that apply to all applications and 34 annexes that provide extra conditions depending on the activity. The generic wording for conditions is used in preference to drafting from first principles. If there are truly unique circumstances relating to a particular location or activity then specific conditions may be included. The template includes provisions and layouts for Tables and Schedules. The detail wording and structure of these, though standardised as far as possible, will vary according to the specific environmental challenges that are identified as a result of the Application.

The Schedules and Tables that form part of the permit include specifically determined emission limits, monitoring and reporting requirements, and other site-specific information.

The template uses colour coding for Environment Agency staff:

- **Black** text is fixed text.
- **Red** text is optional but the wording is fixed. Some red text conditions contain optional text that has to be amended by Environment Agency staff as appropriate.
- **Blue** text is example text and is replaced with site-specific conditions by Environment Agency staff.

There is a web link for the generic template which includes all the annexes.

The generic permit template with all 34 annexes has been downloaded and can be accessed here together with a file listing the annexes.

Annexes 3 to 19 are relevant for sectors that are subject to IPPC control.

An example of an actual environmental permit for an industrial installation regulated under IPPC is provided here. It relates to a major oil refinery in the UK and includes controls on emissions to air, water and land.

18.2 STANDARD IPPC PERMITS

Standard permits are available for certain IPPC installations that have been identified as low risk to the environment. These qualify for control under IPPC because of the hazardous nature of materials used or processes involved, but which have a low risk of releases to the environment. Operators may apply for a standard permit and provide evidence that their installations conform with the requirements of the Standard Rules applicable to their sector or business.

The Standard Rules for low impact installations are available on the Environment Agency web site here, and a downloaded copy can be found here together with the Standard Rules and Generic Risk Assessment. ■

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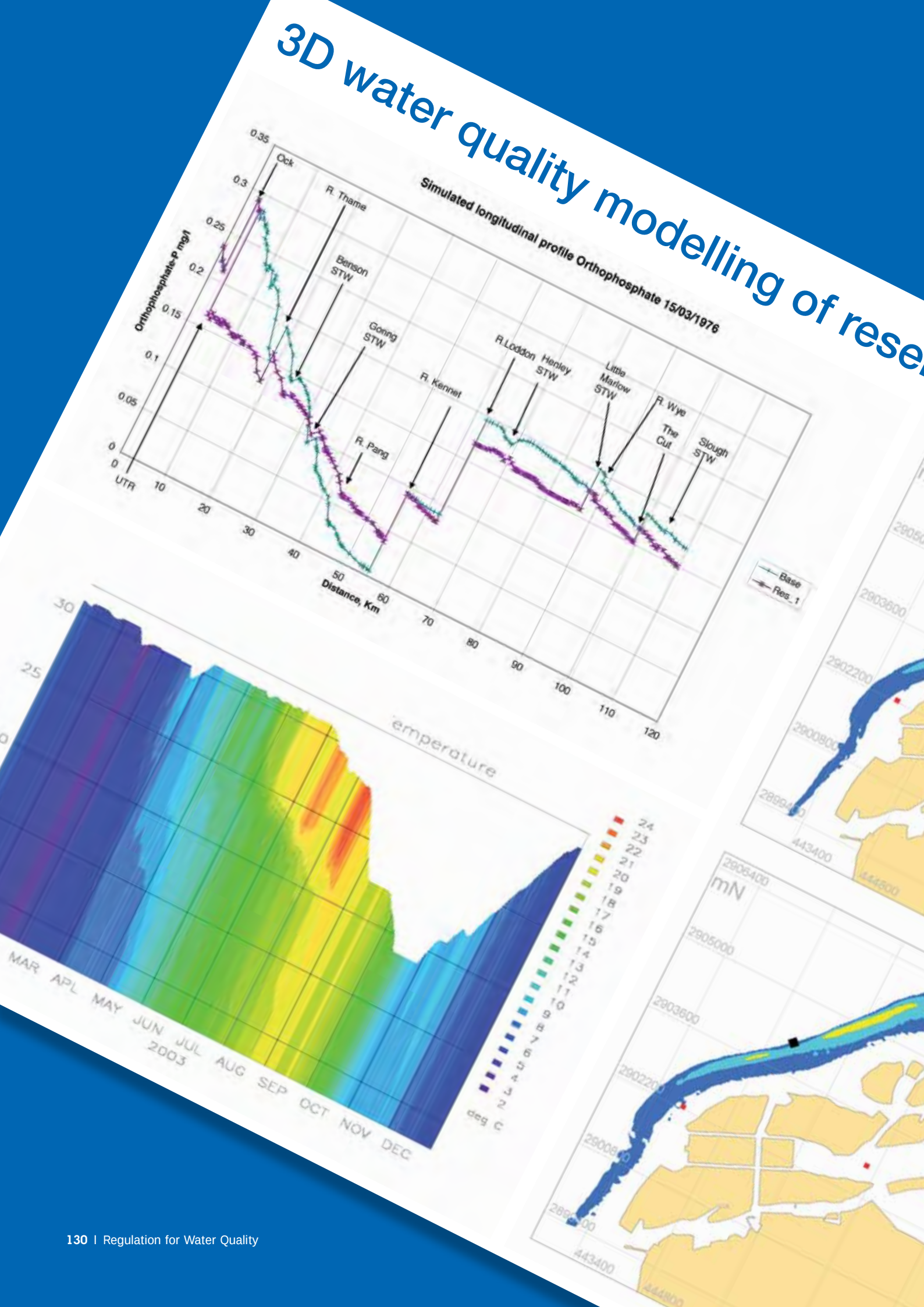


MODELLING

Mathematical Models of water quality are simplifications and approximations. They can aid decision making, and assess options for action, provided that the model is verified and the decision maker knows (or the model calculates) the effects of the limitations of the approximations and data in the model.

rvoirs, rivers, estuaries and coasts

19 EUROPEAN SCALE MODELLING

At the EU level extensive use is made of mathematical models in the planning of future legislation and in the review of success of extant legislation.

19.1 ORGANIZATIONAL FRAMEWORK

In planning legislation the focus of modelling is on prediction of environmental and regulatory impact. In review the focus is on reducing very detailed data from Directive related monitoring and implementation information in Member States to produce an overall European picture.

The European Environment Agency (an Agency of the European Union, serving the European Parliament, Council Commission and Member States) and the European Commission's Joint Research Centre lead in the transforming of detailed scientific data into information accessible by policy makers and the public. Extensive use is made of mathematical models, statistical data reduction techniques and GIS to present the information in a readily understandable manner. Both are key players in managing the WISE network, the Water Information System for Europe.

WISE is a partnership between the European Commission (DG Environment, Joint Research Centre and Eurostat) and the European Environment Agency, known as 'the Group of Four' (G04). The main roles and responsibilities of the partners are:

- **DG Environment**, leads the policy and strategic aspect of WISE. It liases with Member States, especially on official reporting requirements of EU water legislation.
- The **European Environment Agency** hosts the Water Data Centre and the thematic WISE webpages.
- The **Joint Research Centre** conducts environmental monitoring and water resources modelling including nowcasting and forecasting services.
- **Eurostat** collects and disseminates water statistics, also as a part of WISE data and themes, and provides significant input in the development of the GIS part of WISE and, in particular, provides overall implementation co-ordination for the INSPIRE Directive of May 2007. This Directive establishes an infrastructure for spatial information in Europe to support Community environmental policies, and policies or activities which may have an impact on the environment. ▶

19.2 EEA AND FATE

EEA and JRC play a major role in the planning at European scale of environmental regulatory initiatives and in the evaluation of progress and success of those initiatives. Modelling is a key element of this work.

One of the groups working within JRC at European level is the Rural, Water and Ecosystems Resources Unit. The Unit has a high degree of experience and competence in the development of models for environmental impact studies which predict the concentrations and transport of nutrients, pesticides and other chemical pollutants in soils, ground- and surface waters from point and non-point sources.

One of its groups is FATE, the ensemble name for the pool of activities related to the assessment of fate and impacts of pollutants in terrestrial and aquatic ecosystems carried out at the JRC's Institute for Environment and Sustainability (IES). IES.

FATE modelling activities are focused on:

- Nutrients (nitrogen and phosphorus)
- Persistent Organic Pollutants and industrial chemicals (e.g. PCBs, PCDDs/Fs, perfluorinated compounds)
- Polar compounds
- Pesticides and herbicides
- Pharmaceuticals

The FATE modelling approach is shown in Figure 19.1.

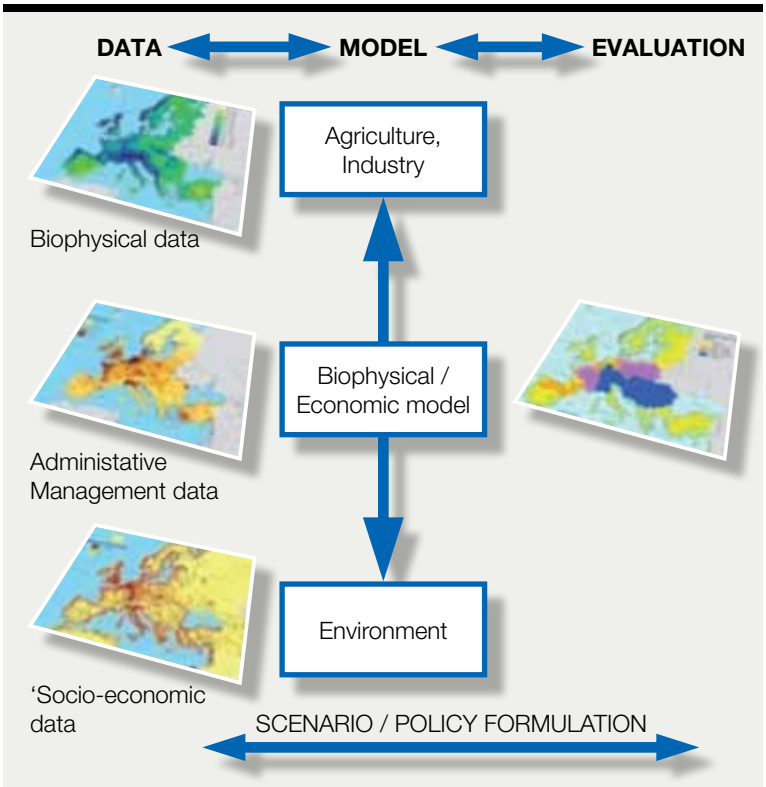


Figure 19.1 FATE Modelling Approach

19.3 WHY MODEL POLLUTANTS?

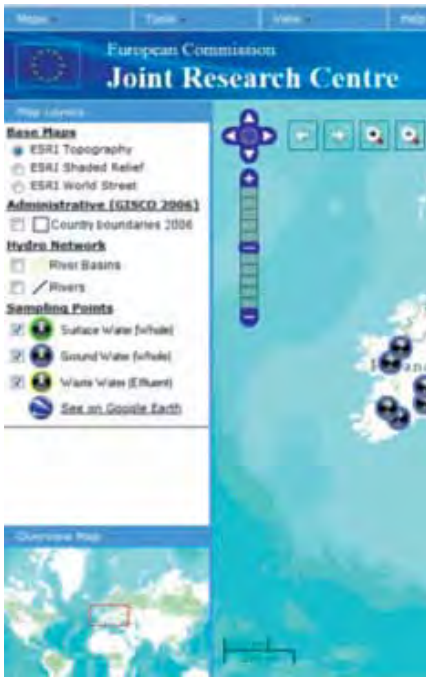
Environmental pollutant models are a simplification and abstraction of the real world and they are used across a broad spectrum of disciplines. Models are efficient tools to evaluate sources of pollution, propose sustainable alternative management practices to alleviate such pressures on water, soil and air, assess the impact of contaminant losses on ecosystems, and develop appropriate sampling strategies for monitoring the impact of implementation of best management practices.

The implementation of the European environmental legislation raises new challenges for the research community and models have been identified as tools to fulfil the requirements stated in the policy framework. Several models have been developed within FATE, covering a wide range of spatial and temporal scales and level of processes, with representation according to the scope of application.

The FATE Interactive Map Viewer can be used to explore results of pollutant fate modelling across Europe.

The FATE interactive map viewer was designed to display thematic maps of pollutants at the European scale. Various tools were implemented to allow the user not only to view the pollutants modelled and the data monitored, but also to perform simple queries against the data and generate simple user commented WYSWYG (What You See is What You Get) reports.

Figure 19.3 Chemicals Monitoring Map



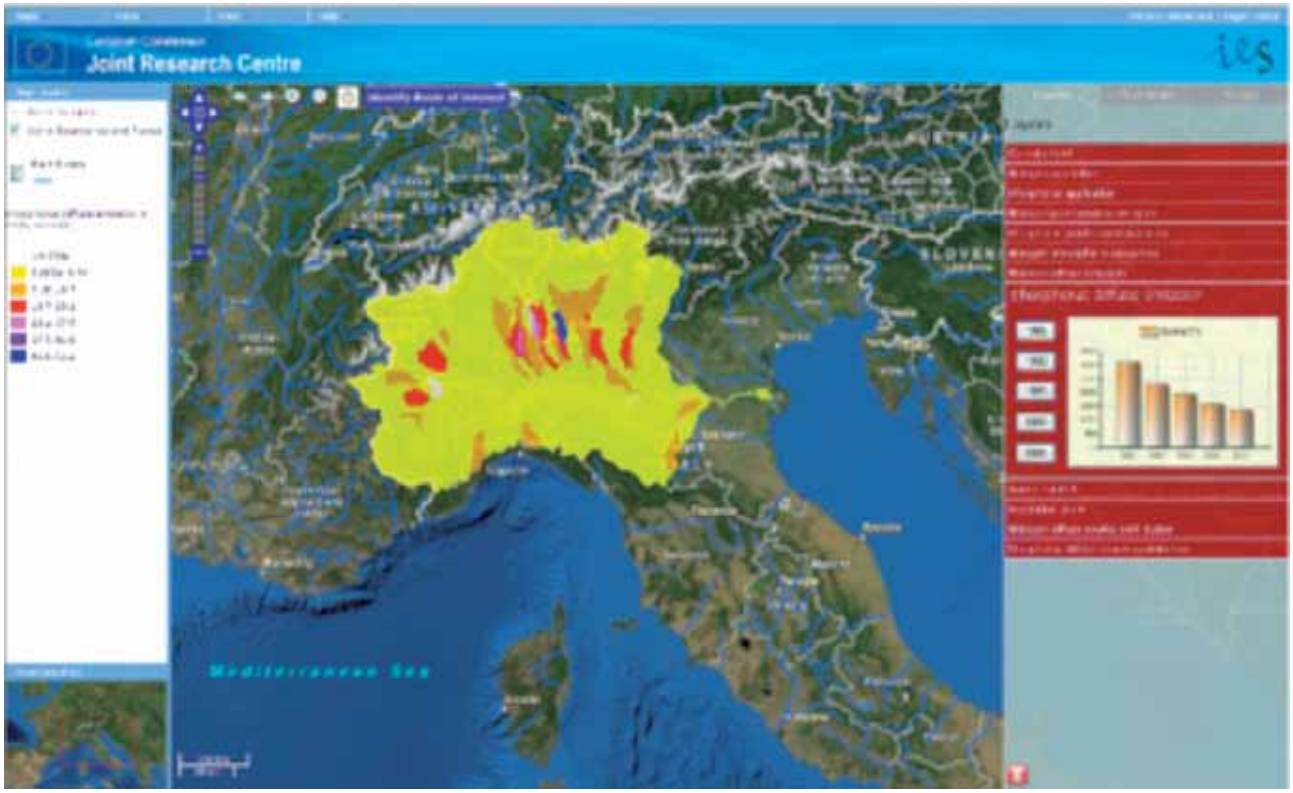


Figure 19.2 FATE Nutrients (Modelling) Map

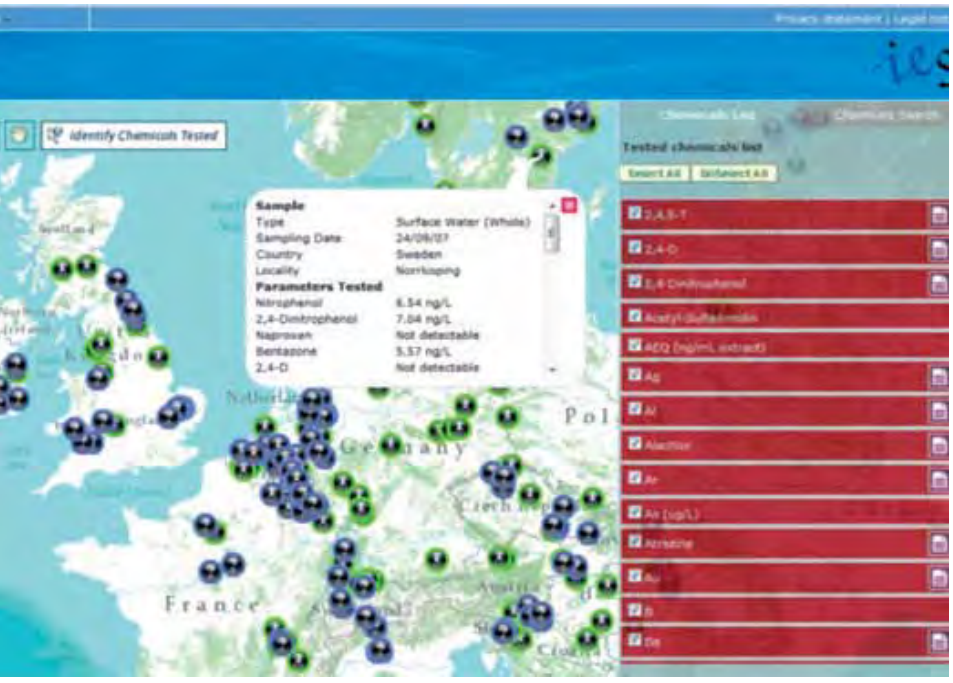
19.4 NUTRIENTS (MODELLING) MAP

The FATE Nutrients (Modelling) Map is an example of the output.

The viewer displays at river basin scale major environmental information linked to climate, landuse, nutrient discharges from wastewater treatment plants, application of fertilizers, diffuse sources of nitrogen and phosphorus, and loads to European rivers.

The Map Viewer allows you to select a point location and provides the option to display spatial information relative to the full river '**basin**' or to the drainage area '**upstream**' of the selected point. Various data layers and time series will then become available for mapping over a time period ranging from 1985 to 2005.

To start the process please launch the FATE Nutrients Modelling Map and use the button 'Identify Basin of Interest' in the map toolbox and then click over your chosen point in Europe.



19.5 CHEMICALS (MONITORING) MAP

The FATE Chemicals Monitoring Map viewer displays the results of pan-European screening exercises on whole water samples in 2007, on unfiltered groundwater samples in 2008, and on effluents from selected waste water treatment plants in 2009. The Map Viewer allows you to select a sampling point location and provides the option to display various chemical concentrations from a specific water sample. ■

20 UK NATIONAL SCALE MODELLING (ENVIRONMENT AGENCY)

At the national scale the Environment Agency makes use of models in a range of activities, from flood forecasting to demand management, and from discharge permitting to pollutant plume movement.

For water quality planning and discharge permitting, the key concept is to set environmental standards as percentiles to be achieved in the watercourse with defined confidence based on available monitoring data. Calculating the discharge that can be permitted and still meet the standard can be done by a series of basic mass balance calculations applied in a statistical framework. Various tools have been produced to assist the process of making these calculations. The complexity of the calculations varies on whether a discharge can be considered in isolation, as part of a river network, or as part of an integrated land and river catchment.

For the case of a single discharge to a watercourse the River Quality Planning (RQP) suite of software was developed by the Environment Agency. RQP contains systems to calculate confidence of compliance with a standard, the assurance that water quality is in or out of a particular class, and permit limits needed to meet standards in rivers. RQP also provides a suite of programs to calculate mathematically correct permit limits based on the mass balance equation for all sorts of statistical distributions of river and effluent flow and quality. The data that is to be used for these calculations needs to be carefully prepared to ensure that it is representative of the current river conditions, and not biased by a few rogue readings or historical changes in the catchment, and allows for various forms of correlation. Details of how this process fits to the Environment Agency's overall H1 environmental risk assessment process can be found in H1 Annex E – Surface Water Discharges (Complex), and how this has been implemented in Scotland is described in the SEPA WQ Discharge modelling Supporting Guidance from April 2013.

RQP only really applies in quite simple river sections with few discharges. In most cases a river network approach is required. To do the calculations for this the 'SIMulation of water quality in river CATchments' (SIMCAT) model was developed and is described later in this chapter. This model provides estimates of catchment-wide and national scale responses to different pollutant loadings and to various management options and scenarios.

More recently the capabilities of SIMCAT have been extended to include more consideration of the runoff from different land uses and also multiple sources of pollution and the factors affecting how pollutants reach watercourses. For this the SAGIS (Source Apportionment Geographical Information System) may be applied and is described further in following sections.

20.1 MIXING A DISCHARGE WITH A RIVER

When an effluent enters a river it is mixed with river water in a way that depends on factors such as type of outfall, the river flow, turbulence in the river, and the nature of the river bed. The mixing process may be complex:

- if the discharge is denser than river water it may have a tendency to hug the bottom
- a warm discharge may tend to rise to the surface
- if the discharge enters one side of the river the pollution may stream down that side of the river for some distance ▶

- sediment may settle on to the river bed at low river flow only to be picked up again when river flow increases

In nearly all cases we can ignore these complications. Enormous simplification follows if we can allow some sort of Mixing Zone, and assume complete mixing downstream of this. So much so that it makes sense (both for the calculations and for the environment) to obtain good and rapid mixing by the choice of outfall arrangements. Determination of mixing Zones is further discussed in chapter 21.1.

In addition, the error in calculating the impact of an effluent is almost always dominated by the low sampling rates used for the river and effluent. This makes it pointless to over-elaborate on the more physical complexities.

The mixing of a discharge with a river is described by the Mass Balance Equation:

$$T = \frac{FC + fc}{F + f}$$

In this:

- **F** is the river flow upstream of the discharge
- **C** is the concentration of pollutant in the river upstream of the discharge
- **f** is the flow of the discharge
- **c** is the concentration of pollutant in the discharge
- **T** is the concentration downstream of the discharge.

If values of F, C, f and c refer to the same instant of time, we can calculate the value of T at that time. A single application of this equation cannot calculate a permit limit, c, needed to meet a river target, T. This is because the standards for rivers and discharges must be annual means or percentiles and the Mass Balance Equation does not work with summary statistics.

We have to use something like **Monte-Carlo Simulation** to do the correct arithmetic. In this, we create thousands of sets of values of F, C, f and c, and use each set to calculate the thousands of values of T.

In its simplest form, the Monte Carlo calculation extracts its thousands of values of F, C, f and c from distributions assumed to be log-normal. But all forms of distribution can be used, including non-parametric (ones that make no assumptions about shape).

The results of the calculation define the link between the distributions of c and T and, accordingly, how the mean and percentile values of T vary with the mean and percentile values of flow and quality for the discharge and the upstream river.

The results also depend on correlations between F, C, f and c. These correlations describe, for example, the extent to which discharge flow increases with river flow, or how river quality varies with the time of year.

In most cases the data can be presumed to be log-normal. In this case only two summary statistics are needed to define the distribution. Any two statistics may be used, so it is best to use those readily available. These are:

- River flow: mean and 5-percentile
- Upstream river quality: mean and standard deviation
- Discharge flow: mean and standard deviation
- Discharge quality: mean and standard deviation

When a river receives many effluents, the decisions at one location can depend on the choices to be made at those upstream. For such rivers, the calculations can be complex and time-consuming because we have to

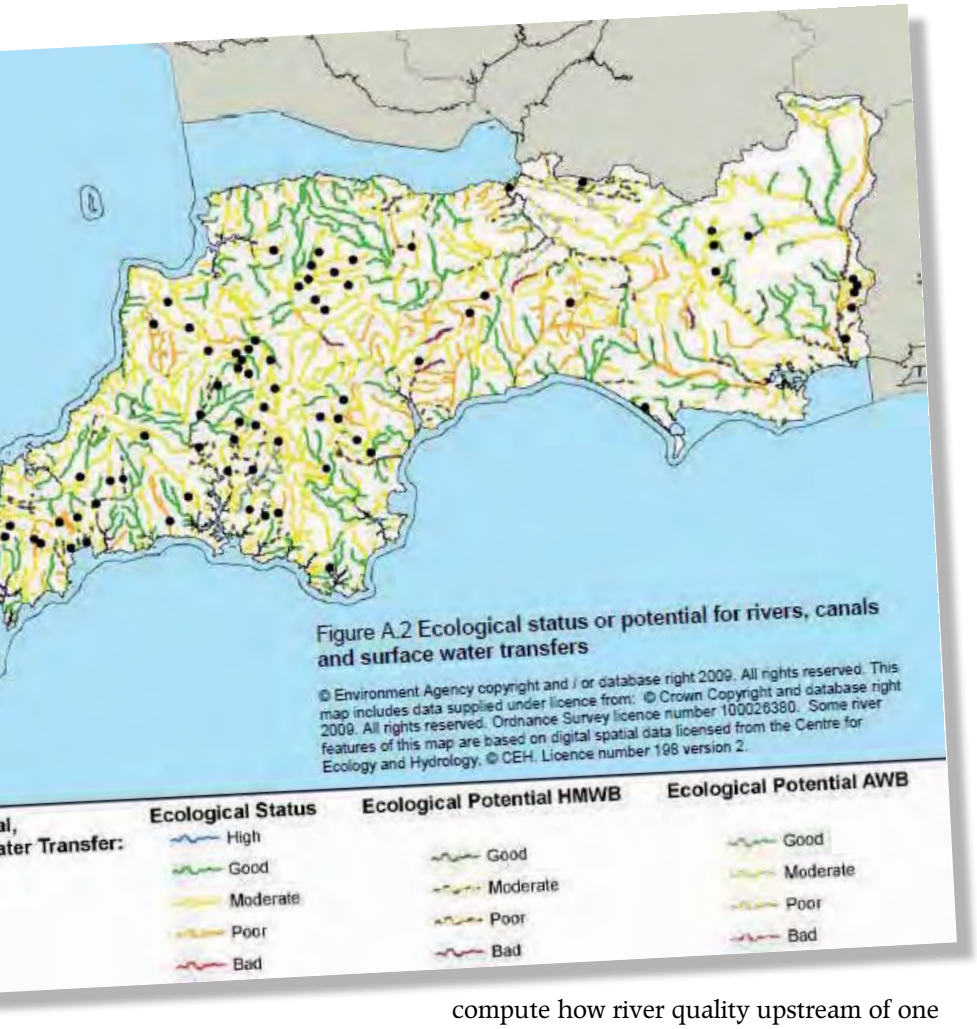


Figure A.2 Ecological status or potential for rivers, canals and surface water transfers

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compute how river quality upstream of one discharge is affected by the decisions we may make at the upstream discharges.

It is therefore attractive to provide an automatic method of doing all the calculations for an entire catchment in one go. Not only does this save a lot of time, it helps plan improvements to river quality which are optimal in terms of their cost. An obvious development was to apply Monte-Carlo Simulation to an entire catchment. This led to models like SIMCAT.

20.2 SIMCAT

SIMCAT is a mathematical model that calculates the statistical distributions of the quality of river water throughout a river catchment. SIMCAT calculates summary statistics of water quality such as means and percentiles. This allows it to deal properly with issues of compliance and with the action needed to secure compliance.

Increasingly, data files for SIMCAT are being produced by databases and mapping systems such as SAGIS (Source Apportionment Geographical Information System), and SIMCAT's results are passed back to such systems for display and ease-of-use. Further information on SAGIS can be found at http://sagis.ukwir.org

SIMCAT has special features such as 'gap filling', which help produce quick results and display where knowledge of sources and sinks of pollution is incomplete. SIMCAT also calculates compliance with standards and displays the effect of the statistical uncertainties associated with water quality data and with other data.

At any points in the catchment, SIMCAT calculates the load of pollution and breaks it down into contributions from different types and sources and from any or all of hundreds of upstream discharges and sub-catchments. This helps us to decide where to act in order to protect water quality. The results can be displayed and interpreted by SAGIS.

20.2.1 SIMCAT CALCULATIONS

SIMCAT calculations start at the upstream end of the river. Packages of shots are extracted from each of the distributions of flow and quality, and start a journey which takes them all the way downstream.

At any point where effluent enters the rivers, SIMCAT uses the Mass Balance Equation to mix the sets of shots for the flow and quality of the discharge with the shots for the flow and quality of the upstream river. This gives the shots for river flow and quality downstream of the discharge. These shots are adjusted to take account of effects such as diffuse sources of pollution and natural purification as the river flows downstream. They will then define the upstream quality for a subsequent discharge.

At a confluence, SIMCAT has to remember the quality of the river and divert its attention to the top of the new tributary. The sets of shots for the tributary are processed down to the confluence, at which point the sets of shots for the main river and tributary are mixed together using the Mass Balance Equation. At abstractions the values of flow associated with the shots may be reduced according to the scale and type of abstraction.

In this manner, SIMCAT crunches its way downstream , perhaps dealing with hundreds of kilometres of river and hundreds of tributaries and discharges. Water quality, as assessed by the values of the shots, is calculated down the whole length.

20.2.2 SAMPLING ERROR

As noted above, a major source of error in taking decisions lies in the sampling rates for water quality and discharges. We only have a small number of samples over the year e.g. one or two samples per month, each with different values. These only give an indication of the true mean value and we can calculate the statistical range in which the true mean might lie if we had had an unlimited number of samples. This is called Sampling Error. Such errors must be quantified, if not directly within SIMCAT, then afterwards when we use the results to take decisions. Sampling Error should also make us think hard about the time we need to devote to details. There may be little merit in researching the intimate details of the in-river processes which affect water quality, or in identifying the subtleties in the input distributions, if the effect on results is a lot smaller than the size of the Sampling Error.

In SIMCAT, Sampling Error is modelled directly. SIMCAT will calculate not only that the mean is say, 6.1 mg/l, but will also give a range, say 4.9 to 7.5 mg/l. If it were vital to guarantee a mean BOD in the river of 5.0 mg/l, we would need to work out the measures needed to reduce the Pessimistic Confidence Limit from 7.5 mg/l to 5.0 mg/l. If, in contrast, it were vital that we waste no money, then we would calculate the measures needed to reduce the Optimistic Confidence Limit, 4.9 mg/l, to 5.0 mg/l. (In this particular case we spend nothing - the Optimistic Confidence Limit is already less than 5.0 mg/l).

20.2.3 GAP FILLING

When we put together the data for a catchment we are very lucky if the results of a first run of SIMCAT agree with the measurements obtained from flow gauges and monitoring stations. We need to make adjustments or get more data in order to secure a fit. This process is called calibration.

When the model has been calibrated we can think about using the model to predict the effect of new discharges and new permit limits. SIMCAT can calibrate automatically using Gap Filling. This reduces the time taken to produce results. As implied above, SIMCAT includes equations to describe processes like natural purification and (15 types of) diffuse sources. Gap Filling can be used to mop up any shortfall in the results of applying them.

In its subsequent outputs on apportionment of the sources of pollution, SIMCAT lists separately those added by gap filling. It is important to take these gaps into account when deciding on actions to improve water quality. It would be foolish to report that 70% of the load in the river is due to discharges if, within this estimate, we have made no estimate of what caused the 'gaps'.

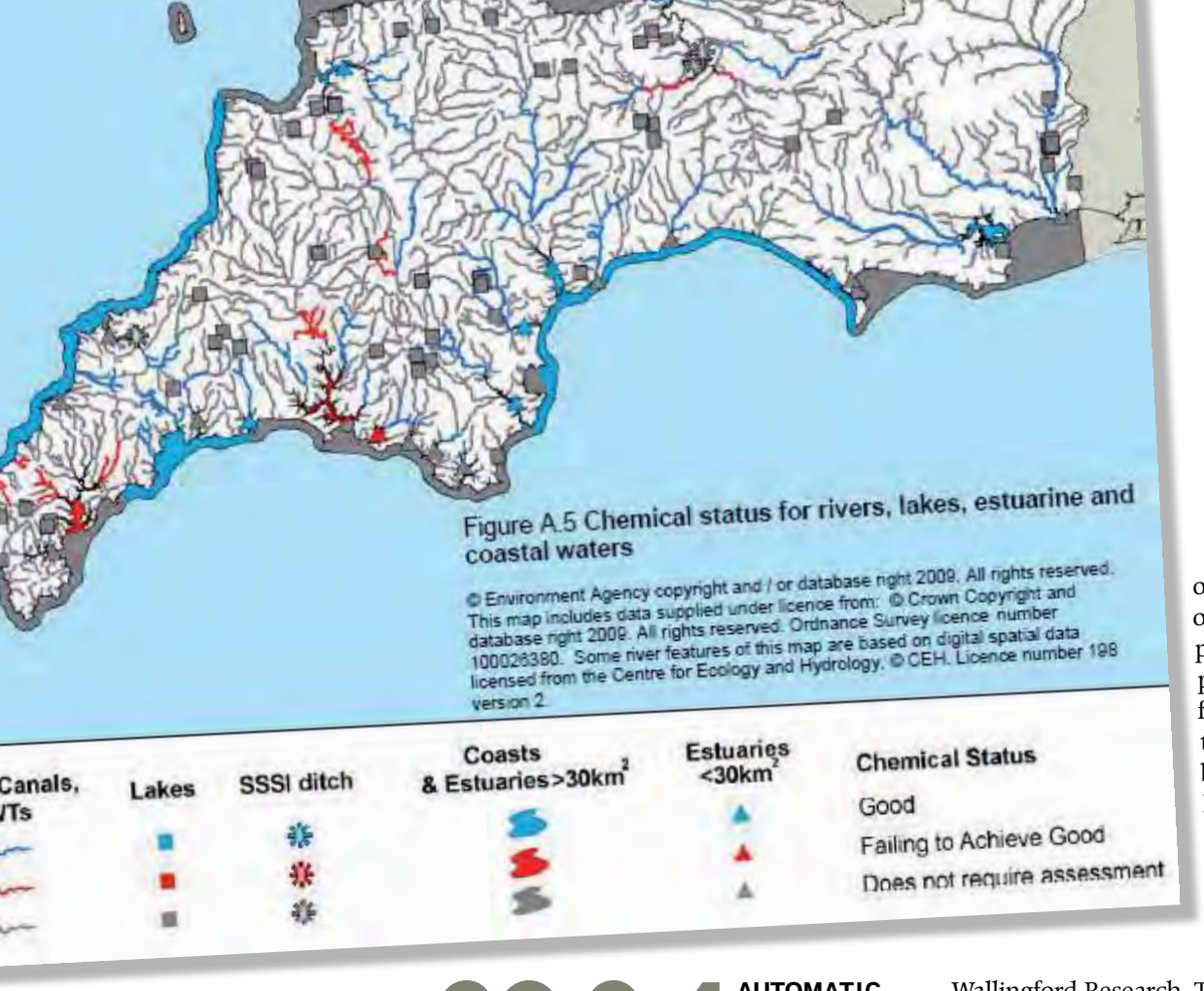

Figure A.5 Chemical status for rivers, lakes, estuarine and coastal waters

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20.2.4 AUTOMATIC CALCULATION OF THE LIMITS FOR DISCHARGE PERMITS

To calculate the discharge limit needed to achieve a river quality standard, SIMCAT compares the river quality target with the percentile value of the calculated distribution of the downstream river quality. If these values are nearly equal, the discharge quality distribution used to compute T gives the required discharge standard. Otherwise SIMCAT adjusts the discharge distribution until the standard is met.

The discharge quality distribution that gives the required river quality distribution is passed downstream. In this way SIMCAT can work down the catchment, calculating the permit conditions required for all discharges to seek to meet targets at any points in the catchment.

20.2.5 OTHER MODELLING SYSTEMS

There are many other river basin water quality modelling systems that have been developed by many different organisations and individuals to address specific aspects of water quality management.

Most of these are time series models which try to simulate the flow and quality of rivers and lakes over a specified period of time producing results for incremental timesteps which may be years, months, hours or seconds. Examples of such models are the DHI MIKE family of models, InfoWorks developed by Wallingford Research, The INCA catchment source and fate model (described further in chapter 22.4 below), and the US EPA QUAL2K stream fate model. Though very useful for understanding the processes in the River system and for simulating and testing solutions to specific problems it is difficult to use time series models as effective regulatory tools for general river basin water quality management. To fit to the statistical framework of water quality standards based on percentiles the time series results would have to be statistically summarised and analysed and understanding of the effects of sampling error incorporated to this analysis.

Generally time series models, and especially dynamic models incorporating solutions of advection dispersion are best suited to the detailed examination of local problems over relatively short time periods especially for understanding effects within mixing zones (see Chapter 21.1) and intermittent discharges (see chapter 21.2).

There are also alternative Stochastic probability function models such as SimBasinQ which is a spreadsheet based model in principle similar to SIMCAT but using the Monte-Carlo modelling package Crystal Ball to allow for much more sophisticated mathematical treatment of correlated Monte-Carlo sampling. ■

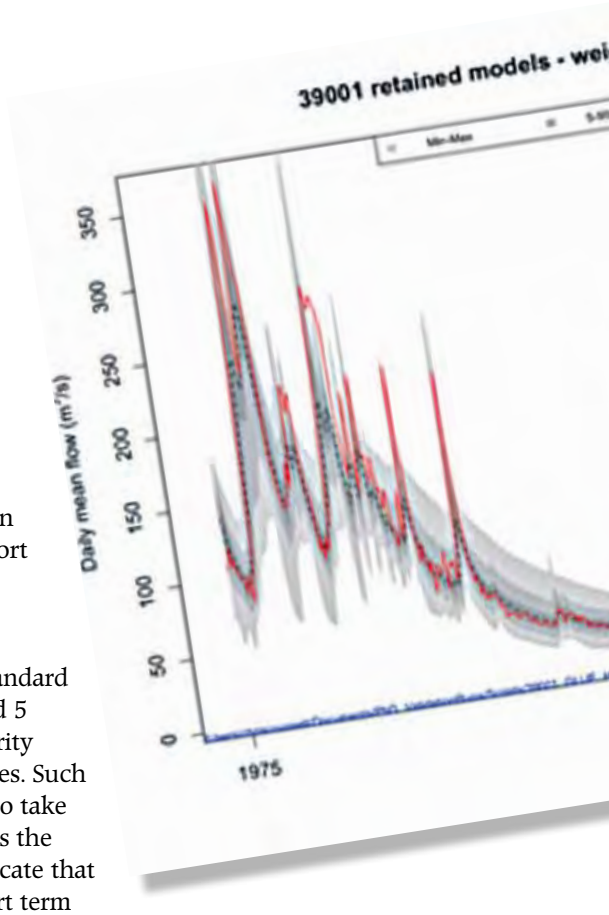
21 MODELLING AND POLLUTION LOAD INCORPORATION IN PERMITS

The mathematical modelling of the fate and behaviour of pollutants is used to help decide which chemicals need to be controlled via European legislation or at a national or local scale; models are also used to justify the controls needed to protect the environment.

This chapter summarises the use of models in planning and delivering water quality regulation. It provides links to published expertise at EU and national level, but does not provide a detailed technical appraisal of the techniques. It draws on the web pages of EU and national specialist bodies.

There is never enough information for certainty. Decisions that affect the environment have to be made on the basis of the best available data and an awareness of the level of confidence provided by such information. Modelling involves approximations and simplifications of real and complex systems whilst including all the factors which are significant for the decisions at hand. Models add value to the data produced by monitoring.

Confidence in a model is generated by comparing its output ▶



(for example the estimates of water quality) with available data (observed water quality and components that affect it such as topography, rainfall, temperature, flow, industrial discharges, etc.). Models shown to fit and link the data may then be used to predict changes in water quality that would occur if one or more of the components were to change. A model that is validated using data from one catchment may also be suitable for another catchment of similar characteristics.

Environmental regulators frequently use models that deal with, and combine, the full statistical distributions of flows and quality. These models address the variations in environmental parameters and levels of pollution. They deal correctly with standards, and calculate the effect of the uncertainties in data. Such models can determine unbiased and statistically robust limits for substances to be discharged under environmental permits.

The complexity required of modelling, and therefore the data and assumptions, is affected by the sensitivity of the receiving water to pollution, and the potential costs of action. In general, simple modelling of mixing in close-to-worst-case conditions is of use only in scoping further work. Such models result in errors. Further detailed modelling of discharge and environmental parameters and distributions, and how these vary, is needed to produce correct results, to reduce the risk of wasted action, and to decide on appropriate action.

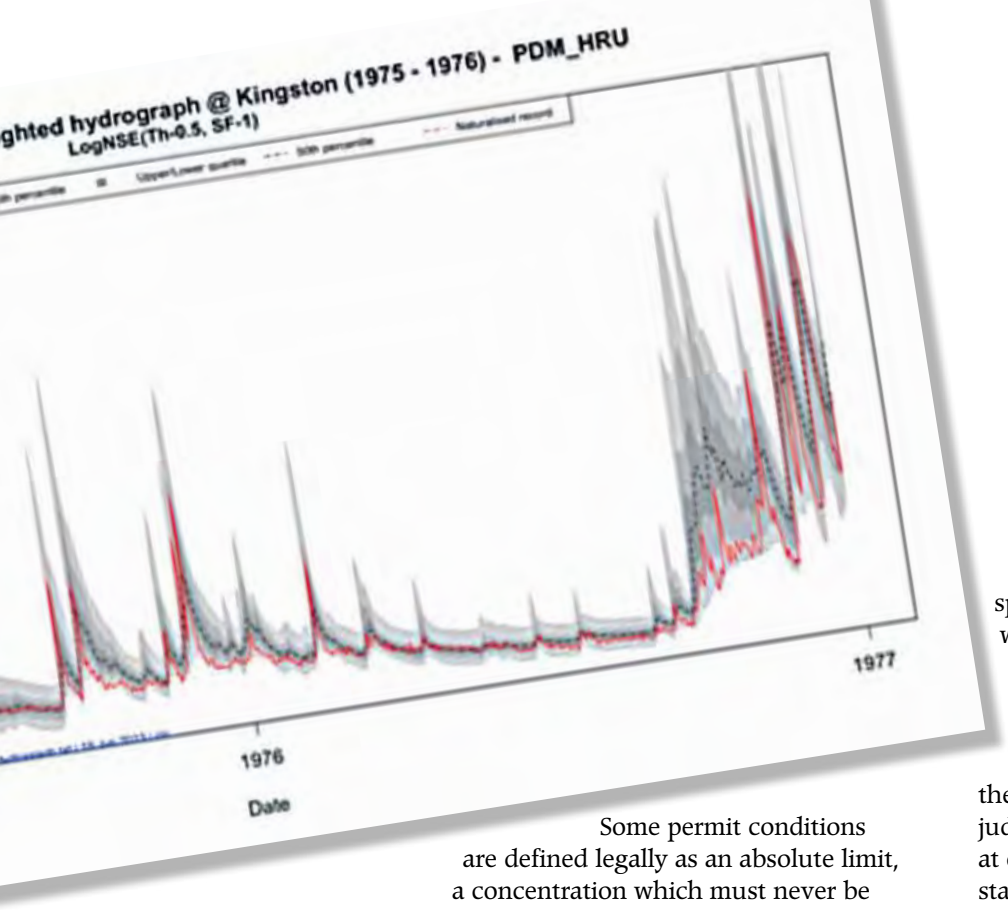
The disciplines used to assess compliance and calculate action demand that environmental standards and discharge limits are specified in a full and correct form. They need to be, at their simplest, summary statistics such as the annual mean or an annual percentile. This is required because a proper standard comprises not just a concentration, but a clear statement of how often this concentration can be exceeded. Anything short of this combination is an incomplete standard and will lead to incorrect decisions.

An absolute water quality standard such as 'no sample shall exceed 5 mg/l', is a standard whose severity varies with sampling frequencies. Such standards should not be used to take serious decisions. In some cases the toxicological evidence will indicate that the ecology can withstand short term exposure at certain levels and this evidence, and knowledge of the potential variability of the substance in rivers and discharges, may help choose the type of summary statistic to use as part of the standard.

The use of the annual mean and annual percentile relies on the similarity of statistical distributions of a substance. The measures that achieve a standard of an annual 95-percentile of 10 mg/l is a firm basis for knowing that concentrations of 20, 50 and 100 mg/l will be of sufficiently rare risk. But there will always be sources of pollution that require more complex regimes.

In any case, the modelling process must involve simulating the combinations of the full range of environmental and discharge conditions to generate summary statistics of river and discharge flow and quality over one or more years.

A standard expressed as an annual mean or an annual percentile may benefit from extra rules and limits to detect things such as accidents and illegal or intermittent discharges. We might suggest that 'the annual 95 percentile should not exceed 5 mg/l and a single sample that exceeds 10 mg/l will lead to investigation and extra monitoring'. The value of 10 might have been chosen as the equivalent of an annual 99.5 percentile under the current annual rates of sampling of 12.



Some permit conditions are defined legally as an absolute limit, a concentration which must never be exceeded. When calculating the permit limits needed to meet river targets, these too are treated as the percentiles, despite the way the standard is described in the permit. In the event of a 'breach of the absolute limit', the background percentile should be taken into account in deciding on enforcement action.

The UK Technical Advisory Group on the Water Framework Directive has produced a useful technical report UK Environmental Standards and Conditions (Phase 1).

The report sets out the requirements for meeting Good Ecological Status, and is aimed at technical specialists. The Introduction in particular is easy to read and provides an excellent summary of how data, or the lack of it, can be used in the derivation of standards upon which sound decisions, such as permit limits, can be made.

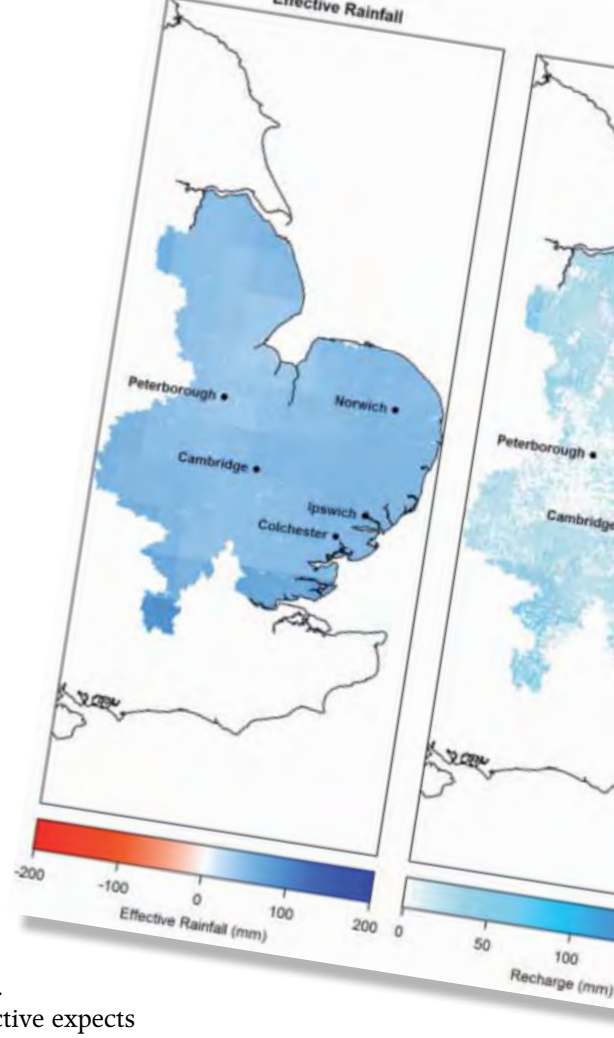
Most EU Environmental Directives specify environmental standards or emission standards but provide little flexibility to set other objectives. The Water Framework Directive allows an approach that is based on risk, where action can be taken in proportion to what it can achieve and what it will cost.

There are at least two distinct ways in which environmental standards are used to take decisions. Both have been used to establish large programmes of investment over the past two decades. An important consideration in using standards is to specify the rules by which the standards will be used to take decisions.

The first approach is called the Direct Model. It applies where regulators are able to estimate, with high confidence, the actual impact of an activity on the receiving water. This means they can judge the effect of the activity by looking at compliance with the environmental standard. The Direct Model applies where there is confidence that compliance with the standard defines all that is needed from the activities that cause failure. There is no need, for example, to seek corroboration by looking at biological data. An example of the Direct Model is setting numeric limits in discharge permits for ammonia, in order to meet an environmental quality standard (EQS) for ammonia in a river. Another might be the control of abstractions so that no more than a set proportion of the natural flow is taken.

The second approach is the Indirect Model. This applies where there is not so much confidence that failure of the standard is enough to judge the cause of damage or risk. We may need local supporting evidence. The Indirect Model applies where the regulator is less able (than for standards that can use the Direct Model) to calculate the impact of an activity on the receiving water – failure of the standard does not always guarantee damage.

Using the Indirect Model the regulator might propose the use of a checklist to confirm whether the water is damaged or at risk. This checklist may include compliance with a numeric standard as in the Direct Model but it will require more than this. It could include, for example, the absence of key species, or the occurrence of nuisance species. The checklist might lead to action such as uniform emission standards for particular discharges, or uniform controls on particular abstractions. It might not ▶



be possible to calculate directly whether this action is enough. It might be treated as a 'step in the right direction' that will be reviewed at a future opportunity, using data collected on the status of the environment.

As an example of the Indirect Method, a chemical standard is used to help decide when to designate Sensitive Areas under certain Directives. Failing the standard is taken with other indicators, some biological, as indicating that action is needed. The action that follows a decision that the water has 'failed' is not always calculated in as precise a manner as the action needed to meet the standard in the receiving water. It may be that a uniform emission standard is imposed at all discharges above a certain size, or that a ban is applied to activities that pose risks to groundwaters.

In the Indirect Model the scale of action is a balance of the confidence that the level of risk is real, and the confidence that the action will help. In the Water Framework Directive such matching of 'action' to 'failure' will be developed under the Directive's Programmes of Measures. One problem with Indirect Methods is that total numbers of reported failures of a standard will tend to be a pessimistic estimate of the true problem.

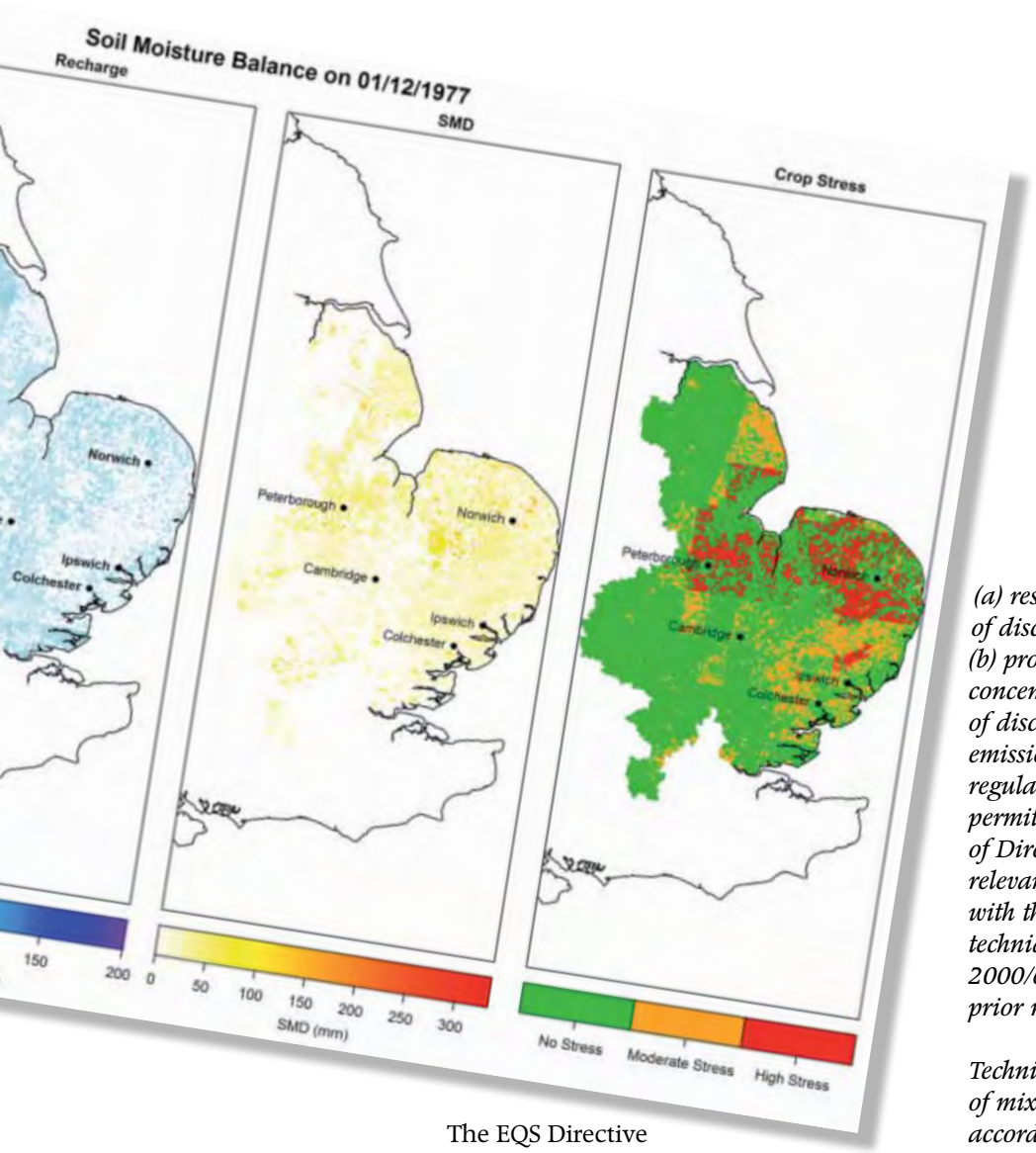
UKTAG has provided this discussion on the Direct and Indirect Models because it is critical to explain how standards lead to decisions. In the past, standards with an established effect on the environment have been associated with the Direct Model. Standards associated with more complex or subtle impacts have used the Indirect Model.

There is also the issue of assessing compliance with standards. In most cases this uses data from monitoring. In other cases it might involve calculations using models. These data or models have errors and uncertainty which need to be translated into statements of confidence that a standard has been met or failed. Knowledge about whether a standard is met or failed with a particular degree of confidence, perhaps 95% confidence, is crucial where compliance is used to issue blame or praise, and to take serious decisions. Particular degrees of increased confidence are provided by calculated levels of extra monitoring (or better models).

The Water Framework Directive expects us to know and report these levels of confidence. The outcome, the confidence that the standard has been failed, is considered when deciding on action. Such action might, for instance, be to require improved effluent treatment, or to intensify monitoring and sampling to provide a higher level of confidence of failure, prior to committing resources to remediation.

21.1 MIXING ZONES

A mixing zone is the region in receiving water where the initial dilution of an effluent takes place. If the permit allows the effluent concentration of a substance to exceed the EQS for the receiving water, then the permitted mixing zone will be that region or volume of water in the vicinity of the outfall that exceeds the EQS when the effluent contains the maximum permitted amount of the substance. Such a mixing zone is legitimate, provided it is not of such an extent that it threatens the compliance of the receiving water body as whole. Because water is mobile, mixing zone dimensions can vary spatially and temporally. It can be problematic to define the boundaries of permitted mixing zones, and also, therefore, monitoring points for permit and EQS compliance assessment.



The EQS Directive 2008/105/EC Article 4 specifies:

Member States may designate mixing zones adjacent to points of discharge. Concentrations of one or more substances listed in Part A of Annex I may exceed the relevant EQS within such mixing zones if they do not affect the compliance of the rest of the body of surface water with those standards.

Member States that designate mixing zones shall include in river basin management plans produced in accordance with Article 13 of Directive 2000/60/EC a description of:
(a) the approaches and methodologies applied to define such zones; and
(b) measures taken with a view to reducing the extent of the mixing zones in the future, such as those pursuant to Article 11(3)(k) of Directive 2000/60/EC or by reviewing permits referred to in Directive 2008/1/EC or prior regulations referred to in Article 11(3)(g) of Directive2000/60/EC.

Member States that designate mixing zones shall ensure that the extent of any such zone is:

(a) restricted to the proximity of the point of discharge;
(b) proportionate, having regard to the concentrations of pollutants at the point of discharge and to the conditions on emissions of pollutants contained in the prior regulations, such as authorisations and/or permits, referred to in Article 11(3)(g) of Directive 2000/60/EC and any other relevant Community law, in accordance with the application of best available techniques and Article 10 of Directive 2000/60/EC, in particular after those prior regulations are reviewed.

Technical guidelines for the identification of mixing zones shall be adopted in accordance with the regulatory procedure referred to in Article 9(2) of this Directive.

While the EQS Directive sets out options it does not provide a specific definition of 'Mixing Zone'. The need for guidance on Mixing Zones was recognised in the WFD Common Implementation Strategy, and a Working Group was established to draft it. The guidance has now been published on the Europa web site as two volumes – Technical Guidelines for the Identification of Mixing Zones, and Technical Background Document on Identification of Mixing Zones. Downloaded copies of the Technical Guidelines document and the Technical Background document are provided here.

In the absence of formal definitions, the drafting group agreed working definitions to aid the development of these guidelines. The working definitions developed are:

'A **mixing zone** is designated by the Competent Authority as the part of a body of surface water which is adjacent to the point of discharge and within which the concentrations of one or more contaminants of concern may exceed the relevant EQS, provided that compliance ▶

of the rest of the surface water body with the EQS is not affected'.

Where the guidelines adopt the term 'Mixing Zones', it may be necessary to assess the size of the mixing zone based on AA-EQS and/or MAC-EQS.

Whilst the guidance is directed at the requirements of the EQS Directive, and the substances listed in it for control, the principles set out in the guidance apply to any substance in, or attribute of (e.g. temperature), an effluent that has the potential to cause harm.

The purpose of the guidelines is to assist Competent Authorities to first establish where a mixing zone is required and to then determine its size and acceptability using a 'tiered approach' designed to apply an appropriate level of detail and scrutiny.

21.2 MODELLING INTERMITTENT STORM SEWAGE DISCHARGES (URBAN POLLUTION MANAGEMENT (UPM) MANUAL)

Fully separate foul and surface water collection systems can help to minimise wet weather discharge of sewage to rivers and lakes. Where systems are combined, which is still common in many areas, the system will be constructed with combined sewer overflows (CSOs) at critical points to discharge diluted sewage to the river during storm events. The proper design of this is crucial to preventing acute pollution of the water course during storms. Much work has been done in the UK on improving the design of CSOs and using sewer network models to understand system behaviour and so optimise the design of measures to reduce the frequency and severity of spills.

This process is described in the Urban Pollution Management (UPM) Manual, the product of collaborative research by the whole of the UK water industry to provide a best practice manual on control of intermittent wastewater discharges. It was reviewed in 1998, to produce UPM2, sponsored by the environmental regulators OFWAT and the water industry. It has again been reviewed to reflect technological changes and emergent regulatory pressures such as climate change, population growth, and legislative changes such as the Water Framework Directive. The latest edition of the Urban Pollution Manual (UPM3) was published in 2012 as a web-based electronic book, which apart from making it more widely accessible, should also facilitate periodic updating. It is published by the Foundation for Water Research (FWR). (To access it click on the link above, and then the UPM Manual tab at the top of the page.)

The sectors which have been identified as most likely to be impacted by intermittent sewage discharges are:

River aquatic life

Frequent short periods of low DO (dissolved oxygen) or high unionised ammonia concentrations in a river or other freshwater body can affect invertebrates and fish and so hinder the establishment of a sustainable fishery. Wet weather discharges can be the cause of such events.

Bathing and Shellfisheries

This use applies to identified bathing waters and shellfish waters where there is a requirement to ensure compliance with the EC Bathing Water or Shellfish Waters Directive. Intermittent discharges of storm sewage can increase the risk of non-compliance with microbiological standards in these Directives.

General amenity

The amenity value of a body of water is affected by many visual factors including

the presence of gross sewage solids. Discharges from CSOs are often a major source of gross solids.

Most storm sewage discharges are of relatively short duration, although if there is low river dilution they can be very polluting. Two approaches are available to identify standards for oxygen and ammonia concentrations to protect freshwater aquatic life from wet-weather pollution episodes. These are:

Intermittent standards which are directly related to the characteristics of events which cause stress in river ecosystems. These standards are expressed in terms of concentration-duration thresholds with an allowable return period or frequency;

High percentile standards (such as *99* percentiles) based on an extrapolation of the *90/95* percentile thresholds used for protecting ecosystems which receive polluting discharges.

Demonstration of compliance with either or both types of criteria may be required, depending on environmental policy with respect to site-specific conditions. ■

GOOD REGULATION MUST CONSTANTLY RESPOND TO NEW AND EMERGING CHALLENGES

FURTHER POLLUTION CONTROL ISSUES

There are elements of water pollution control that require innovative solutions and continual review and improvement. Diffuse pollution is raising new challenges to land and water management in rural and urban environments. If pollution prevention and control fails we need robust and tested contingencies to manage water pollution incidents, limit damage, clean up and restore. Firm and fair enforcement and prosecution is an essential component of the regulatory cycle. Finally there are new issues emerging and we need open minds to find effective solutions.

22 REGULATION OF DIFFUSE POLLUTION

Diffuse water pollution is a serious problem in the majority of river catchments. It is caused by many small or scattered sources. It represents a widespread and long-term threat to the ecology of lakes, rivers and coastal waters, and to the quality of groundwater and the costs of water supplies.

Clean water is vital in securing economic benefits for agriculture and other sectors, meeting human health needs, maintaining viable ecosystems, and providing societal benefits, such as the recreational, visual amenity, and cultural values society attaches to water systems

One of the major challenges for environmental regulation is to address the sources and causes of diffuse pollution. Conventional permitting based regulation works well for point sources of pollution, but has been ineffective at addressing diffuse sources such as pollutant runoff from agricultural practice, forestry, and urban hard surfaces. It is clear that behaviour change is needed on the part of the people and organisations responsible for generating the diffuse pollution, who are often in complete ignorance of the impact their activity creates.

22.1 INTRODUCTION

Diffuse pollution is a major challenge for regulators. In some cases it may be due to failure of effective regulation, but for the most part it can be attributed to human activities that are not directly regulated, like much of the agricultural sector, or where regulatory decisions are remote from how people ▶

interact with the environment. As an example of the latter, road drains convey surface water away from the road to avoid flooding and danger to road users. The regulatory decision is in relation to planning the roads and road user safety. Citizens wash their cars and allow the polluting detergents and oil to wash into the road drain. Even if there is a local law preventing such behaviour it is culturally desirable to have a clean car, and socially acceptable to ignore the law unless it is enforced.

The Environment Agency produced a very helpful report on Diffuse Pollution in 2007 - The Unseen Threat to Water Quality.

The Executive Summary summarises the issues:

Diffuse water pollution is a serious problem in England and Wales. It is caused by many small or scattered sources. It represents a widespread and long-term threat to the ecology of lakes, rivers and coastal waters, and to the quality of groundwater and the costs of water supplies.

Tackling diffuse pollution is essential if we are to ensure the sustainable use of this vital natural resource. It is important that diffuse water pollution features in major forward-looking exercises, such as the implementation of the Water Framework Directive and the water strategies being developed by EU Governments.

Our main concerns are:

- *high levels of nutrients in rivers, lakes, estuaries and coastal waters, which can cause eutrophication;*
- *nitrate contamination of water used for drinking water;*
- *hazardous chemicals leaking into rivers, lakes and groundwater from industrial sites;*
- *pesticides and sheep dip from agriculture entering rivers, lakes and groundwater;*
- *oxygen depletion in water due to organic pollution from livestock manure;*
- *sediments from soil erosion smothering habitats in rivers, lakes and estuaries;*
- *bacteriological contamination of bathing waters and shellfish waters from farm waste and illegally connected sewers.*

We need to take concerted action across many sectors. The European Water Framework Directive (WFD) is a significant new piece of environmental legislation that will help us do this. It requires all inland and coastal waters to be of good status by 2015. We are establishing river basin districts within which demanding environmental objectives will be set, including ecological targets for surface waters. As part of this, we are refocusing our monitoring to provide better information on the impacts of diffuse pollution so that we can develop targeted measures to improve water quality.

We need to tackle both urban and rural sources of pollution. In urban areas run-off from roads and other surfaces, foul drains wrongly connected to surface drains, leaking sewers and spilled chemicals, oil and fuel pollute rivers and groundwaters. We want sustainable drainage systems (SUDS) that intercept pollutants and reduce flood risk to become a common feature of urban design. We will work with central and local government to promote SUDS and reduce diffuse water pollution through land-use planning and remedial measures.

We are working with businesses to promote pollution prevention, for example through our Oil Care Campaign. We want to see all industry sectors take straightforward steps to prevent diffuse pollution. Investment and regulation have improved sewage discharges and water quality over the past decade. The further measures that are needed include the safe storage of chemicals, better maintenance of pollution control equipment and more staff training to raise awareness about the risk of causing pollution. We also ask the general public to take care in disposing of used oil and chemicals, and to make sure that their foul drains are correctly connected. We want building inspectors to check that foul drainage is not illegally connected into clean water sewers at new housing developments.

The Department for Environment, Food and Rural Affairs (Defra) and the Welsh Assembly Government (WAG) are reviewing non-agricultural sources of diffuse water pollution. They are working with us, industry sectors and others to prioritise the most urgent problems to address. They will assess the effectiveness of existing measures and determine what changes and additional measures are needed. An expert steering group has been set up to take the work forward and both governments have recently gone to public consultation on the issue.

Farming can be a significant source of diffuse pollution. Inorganic fertiliser use is significantly higher than 50 years ago and has contributed to elevated levels of nutrients in water. Run-off from agricultural land depletes oxygen in the water if animal manure or silage effluent are present. Bacteria washed out of manure spread to land can adversely affect bathing water quality. Soil erosion can be caused by inappropriate cultivation, trampling of riverbanks by livestock, construction and other land disturbance leading to sediment build-up in rivers and lakes.

We will work with farmers, the Natural England Partnership, Defra, WAG and others, to protect the water environment, using targeted advice, incentive schemes that reward good practice and regulation where it is necessary. Agri-environment schemes such as Environmental Stewardship projects in England and Tir Cynnal and Tir Gofal in Wales are now paying land managers to adopt resource protection measures such as nutrient and soil management and to introduce buffer strips. Special advisors are working with farmers in 40 river catchments in England, and two in Wales, to share advice and knowledge to reduce water pollution under the Catchment Sensitive Farming Delivery Initiative. As well as running workshops and farm demonstrations, advisors are working on a one-to-one basis with farmers, advising on, for example, the use of fertilisers and livestock densities. The catchment sensitive farming initiatives in England and Wales focus at the local level and pull together farmers, farm advisors, government agencies and other organisations.

To reduce urban and rural diffuse pollution further, we are likely to need new or improved legislative powers, for example to improve land management practices, and a combination of voluntary, regulatory and economic measures.

22.2 THE CATCHMENT-BASED APPROACH

In response to these challenges the government, as part of its Policy for Improving Water Quality, has introduced a 'Catchment Based Approach' for England to stimulate more locally focussed debate, decision-making and action regarding the future direction of improvements to the water environment, and to support larger scale river basin management planning as part of Water Framework Directive activities.

The aim of the Catchment Based Approach is to deliver better co-ordinated action at the catchment level by all those who use water or influence land management. This needs greater engagement and delivery by stakeholders at catchment and local level, as well as support by the Environment Agency, local government and environmental Non-Governmental Organisations (NGOs).

The Catchment Based Approach is particularly important when trying to address the significant pressures placed on the water environment by diffuse pollution from both agricultural and urban sources, and widespread, historical alterations to the natural form of channels.

For the approach to work there needs to be a clear understanding of the issues in the catchment, and engagement, collaboration and involvement of local communities in decision-making - by sharing evidence, in working out priorities for action, and co-ordinating and integrating projects to address local issues in a more cost-effective way.

Defra sponsored Pilot Studies of the Catchment Based Approach which ran from 2011 to the end of 2012. There were a total of 62 catchments involved, 25 as catchment pilot projects and 37 as locally organised catchment management initiatives. Its final report concluded that the approach was viable, but needed development to transform practices towards collaborative planning and management of whole catchment systems. There is a need for greater clarity on long-term government policy and funding so that the host organisations and participants can better engage and understand the viability and inter-connectedness of turning aspirations into reality. Further guidance is needed on the hosting role to ensure a truly collaborative catchment planning and management process, incorporating a broad and balanced range of interests and perspectives. The report can be accessed from the Catchment Change Management Hub (CCMS) web site.

Defra has since published a 'Guide to Collaborative Catchment Management', based on the learning from the catchment pilots. This guide is intended as a tool for existing catchment partnerships as well as for groups that are just starting to work collaboratively. This can also be accessed from the CCMS web site. Click for downloaded copies of the Guide, Methods and Tools, and Case Studies.

Summary articles on the Catchment Based Approach can also be found in the November 2012 FWR Newsletter a downloaded copy of which can be accessed here, and in the November 2013 Water Active magazine, a copy of which can be accessed here.

In the past, under the UK regulatory model, water companies have only been allowed to use regulated revenues to invest in catchment based solutions on land belonging to the water company themselves. This greatly restricted the options available for catchment based solutions. However, from the investment cycle, commencing 2015, water companies will be allowed to propose solutions to meeting WFD standards in rivers that can

involve them paying other land owners to change their practice and infrastructure if this can be demonstrated to represent better economic and environmental practice compared to solutions relying solely on enhanced wastewater treatment processes. Thus, for example, for a river failing standards because of P driven eutrophication, modelling can be used to demonstrate that a solution involving farmers changing slurry spreading timing and equipment and providing bigger buffer zones around rivers will be more cost effective than upgrading a treatment plant with chemical dosing for phosphorous removal. The water company may then be allowed to allocate funds to be dispersed to farmers, possibly through an NGO organisation such as a Rivers Trust to incentivise operational change. Such solutions can have lower environmental impacts and be more sustainable through the engagement of the local community in the river basin management process.

There are still many practical and legal issues to resolve before catchment based solutions become main stream practice in England.

In Scotland, SEPA administers the Controlled Activities Regulations, which establish, according to risk of impact on environmental water, generally binding rules, registration or permit requirements for many activities that may cause point source or diffuse pollution in any catchment. Discharges, disposal to land, abstractions, impoundments and engineering works are all regulated by SEPA. This approach is detailed in the CAR Practical Guide a downloaded copy of which can be accessed here.

Diffuse pollution activities covered by the CAR Generally Binding Rules include the:

- storage and application of fertilisers;
- keeping of livestock;
- cultivation of land;
- discharge of surface water run-off;
- construction and maintenance of roads and tracks;
- storage and application of pesticide;
- operation of sheep dipping facilities.

22.3 AGRICULTURAL DIFFUSE POLLUTION

Whilst in the EU there has been great progress in reducing point source pollution over recent decades, non-point/diffuse pollution, especially of nitrate and phosphorous from agricultural land, has generally remained stable or become worse. Awareness of this issue is often low, with the majority of farmers (85%, UK national Audit Office surveys, 2010) not realising that they are major contributors to surface and groundwater pollution. There are often significant time lags between the application of fertiliser, pesticide or manures/sludge to the land and its transport to the river by surface or sub-surface routes. These will be dependent on weather, with site-specific factors affecting pathways.

It is certain that no single tool will deliver effective diffuse pollution control and that a variety of measures will be needed. The most directly acting are likely to be financial – taxes, levies or subsidies – aimed at particular activities. But these are likely to generate resentment in some sectors of society, and may distort markets, leading to knock-on environmental, social or economic problems. Over the long term, innovation, education and instilling in the ▶

general population a higher appreciation of the value of a clean environment, are likely to be the most effective means of securing improvements. When activities that currently lead to diffuse pollution are seen as being seriously anti-social, the perpetrators of diffuse pollution are far more likely to change their ways.

Environmental regulators most probably have the technical knowledge and skills to promote such changes but are often limited by their quite restricted mandate. Opportunities exist to influence public attitude through targeted use of social networking sites, something which single issue NGOs do to great effect. Given the intense consumer desire to use these sites, it is possible to generate 'informed' customer demand for retailers to exert pressure on their suppliers to demonstrate and verify their environmental credentials.

Perverse incentives in agricultural policy should be removed, such as those that raise producer prices or subsidise chemical input use. These encourage intensive farming in environments that cannot absorb the pollution arising from this and reward farmers for excessive chemical use that ends up as runoff. It is better to target subsidies to education programmes and provision of equipment that allows farmers to measure the specific fertiliser needs of their soils and crops and to work out the exact amounts to apply, with correct timing to maximise benefit to yield, minimise waste and runoff, and also to save their own expenditure on fertilizer.

In 2012 OECD produced a comprehensive report on the water quality impacts of agriculture.

The report examines the links between agriculture and water quality. It discusses the overall trends and outlook for agriculture and water quality in OECD countries; describes recent actions by policy makers to address water quality issues in agriculture; and provides a set of recommendations for countries to meet the challenge of improving agricultural water quality.

The report identified that key challenges for policy makers to address water quality issues in agriculture are to reduce farm contaminant lost into water systems whilst encouraging agriculture to generate or conserve a range of benefits associated with water systems (e.g. recreational use). Water pollutants from agriculture include runoff and leaching into water systems from nutrients, pesticides, soil sediments, and other contaminants (e.g. veterinary products).

The report concluded that the impact of agriculture on water quality is either stable or deteriorating. A major challenge for agriculture is to produce more food, feed, fuel and fibre, to meet growing global demand. Agricultural production also generates effects external to markets, both positive (conserving a wetland) and negative (such as water pollution). As there are no markets for these externalities, although they can provide a great benefit or impose a high cost on society, there is little incentive for farmers to internalise the costs of these external production effects, other than the farmer's own motivation to do so.

22.4 DIFFUSE POLLUTION CATCHMENT MODELLING – SOURCE AND FATE

Across the EU there are concerns about a wide range of pollutants that affect water resource systems in addition to environmental effects such as land use change and climate change. With the EU Common Agricultural Policy (CAP) and farming reforms there has been changing agriculture and land use, and this will

continue into the future. The Water Framework Directive will also drive new policy over the next ten years. In addition, climate change is beginning to alter hydrological regimes and temperatures and this will affect water resources, river ecology, agriculture, terrestrial ecosystems and land use.

As an example of a chemical of concern, nitrogen (N) in lowland and upland fresh water systems can cause eutrophication, leading to rapid aquatic plant growth. Such increases in growth are often viewed as a nuisance as certain plant species may grow at the expense of others and, within freshwaters, the microbial breakdown of the dead plant matter can lower oxygen levels which is detrimental to invertebrate and fish populations. The problems of freshwater eutrophication are usually associated with lowland, intensively farmed areas where fertilisers provide a significant source of N and P and/or urban areas where domestic and industrial effluent is discharged to the receiving watercourse and groundwater.

Whilst management strategies have been implemented to control N and P in river systems, these have tended to address single issues: either diffuse or point sources, or upland or lowland areas. However, the N concentrations and loads in rivers reflect the cumulative catchment N sources: fertiliser inputs, atmospheric deposition and sewage discharges. Superimposed on these anthropogenic inputs are contributions from the vegetation and mineralisation (and subsequent nitrification) of organic N in soils. Furthermore, the combination of the multiple catchment N sources has a downstream effect, influencing the options for further water utilisation and impacting on the water quality of estuarine and marine areas. Thus, given the holistic nature of the N problem, an integrated management approach is required.

The INCA suite of models has been developed to support such an integrated approach. The INCA model has been developed over the past 12 years as part of two EU funded projects (EU- INCA and Eurolimpacs) and other projects funded by the Environment Agency, National Power, DEFRA, Natural England, English Heritage, EPSRC, ESRC and NERC(e.g. the NERC LOCAR project).

INCA is a processed based dynamic model representation of plant/soil system dynamics and instream biogeochemical and hydrological dynamics. The INCA model has been used to assess a wide range of environmental change issues in catchments, such as land use change, climate change and changing pollution environments including point and diffuse pollution. The model has been applied to a wide range of key European ecosystems.

The INCA model has been designed to investigate the fate and distribution of chemicals in the aquatic and terrestrial environment. The model simulates flow and water quality and tracks the flow paths operating in both the land phase ▶

and riverine phase. The model is dynamic in that the day-to-day variations in flow and water quality can be investigated following a change in input conditions from point or diffuse sources such as atmospheric deposition, sewage discharges or fertiliser addition. The model can also be used to investigate a change in land use (e.g. moorland to forest or pasture to arable) or a change in climatic conditions. Dilution, natural decay and biochemical transformation processes are included in the model as well as the interactions with plant biomass such as nutrient uptake by vegetation on the land surface or macrophytes in streams.

INCA has been designed to be easy to use and fast, with excellent output graphics. The menu system allows the user to specify the semi-distributed nature of a river basin or catchment, to alter reach lengths, rate coefficients, land use, velocity-flow relationships and to vary input loads.

INCA provides the following outputs:

- daily time series of flows and water quality concentrations and sediment movements at selected sites along the river.
- profiles of flow or water quality along the river at selected times.
- interactions with Algae and Macrophtes.
- cumulative frequency distributions of flow and water quality at selected sites.
- tables of statistics for all sites.
- daily and annual pollution loads for all land uses and all processes.

Similar types of models have also been developed elsewhere in Europe for the calculation of N and P runoff from different types of land use. These models consist of land use data; pollution source factors, migration factors and transport factors. Digital elevation mapping (DEM) may also be used to calculate soil erosion rate, designate the soil erosion area, and calculate the shortest flow path distance from soil erosion area to surface waters.

Large data sets are required to develop the relationships between rainfall, runoff, and the impact of diffuse and point sources on river water quality under different weather conditions. Models such as INCA go some way to doing this on a time series basis. SAGIS can establish the general statistical relationships. The next stage for the development of such models is to incorporate these relationships to a model which fits the statistical framework of regulation and also takes account of the effects of interventions in land use and seasonal variations considering different agricultural activity, rainfall runoff and temperature on the sensitivity of waters to meet WFD defined quality objectives and ecological outcomes.

In this respect there is still far to go in fully incorporating source and fate modelling to the regulatory regime.

22.5 URBAN DIFFUSE POLLUTION

On the urban development side, there is increased awareness of the need to promote sensible management of rainfall runoff, to minimise risk of pollution and flooding. Measures are best undertaken at the planning stage. Retrofit solutions, although possible, are expensive and disruptive for the urban population. Strong regulatory measures are needed to ensure that drainage from new and re-developed property is managed sustainably, minimising risks to the population and the environment, whilst often creating a better local ambience and recreational feature, such as a wetland or pond.

Chief sources of urban diffuse pollution are contaminated surface water runoff from roads and yards, storm sewage overflows, leaking sewers and illegal discharges into surface water drains.

In the UK the underground assets of sewerage undertakers (sewers, manholes, pumping stations, etc) in all urban drainage catchments have been surveyed and digitised in GIS and asset management systems. These networks are then analysed using computerised hydraulic models (such as InfoWorks by HR Wallingford/ MWH). This allows us to understand how they will behave in wet weather, where there are flooding risks and where and how frequently there will be spills from the sewers to the river. Reports on each catchment (Drainage Area Studies) are prepared and used as a planning tool to understand the flood risk and water quality impacts of the sewer system. The UPM standards and procedures discussed in Chapter 21.2 are seen as being particularly important in helping to understand and control the water quality aspects of designed combined and surface water sewers.

Fully separate foul and surface water collection systems can help to minimise wet weather discharge of sewage to rivers and lakes, reduce flood risk, and in many cases generate locally treasured wetlands and open water space. Historically drainage engineers were more concerned with reducing flood risk than with water quality, and many of Britain's road drainage and sewerage systems were designed as combined systems, with overflows combined sewer overflows (CSOs) intended to operate after significant rainfall, primarily to minimise local flood risk, with little concern for the downstream impact of the discharged water, either in terms of increased downstream flood risk or of water quality.

Whilst we are now more enlightened and much more care is placed in the drainage planning of new development, we are still faced with the legacy of combined sewers in the majority of our urban areas. Whilst some redevelopment may facilitate the adoption of sustainable drainage systems (SUDS), the disruption likely to be caused by widespread retrofit of surface water separation from foul sewerage has so far inhibited much progress. So combined sewers are likely to be a significant feature of existing sewerage systems for the foreseeable future.

The proper design of combined sewer improvements is therefore critical, providing attenuation of flows and/or storage to ensure that discharges from combined sewer overflows do not cause deterioration of water quality, acute pollution or enhance flood risk. The UK has done much work over the past thirty years or so, improving design, construction and operation of sewerage systems, including CSO design and network modelling to understand how the overall sewerage system responds to varying flows and thereby optimise design and operation to minimise the frequency and severity of CSO spills. This process is described fully in the Urban Pollution Management (UPM) Manual

Where systems are combined, which is still common in many areas, the system will be constructed with combined sewer overflows at critical points to discharge diluted sewage to the river during storm events. The proper design of this is crucial to preventing acute pollution of the water course during storms. As outlined in Chapter 21 much work has been done in the UK on improving the design of combined sewer overflows and using sewer network models to understand system behaviour and so optimise the design of measures to reduce the frequency and severity of spills.

22.6 SUSTAINABLE URBAN DRAINAGE

One of the major problems of urbanisation has been the creation of vast impervious areas that prevent rainfall from infiltrating to groundwater, and which require the resultant surface water runoff to be channelled quickly to the nearest watercourse to prevent flooding of the properties on which the rain falls. Unfortunately this can cause flooding and pollution elsewhere. In the past, urban planners considered rainfall runoff to be an unwanted nuisance to be collected, piped and discharged away to a watercourse as quickly as possible. They now recognise that such a policy is untenable and that urban planning that does not effectively manage flood and pollution risk fails the citizens of that urban area and possibly beyond.

In a sense there are two challenges – dealing with the problems caused by existing development, and preventing new or re-development from further adding to the problem.

Sustainable urban drainage aims to deal with the surface water at source as much as possible, ideally infiltrating it into the soil to replenish the groundwaters covered by the urban impervious services. Realistically this is not entirely feasible in most cases and so a hierarchical approach needs to be adopted. Design should allow for as much rainfall as possible for the local ground conditions to be infiltrated into soakaways adjacent to the properties or roads (also minimising the risk of the runoff becoming contaminated). Attenuation and storage ponds or tanks should deal with normal peak flows, draining down to groundwater after the storm ceases and only exceptionally

would storage ponds discharge to a watercourse. Additionally, planning for extreme downpours should ensure that suburban roads are generally flooded ahead of properties and form the emergency surface water flooding relief. The overall aim is for the urban area to have no overall effect on runoff rates to watercourses or to groundwater.

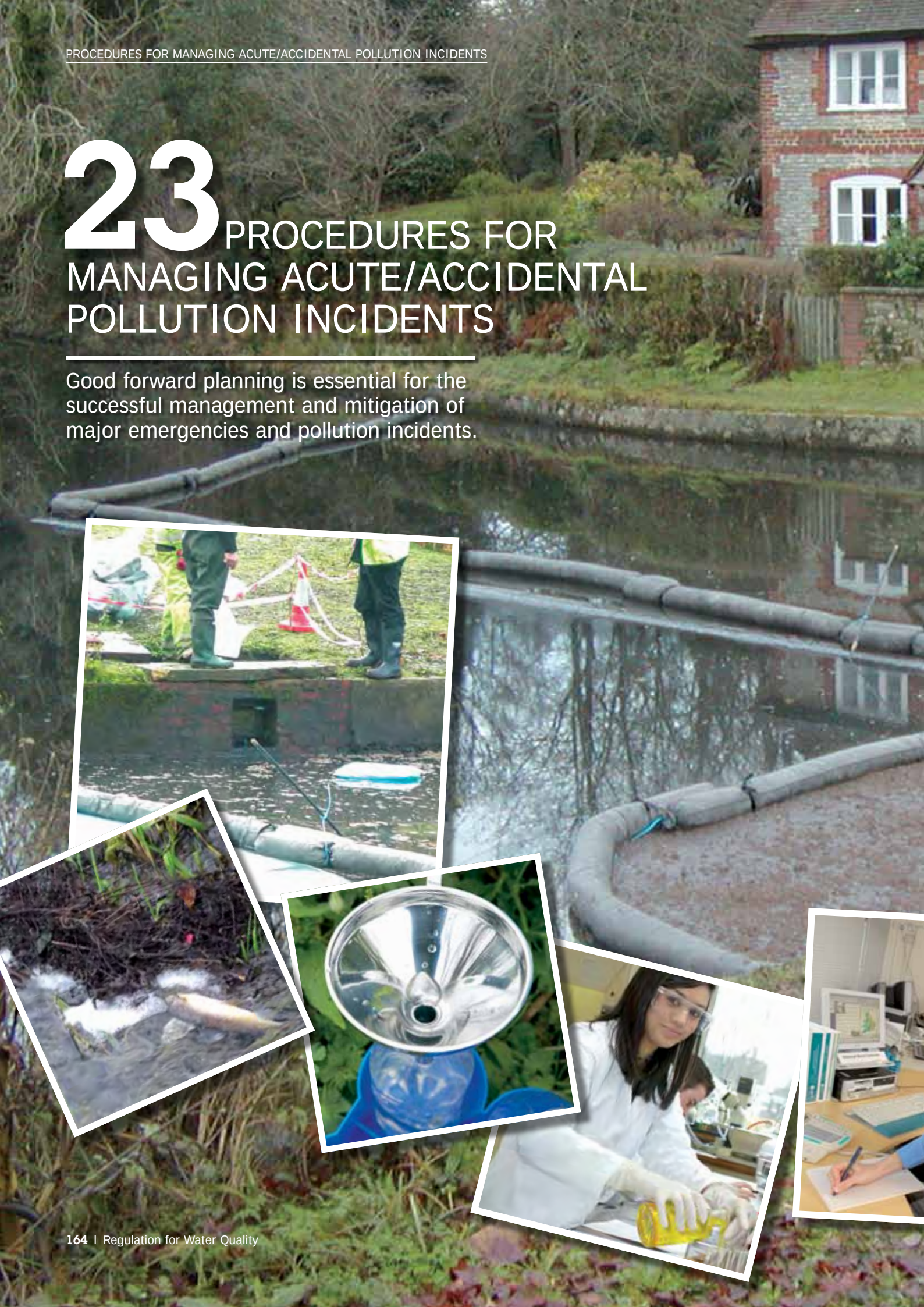
It is clearly easier to include appropriate drainage measures in the design of new builds or re-developments than to comprehensively retrofit sustainable drainage solutions to an existing area, but there are some notable case studies. For instance a downspout disconnection programme in Portland, Oregon, USA resulted in 42,000 homes disconnecting, reducing flows to the combined sewer system by 942 million gallons per year(~3.5million cubic metres).

In the UK, adoption of sustainable drainage systems (SuDS) has been taken up much more quickly in Scotland than elsewhere, due to active devolved government support. The Scottish Environment Protection Agency has generally binding rules under the Controlled Activities Regulations, specifying the SuDS requirements for roads and housing. Details are provided on the SEPA SUDS web site.

In England and Wales, Defra has made slow progress with proposals for SuDS for new developments and re-developments. Regulations are expected at some time after October 2014 which will require developers of major sites to get a SuDS approval from the local authority before commencing any construction work. Developers will have to demonstrate that they can deliver surface water drainage which meets draft standards for flood risk and water quality protection and, if possible, improving amenity and biodiversity. ■

23 PROCEDURES FOR MANAGING ACUTE/ACCIDENTAL POLLUTION INCIDENTS

Good forward planning is essential for the successful management and mitigation of major emergencies and pollution incidents.



23.1 INTRODUCTION

There is a logical hierarchy of action in the event of a significant pollution incident.

In the event of any pollution incident, and particularly where the impact of pollution is evident and significant, the first duty of the regulator is to secure evidence for possible future use in legal enforcement against the polluter, and secondly to investigate, control, minimise and mitigate the effects of the pollution.

However, if the pollution causes a real, tangible risk to human health, a civil emergency exists and all effort must initially be focused on ensuring that the risk to health is minimised as rapidly as possible. That is a task for emergency services, or regional or national government, advised as necessary by environmental regulators and specialists with knowledge of the risk and its management. In such cases the Emergency Controller co-ordinates and directs the movement and action of all persons involved in the affected ▶

area, including the environmental regulator. Collection of evidence at the incident site may have to wait until the emergency co-ordinator deems the risks to staff responding to the incident to be acceptable. This may make subsequent apportionment of blame for causing the pollution very difficult. But evidence of off-site impact, e.g. collection of dead fish from watercourses, for post mortem examination will normally be practicable, and is invaluable in helping to define the extent of the damage.

23.2 EUROPEAN COMMUNITY LEVEL ACTION

At EU level, the Community has established a Community Mechanism for Civil Protection, administered by the European Commission Humanitarian Aid and Civil Protection Directorate. The main role of the Mechanism is to facilitate Member State co-operation in civil protection assistance interventions in the event of, or imminent threat of, major natural or technological emergencies which may require urgent response actions. It is therefore a tool that enhances community co-operation in civil protection matters.

The Mechanism has four major components: the Monitoring and Information Centre, the Common Emergency and Information Service (CECIS), a Training Programme, and Civil Protection Modules.

The Monitoring and Information Centre (MIC) is the operational heart of the Mechanism. It is operated by the European Community Humanitarian Office (ECHO) of the European Commission and is accessible 24 hours a day. It gives countries access to a platform, to a one-stop-shop of civil protection means available amongst all the participating states. Any country inside or outside the EU affected by a major disaster can make an appeal for assistance through the MIC. It acts as a communication hub at headquarters level between participating states, the affected country and despatched field experts. It also provides useful and updated information on the actual status of an ongoing emergency. Last but not least, the MIC plays a co-ordination role by matching offers of assistance put forward by participating states to the needs of the disaster-stricken country.

The Common Emergency and Information System (CECIS) is a reliable web-based alert and notification application created with the intention of facilitating emergency communication among the participating states. It provides an integrated platform to send and receive alerts, details of assistance required, to make offers of help and to view the development of the ongoing emergency as it happens in an online logbook.

A training programme has also been set up with a view to improving the co-ordination of civil protection assistance interventions by ensuring compatibility and complementarity between the intervention teams from the participating states. It also enhances the skills of experts involved in civil protection assistance operations through the sharing of best practices.

This programme involves training courses, the organisation of joint exercises and a system of exchange of experts from the participating states.

Civil protection modules are composed of national resources from one or more Member States on a voluntary basis. They constitute a contribution to the civil protection rapid response capability called for by the European Council in the Conclusions in June 2005 and by the European parliament in its Resolution in January 2005 in response to the South–East Asia tsunami disaster of December 2004. Thirteen civil protection modules have been identified by the Commission together with Member States.

The Directive on Control of Major Accident-Hazards involving Dangerous Chemicals (COMAH) is closely linked to the IPPC Directive. It focuses on protection of the environment from accidental releases of substances considered dangerous for the environment, in particular aquatoxics. It introduced new requirements relating to safety management systems, emergency plans and land-use planning, and tightened up the provisions on inspections and public information.

23.3 MEMBER STATE LEVEL – UK EXAMPLE

The UK has a strong Emergency Management framework, and there is a large body of information on the organisation of planning and response. Exercises at all levels of governance and response are carried out frequently. At national government level the Cabinet Office is responsible for the planning of response to any Civil Emergency. Details of policy and guidance are on the gov.uk web site under the heading Improving the UK's ability to absorb, respond to and recover from emergencies. Preparedness work is based on four main actions, each of which is covered in some detail via links from the web page:

- risk assessment
- preparation and planning
- response and recovery
- building a resilient society to ensure businesses and communities are better prepared for emergencies, and able to recover from them.

The fundamental principle is one of tiered response, with incident co-ordination rapidly moving from local to regional to national if the incident demands it. Incident response by emergency services, including environmental regulators, comes under a gold–silver–bronze command structure. This establishes a hierarchical framework for the command and control of major incidents and disasters. If the incident is of significance to government 'platinum control' is undertaken by a Cabinet Office Briefing Room (COBR), overseen by the National Security Council.

An alternative description of the tiered response command structure is strategic–tactical–operational, but the different categories are equivalent. Whilst this system does not explicitly signify hierarchy of rank, with the roles in different tiers not being rank-specific, usually the chain of command will be the same as the order of rank.

23.4 LOCAL SCALE POLLUTION INCIDENTS

For less severe incidents if resources are limited, as they often are in the early stages of an incident, the investigating officer will need to prioritise effort towards securing evidence, whilst providing advice and leadership in organising the response to the incident.

It can be very easy for the investigating officer to be diverted from the evidence collection task, particularly if he or she believes that urgent action may prevent an escalation of the incident. However if the collection of evidence is not carried out meticulously there is a strong chance that the offender will escape rightful punishment, as the evidence will be challenged in court. The longer after the commencement of a pollution event the investigation starts, the more difficult it becomes to obtain conclusive proof of guilty parties.

The IMPEL Guidance on Environmental Inspections provides a substantial suite of 'How To' information for investigation of environmental performance and in dealing with incidents: The IMPEL Reference Book for Environmental Inspection (1999); and in a step by step guidance book for planning environmental inspections: 'Doing The Right Things 2' (2007).

23.5 INCIDENT CLASSIFICATION

Regulators rely to a large extent on notification from the public when environmental incidents happen. In the early stages of an incident it can be difficult to determine how significant the incident is, until the regulator's inspectors have commenced an on scene investigation. It is clearly important for environmental regulators to target most resources to dealing with the most significant incidents. Reports of pollution are categorised at the call centre according to the description of the incident from the person(s) reporting the event. A checklist allows incidents to be categorised into one of four categories under the Environment Agency Common Incident Classification System. The Environment Agency has target response times for different categories of incident, the most significant being attended within two hours of notification, whilst the least significant may not be investigated for some days.

The Environment Agency publishes an annual report on Pollution Incidents. The 2012 Report concludes that:

- serious and significant pollution incidents in England and Wales have halved since 2000 but there is evidence that the trend is levelling off.
- the Agency is determined to ensure that the number and impacts of incidents keep falling.
- three sectors - waste management, agriculture and the water and sewerage sector - continue to cause the most pollution incidents.
- waste-related incidents are increasing, particularly in relation to odour and newer technologies.
- pollution incidents harm businesses in terms of cost and reputation.
- it makes good sense for businesses to understand the risks of uncontrolled releases into the environment and invest in cost-effective risk-management measures.

- almost all pollution incidents are preventable through good design, housekeeping and maintenance.
- some pollution incidents are the result of third party actions including vandalism.
- the Agency is using its evidence to help businesses reduce the number and impact of pollution incidents.
- the Agency's work with partners and its attendance at incidents reduces the consequences for people and the environment. ■

24 TRANS-BOUNDARY ISSUES AND CONFLICT RESOLUTION

Rivers, lakes, and estuaries often cross or form regional or national boundaries. Ensuring a fair distribution of water resources across the whole catchment can involve considerable negotiation and diplomacy.

24.1 INTRODUCTION

One of the major problems for regulators can be the differing local, regional and national jurisdictional boundaries between government departments and their agencies, and local governance. Typically national, regional boundaries, and land use planning and local authority boundaries bear no resemblance to natural hydrological catchments used for River Basin Planning. Decisions on land use in one part of the catchment may have a significant effect on another part, which may be in another administrative authority area or in

another state or country. Integrated water management and effective river basin planning can only take place if there is good dialogue between interested parties, and good understanding of catchment and sub-catchment issues and dynamics.

At the EU level the Common Implementation Strategy (CIS) for implementation of the Water Framework Directive is aimed at promoting a common understanding of issues and a common approach to their resolution. A substantial consensus has been achieved in the form of the CIS documentation on agreed best practice for Member States on a range of Water Framework Directive issues, which although not legally binding, provides a marker against which individual behaviours can be judged. The CIS Web Site provides an extensive suite of documentation on implementation issues. At the European Commission level, referral of cases of non-implementation of or non-compliance by Member States with EU law to the European Court of Justice is a powerful constraint on political tardiness in delivering the agreed outcomes. Complaints may be raised by the Commission, Member States, individuals, businesses, or non-governmental organisations (NGOs) The Commission's position on Legal Enforcement is outlined on its web site. An important initiative to force some degree of harmonisation of approach to environmental crime across Member States has been the Directive 2008/99/EC on the protection of the environment through criminal law. This requires the Member States to provide for criminal sanctions ▶

for the most serious environmental offences because only this type of measure seems adequate and dissuasive enough to achieve proper implementation of environmental law. More detail is provided in the Environmental Crime web page.

24.2 THE CONVENTION ON THE PROTECTION OF THE RHINE

The Rhine Convention is designed to preserve and improve the ecosystem of the Rhine, which flows through nine riparian States.

The aims of the Convention are as follows:

- sustainable development of the Rhine ecosystem through:
  - maintaining and improving the quality of the Rhine's waters, and its natural function;
  - protecting species diversity.;
  - reducing contamination.
  - conserving and improving natural habitats for wild fauna and flora.
  - ensuring environmentally sound management of water resources.
  - taking ecological requirements into account when developing the waterway.
- production of drinking water.
- improvement of sediment quality.
- flood protection.
- co-ordination with measures to protect the North Sea.

The riparian States undertake to:

- co-operate in taking actions to protect the Rhine.
- implement programmes and studies concerning the river.
- identify the causes of and parties responsible for pollution.
- ensure that technical measures liable to have a serious effect on the ecosystem, as well as discharges of waste water and hazardous substances, are subject to prior authorisation.
- reduce the risks of environmental accidents.

The International Commission for the Protection of the Rhine (ICPR) comprises of representatives of the Contracting States. It is chaired by those States in turn. It takes decisions unanimously and communicates them to the Contracting Parties.
The tasks of the ICPR are as follows:

- prepare studies and programmes on the Rhine ecosystem;
- make proposals for actions.
- evaluate the effectiveness of the actions carried out.
- co-ordinate warnings and alerts.
- inform the public as to the state of the Rhine and the results of its work.

Each year, the ICPR draws up an activity report and submits it to the Contracting Parties. The Contracting Parties report regularly to the ICPR on the legislative, regulatory and other measures they have taken with a view to implementing the Convention, plus the results of those measures.

Further details of the Rhine Convention can be found at Europa, Summaries of EU Legislation, Water Protection and Management and at the ICPR Web Site.

24.3 DANUBE RIVER PROTECTION CONVENTION

A similar Convention applies to the riparian states through which the Danube flows to the Black Sea. Details of the Convention and the actions taken under the Convention can be found here: International Commission for the Protection of the Danube River.

24.4 LARGE SCALE INFRASTRUCTURE PROJECTS - NATIONAL PLANNING POLICY FRAMEWORK AND STATEMENTS

At national level the current government has developed the National Planning Policy Framework which provides the government's view of what sustainable development means in practice for the development planning system in England. Within this Framework, local authorities will plan development and make the majority of planning decisions.

The government has also produced National Policy Statements (NPS) for England and Wales for major infrastructure projects in order to ensure that major, nationally significant projects such as energy generation, transport infrastructure, water supply, waste water and waste are subject to timely and consistent planning and permitting procedures. These decisions are often locally very contentious and in the past have been subject to significant delays due to inter-authority differences of opinion, or challenges to EIAs, etc. The decision making for NPS schemes is now undertaken by the Planning Inspectorate. Details of the National Policy Statements and National Infrastructure Planning are available on the Planning Inspectorate web site.

The NPSs are subject to consultation prior to issue and include the government's objectives for the development of nationally significant infrastructure in a particular sector. They cover:

- How this policy will contribute to sustainable development.
- How these objectives have been integrated with other government policies including those relating to the mitigation of, and adaptation to, climate change.
- How actual and projected capacity and demand have been taken into account.
- Consideration of relevant issues in relation to safety or technology.
- Circumstances where it would be particularly important to address the adverse impacts of development.
- Specific locations, where appropriate, in order to provide a clear framework for investment and planning decisions. ■

25 ENFORCEMENT & PROSECUTION

Enforcement and prosecution are necessary tools for environmental regulators, but their use is almost invariably as a result of environmental damage, and therefore a failure of the regulatory process to prevent harm from occurring.

Nevertheless, powers of enforcement for regulators, and clear willingness to use them against offenders, are an essential part of the regulatory tool kit.

Certainty of punishment for failing to do the right thing is a great incentive for encouraging good performance by those who might be tempted to do otherwise.

25.1 INTRODUCTION

Enforcement and prosecution operates at many levels:

- The European Commission may initiate infraction proceedings against Member States in the European Court of Justice for non- or late-transposition of Directives, or for non-compliance with Directive obligations, e.g. prior authorisation, permitting, reporting, etc.
- Within Member States the lead Ministry or Parliament may censure the regulator for poor performance in securing intended environmental outcomes, and aggrieved parties may be granted judicial review if regulators fail to adhere to statutory procedures and processes.
- Regulators may instigate a wide variety of enforcement measures against operators, dischargers and polluters, including criminal prosecution by the regulator or State prosecutor, and imprisonment or fining of guilty parties.

In all cases there are likely to be multiple aims for enforcement at whatever level, any one of which may be dominant:

- To prevent occurrence or recurrence of non-compliance
- To rectify damage caused to the environment (and to affected businesses)
- To encourage others to comply and to follow good practice
- To punish for the public good (adverse publicity for offender)
- To punish on behalf of society for serious damage to the environment.

There are a wide variety of enforcement mechanisms available to regulators. The precise mix varies according to the laws and customs of Member States. These range from criminal and civil law sanctions, including imprisonment, to training and education. The common thread is significance of risk of harm, or degree of actual harm caused, to the environment.

Criminal enforcement may be entirely undertaken by the environmental regulator or, more commonly in Member States, by the State prosecutor, on the basis of evidence provided by the regulator. Criminal enforcement is usually used only when there is, or has been, serious harm to the environment, or wilful risk of serious harm. Criminal enforcement is undertaken against the legal person (which depending on the significance and nature of the offence, may be Company, Director(s), manager or operative) who caused or permitted the environmental offence to occur. Punishment may include fines, imprisonment and paying the cost of rectifying the environmental and economic damage caused. If the circumstances fit, criminal enforcement may apply to accidental pollution from an activity that would not normally require an environmental permit, e.g. bad maintenance resulting in spillage from a pipeline. National law may identify separate criminal offences of causing pollution, failing to have a permit, or failing to comply with a permit. Causing pollution is generally regarded as the more serious offence as, in many cases, by good luck or the conservative nature of the permit limit, the circumstances of permit breach do not cause pollution, e.g. a high concentration discharge breaches permit conditions but does not cause pollution because of high river flow providing rapid dilution.

Civil sanctions, also referred to as administrative enforcement, are generally used in response to offences for lower risk activities that nevertheless require permits or notification, or for technical breaches of permits which do not cause serious pollution, e.g. failing to keep adequate records; failure to report data, etc. Typically the sanction may consist of a fine imposed by the regulator, with escalation to criminal sanction for repeat failure. Rules vary between Member States as to whether such fines may, or may not, be retained by the regulator and used for environmental purposes, or be paid direct to central government. Several other administrative or civil techniques may also apply aimed at public acknowledgement by companies of previous wrong doing, and payment by them for restoration of damage done.

25.2 ENVIRONMENTAL ENFORCEMENT

Until recently environmental law in the UK has been enforced using criminal sanctions set out in primary legislation. The Regulatory Enforcement and Sanctions Act now allows regulators to use civil sanctions as an additional means of enforcement.

PROSECUTIONS

When undertaking prosecutions the regulator has to pay close attention to the collection of evidence and presenting it in court. This has to be undertaken to a very high standard to withstand legal scrutiny in court. The requirements are set out in the Evidence Requirements of the Code for Crown Prosecutors, a downloaded copy of which can be accessed here. Any fines imposed by the court go to the government, so there is no incentive for the regulator to use enforcement as an income stream. However, the regulator can be awarded costs by the court for actions taken in response to a pollution incident and in the mounting of the prosecution. A successful prosecution also helps any persons whose rights have been affected by a pollution incident (e.g. abstractors), as this can be used in their evidence to Civil courts when seeking damages from the offender.

The Environment Agency's approach to taking sanctions against offenders is set out in its enforcement Web Page.

The Agency encourages individuals and businesses to put the environment first and to combine good environmental practices ▶

with normal working methods. It also offers information and advice to those it regulates to help cut down on unnecessary paperwork and cost.

The aim of enforcement is to make sure business and industry take appropriate action to protect the environment, to ensure that regulations which prevent pollution are complied with and secure better outcomes for the environment, people and business.

The Agency may decide to enforce when any of the following occur:

- an incident
- breach of the conditions of a permitted activity
- non-compliance with legislation.

25.3 CIVIL SANCTIONS

Europe was the home of the first Industrial Revolution, and still bears the scars. Much of its environment is degraded because of the actions of our forbearers, although in the last sixty years, with concerted effort, substantial progress has been made in cleaning up the worst excesses. Environmental regulation in Europe has been, to a large extent, successful in ensuring that the current local administrations and business communities respect the environment upon which success ultimately depends. So the regulatory focus now is moving towards developing tools to instil the right behaviours so that 'hard' or 'direct' regulation is needed less for most currently regulated activities. Regulators are being encouraged to consider the businesses and people that they regulate as 'customers', who, whilst they need the service of good and effective regulation, also have legitimate expectations of the regulator as the service provider. Undoubtedly, mutual understanding of the needs and issues of a regulated business,

and of regulatory imperatives, significantly aid the regulator and the business in determining the best way of achieving an intended regulatory outcome.

Until recently UK environmental law was only enforceable through the criminal courts. This was a good means of punishing serious pollution, but acted as an inhibitor on the regulator in enforcing for less serious offences, that, nevertheless, impact on the environment or prevent the effectiveness of regulation. Regulation was seen as being heavy-handed due to criminalising persons for 'petty' offences such as failing to keep records or provide data in accordance with permit. A major concern of businesses has always been to be allowed to compete 'on a level playing field'. Environmental regulatory 'cheats' who failed to keep records or provide regulatory data often 'got away' with it, and were able to undercut their competitors who were fully compliant with regulatory requirements.

Following the Hampton Review (see Chapter 8) the Environment Agency has been granted a limited set of civil sanctions to use in cases where criminal sanction would be excessive, or less likely to generate the required compliance.

New civil sanctions give regulators a much wider portfolio of tools to encourage potentially recalcitrant businesses to improve their performance, whilst removing the stigma of criminal prosecution.

Unlike prosecution, civil sanctions are imposed or accepted by the regulator. There are six types of civil sanctions available to the Environment Agency:

- **Compliance Notice** - a regulator's written notice requiring actions to comply with the law, or to return to compliance, within a specified period.
- **Restoration Notice** - a regulator's written notice requiring steps to be taken, within a stated period, to restore harm caused by non-compliance, as far as possible.
- **Fixed Monetary Penalty** - a low-level fine, fixed by legislation, that the regulator may impose for a specified minor offence.
- **Enforcement Undertaking** - an offer, formally accepted by the regulator, to take steps that would make amends for non-compliance and its effects.
- **Variable Monetary Penalty** - a proportionate monetary penalty which the regulator may impose for a more serious offence.
- **Stop Notice** - a written notice which requires an immediate stop to an activity that is causing serious harm, or which presents a significant risk of causing serious harm.

More detail is available on the Environment Agency web site page on Civil Sanctions. Details of the Defra/Welsh Assembly Government guidance to regulators are provided here. ■

26 FUTURE TRENDS IN WATER AND ENVIRONMENTAL REGULATION

There are a number of areas of regulation and permitting that are the focus of current development and political and technical scrutiny. Some of these issues are highlighted below.

26.1 ECOSYSTEM SERVICES

The identification of man-induced climate change, continued exponential population growth and the world economic crisis have created major uncertainties about environmental capacity, social cohesion and economic growth. The focus is on 'sustainable development', but the fear is that the old economics-dominated approach to improving the quality of citizens' lives will continue to prevail over more holistic and inclusive measures.

However, the European Union has a history of acting to protect the environment, recognising that all human endeavour is critically dependent on all natural resources, and that in the long term (and often the short term) it pays to manage them well. Up until recently there were few metrics for measuring or quantifying the 'value' of environmental resources other than as commodities. There are now emerging methodologies to place values (monetary or relative) on the components of the environment that we make use of, often without thought. These methods provide the opportunity to assess the likely overall environmental, social and economic impacts of options for policies, legislation and implementation over the planned lifetime of an initiative, so that its true value to society can be evaluated.

It therefore seems likely that the emerging science or discipline of Ecosystem Services evaluation will increasingly influence Regulatory Impact Assessment at the law-making scale, and on land use and environmental regulators' decisions.

Ecosystem Services can be grouped into four broad categories:

- **Supporting services**, such as nutrient cycling, oxygen production and soil formation. These underpin the provision of the other 'service' categories.
- **Provisioning services**, such as food, fibre, fuel and water.
- **Regulating services**, such as climate regulation, water purification and flood protection.
- **Cultural services**, such as education, recreation and aesthetic value.

A useful outline of Ecosystem Services is provided in a UK Parliamentary Office of Science and Technology Note, a downloaded copy of which can be found here. More detail is available on the Defra web site. There is also some very interesting analysis in the Ecosystem Services pages of the gov.uk web site.

The documents 'What Nature can do for you', 'Payments for Ecosystem Services', and 'An Introductory Guide to Valuing Ecosystem Services', are of particular interest and can be accessed as downloaded electronic copies via the links above. ▶

There are also several specific Ecosystem Services case studies, and details of recent and ongoing research on the research and case studies pages of the gov.uk web site.

26.2 INNOVATIVE TREATMENT METHODOLOGIES

Advances in chemical engineering and treatment processes continue. It is important to ensure that regulation drives innovation rather than stifles it. The regulated sectors often complain about regulation, but if planned, designed and applied well it can stimulate innovation and the development of new processes. Setting tighter standards can drive new technology and provide the incentive for evolution. The following are examples of environmental regulation that have promoted innovative approaches:

- Setting strict water use reduction targets is an important way of optimising scarce and expensive resources. In all cases significant quantities of water can be saved by closed systems and water recycling. In most cases industry also saves significant costs, providing a win – win situation. This may be achieved through tightening of permits or through economic regulation via price-setting mechanisms.
- Setting strict carbon reduction targets stimulates the development of new energy-saving processes, including anaerobic treatment methodologies, sludge treatment, composting and process optimisation, to achieve the same quality product and/or effluent with less energy. In sewage and sludge treatment there is significant opportunity for energy production through anaerobic digestion to produce methane. Treatment plants can be self-sufficient in energy and export to the grid. Energy is expensive and significant savings can be made.
- Innovative process and materials can be developed if the correct regulatory stimulus is applied. Areas for innovative treatment include bio-engineering, materials science, nano-particles and process control.

26.3 WATER CATCHMENT OPTIMISATION

The EU WFD encourages innovative approaches to find the most cost effective ways to achieve the objectives set in the aquatic environment. This can include modelling the behaviour of water catchments to optimise permits and the performance of discharges. This can be undertaken as a

periodic review and the Simcat / SAGIS, and other models described in chapter 20 above can be used to carry out this work.

There are other developments in sensors, telecommunications and data processing that may allow river catchments and abstractions and discharges to be managed in real time. In this way controls can be applied to optimise uses made of the water environment within the catchment, **and** river flow and pollution loads.

26.4 SOURCE CONTROLS

Prevention is always better than cure. Preventing chemicals and pollutants from entering the water medium reduces risks to health and the environment. REACH is an example of this developing regulatory field. REACH is the European Community Regulation on chemicals and their safe use (EC 1907/2006). It deals with the **R**egistration, **E**valuation, **A**uthorisation, and Restriction of **Ch**emical substances. The law came into force on 1 June 2007. Information on REACH can be found in the Enterprise and Industry Section of the European Commission web site.

The aim of REACH is to improve the protection of human health and the environment through the better and earlier identification of the intrinsic properties of chemical substances. At the same time, REACH aims to enhance innovation and competitiveness of the EU chemicals industry. The benefits of the REACH system will come gradually, as more and more substances are phased into the system.

The REACH Regulation places greater responsibility on industry to manage the risks from chemicals and to provide safety information on the substances. Manufacturers and importers are required to gather information on the properties of their chemical substances, which will allow their safe handling, and to register the information in a central database run by the European Chemicals Agency (ECHA) in Helsinki. The Agency acts as the central point in the REACH system: it manages the databases necessary to operate the system, co-ordinates the in-depth evaluation of suspicious chemicals, and is building up a public database in which consumers and professionals can find hazard information.

REACH also calls for the progressive substitution of the most dangerous chemicals when suitable alternatives have been identified.

26.5 FUTURE DIFFUSE POLLUTION CONTROL DEVELOPMENT

One of the major challenges for environmental regulation is in addressing the sources and causes of diffuse pollution. This is highlighted in Chapter 22 which examines rural and urban diffuse pollution and some of the developing methods for mitigating impact. Conventional permitting-based regulation works well for point sources of pollution, but has been ineffective at addressing diffuse sources ▶

such as pollutant runoff from agricultural practice, forestry, and urban hard surfaces. It is clear that behaviour change is needed on the part of the people and organisations responsible for generating the diffuse pollution, often in complete ignorance of the impact their activity creates.

While in the EU there has been great progress in reducing point source pollution over recent decades, non-point / diffuse pollution, especially of nitrate and phosphorous from agricultural land, has generally remained stable or become worse. Awareness of this issue is often low with the majority of farmers (85%, UK national Audit Office surveys, 2010) not realising that they are major contributors to surface and groundwater pollution. There are often significant time lags between the application of fertiliser, pesticide or manures / sludge to land and its transport to rivers by surface or sub-surface routes. These will be dependent on weather, with site specific factors also affecting the pathways of pollutants to the receiving water.

It is certain that no single tool will deliver effective diffuse pollution control and that a variety of measures will be needed. The most directly acting are likely to be financial – taxes, levies, or subsidies – aimed at particular activities. But these are likely to generate resentment in some sectors of society, and may distort markets, leading to knock on environmental, social or economic problems.

Over the long term, innovation, education and instilling in the general population a higher appreciation of the value of a clean environment, are likely to be the most effective means of securing improvements. When activities that currently lead to diffuse pollution become seen as being seriously anti-social, the perpetrators of such pollution are far more likely to change their ways.

26.6 DEVELOPMENT OF REGULATORY TOOL BOXES

There are many methods for reducing the environmental impact of man's activities on water. Conventional 'hard' regulatory methods, including permitting are not always effective. 'Better regulation' or 'modern regulation' initiatives seek to optimise regulatory systems to achieve key objectives for society and the environment at least cost. (See also Chapter 11.) These regulatory methods and systems need to change in response to developing maturity of sectors, the quality of the environment, the timescales for improvement and protection, and societal expectation. For this reason the development of regulatory toolboxes is important, using combinations of regulatory instruments, and readily available information about their application, to be matched to specific sectors and challenges.

Modern regulation also extends to monitoring and inspection methods, enforcement and prosecution, civil and criminal law, and the provision of information to the public. This includes publicly available compliance assessment and prosecution policy, public information techniques, and the development of pollution league tables, including the best and worst performers.

Appropriate regulatory methods for a highly polluting emerging economy may be different to those for a mature economy needing to maintain and improve environment within a highly discerning society. The challenge for both types of economy is to select methods that meet current and future needs, but allow the progressive movement towards water security and a sustainable water environment. ■

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28 GLOSSARY OF TERMS

Artificial Water Body (AWB): A discrete and significant man-made water body or part of a man-made water body (as opposed to a modified natural water body) with the potential to support, or supporting, a functioning aquatic ecosystem. Includes canals, some docks and some man-made reservoirs.

Catchment: A geographic area defined naturally by surface water hydrology. Catchments can exist at many scales but within this framework, we have adopted the definition of Management Catchments that the Environment Agency uses for managing availability of water for abstraction as our starting point.

Catchment Partnership: Working at the catchment level, this partnership is a group that works with key stakeholders to agree and deliver the strategic priorities for the catchment and to support the Environment Agency in developing an appropriate River Basin Management Plan, required under the Water Framework Directive.

Environmental objectives: Means the objectives set out in Article 4 of the Directive. Objectives include the protection of water bodies, attainment of Good Status and other environmental requirements of the Directive.

Environmental quality standard: Means the concentration of a particular pollutant or group of pollutants in water, sediment or biota which should not be exceeded in order to protect human health and the environment.

Full external cost of water: Economic activity in the water sector includes outputs that have negative and positive effects on the welfare of people and organisations in society. The negative effects, such as pollution, loss of habitat, reduction in flows available for downstream abstraction, etc., are not taken into account by the organisations causing them, as they receive no compensation (or sanction) for their production. These outputs are said to be "external" to the water supply and wastewater treatment decisions in the sector.

Groundwater: Refers to all water that is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.

Macroalgae: Multicellular algae such as seaweeds and filamentous algae.

Macroinvertebrates: Larger animals (visible to the naked eye) but without an internal skeleton, living in the aquatic environment, such as insects (larvae), worms, snails, etc.

Macrophyte: Larger plants, typically including flowering plants, mosses and larger algae, but not including single-celled phytoplankton or diatoms

Member States: The individual countries that belong to the European Union and are bound by the Water Framework Directive. Other sovereign nations may choose to adhere to the Directive in order to co-operate with the EU, but are not bound by the legislation.

No Deterioration: A basic requirement of EU water legislation that the existing quality of water shall not be allowed to get worse as a result of regulation. Particularly important where current EQSs are not met, and in ensuring that high quality water remains so.

Outcomes: These are the overall environmental, economic or social conditions required by European society, within a river basin. They include: good quality water environment; water suitable for potable abstraction and use; fisheries; recreational use etc. These will lead to healthy environments for people, sustainable economic use, (e.g. tourism) and healthy ecosystems.

Phytoplankton: Solitary and colonial unicellular algae and cyanobacteria that live in the water column, at least for part of their lifecycle.

Phytobenthos: Aquatic algae, living on substrates such as stones, reed stems, etc. Often only the group of diatoms are used for classifying the phytobenthos community.

Pressures: Human activities such as abstraction, effluent discharges or engineering works that have the potential to damage the water environment.

Quality Element: A feature of an aquatic ecosystem listed in the WFD which is measured and used as part of the process of assessing the quality of the ecosystem.

Reference Conditions: The benchmark against which the effects of human activities on surface water ecosystems can be measured and reported in the relevant classification scheme.

River Basins: Sometimes known as a river catchment, a 'river basin' is the area of land from which all surface run-off flows through a sequence of streams, rivers and sometimes lakes into the sea at a single river mouth, estuary or delta.

Surface Water: Refers to rivers, lakes, estuaries (also known as transitional waters) and coastal waters.

Water body: The basic building block of the river basin planning process. It delineates the sub-unit to which environmental objectives should apply. The size of water bodies is determined by the optimum management unit and the variability of the water affected. ■

NOTES

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OUR MISSION...

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OUR VISION...

...is a society well informed on water and related environmental matters. One whose citizens are knowledgeable about issues affecting the sustainable management of water and are thus empowered to contribute to environmental stewardship

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