

Note to reader – This paper has been produced with the single intent to go to the Mayor for London, to ask for his support to create a single London wide strategy for water, to ensure that decisions are seen in an integrated way.

Water – exploring the issues

A discussion paper

Objective of this paper

The purpose of this paper is to set down the issues and concerns related to water in London and to call for a single integrated strategy.

Introduction

One of the principal purposes of the Greater London Authority (GLA), as laid down in the GLA Act, is promoting the improvement of London's environment. The Mayor is specifically required to prepare four environmental strategies, and in doing so to have regard to their effects on the health of Londoners as well as the

achievement of sustainable development in the United Kingdom. He is also required to prepare a State of the Environment Report.

Although the Mayor is required to report on water quality and emissions to water, as well as on groundwater levels, in his State of the Environment Report he is not required by the GLA Act to prepare a water strategy. Nevertheless, water is the subject of growing concern. Concerns relate to long-term issues, such as the adequacy of water resources to meet the needs of London's growing population at a time when there is the prospects of diminishing water resources as a result of climate change, as well as more immediate problems such as the overflow from the sewer system into the River Thames.

Different agencies are responsible for different aspects of water and, although each agency may be fulfilling its statutory responsibilities, there is no overall framework within which individual actions can be seen to fit. There is concern that, in the absence of such a framework, individual actions may have unintended consequences.

Water impinges directly on the Mayor's statutory responsibilities. Adequate and wholesome water supplies are essential to the health of all Londoners. Adequate resources are essential to accommodate the growth in population forecast in the London Plan. Flooding, and particularly sewer flooding, is a health hazard. Good quality water in lakes, canals, rivers and streams is essential to the maintenance of

London's biodiversity. Flood prevention and protection against rising levels of ground water impose significant costs on the London economy.

The Mayor needs to take the lead with key stakeholders to lead in preparing a framework for action on water, which will set out policies and actions on how London can develop as an exemplary world-class city for sustainable water. The aim should be to have a draft framework supported by the appropriate analysis so that decisions such as Thames Water's application can be considered in the context of the framework.

A vision and objectives for water in London

The stakeholders who have supported this paper to the Mayor want to work with the GLA to develop London as an exemplary sustainable world city. London has retained its position as one of the world's great cities over many centuries because of the quantity, quality and diversity of its people, businesses, infrastructure and natural resources. At the same time London had, and still has, problems of social division, pollution and increasingly wasteful use of resources.

We need to ensure collectively that the vision for London is a place where all Londoners and visitors feel the greatest possible sense of physical, emotional, intellectual and spiritual well-being. The goal must be to meet the needs of Londoners today without compromising the ability of future generations to meet their needs. This means that London must seek to ensure that the ways in which

people live, work and relax will not interfere with nature's inherent ability to sustain life in the centuries to come.

In order to achieve this, we must all take responsibility for the burden which city life imposes, locally, regionally and globally. Resources must be used efficiently and fairly, and the natural and built environment protected. Those who live or work in London, as well as those who make use of London's services, all have a part to play in achieving this goal. Each step must be supported by clear objectives and targets, so that we can learn from both successes and from failures. To help move London towards this long-term goal, a more detailed set of objectives and principles for water management in London is proposed.

Objectives

To create a compelling vision for water for London, there are three objectives:-

1. To enable London to become 'water resources neutral'

The demand for water in London is being forecast to increase over the coming years, with our propensity to use more water and a growing population. But London cannot sustain ever-growing demand, particularly with the prospect of hotter and dryer summers as a result of climate change. London needs to meet future needs from existing resources, by being more efficient and less wasteful. We have called this becoming 'water resources neutral'.

2. To ease the consequence of surface flooding in London

Risk incorporates *chance* and *consequence*. London's defences against storm waters are amongst the best in the world and offer a minimal chance of being breached. Yet the consequence of surface flooding remains severe. Greater resilience to flooding, improved warnings and secondary defences are some ways in which we can ease the consequence.

3. To ebb the tide of untreated sewerage being discharged to the river Thames

The discharge of an estimated 20 million cubic metres of untreated sewage into the river Thames every year through our overloaded drainage system, must cease. Clearly the consequences of such discharges are immense for biodiversity, tourism and business location.

Principles

In delivering these objectives, three overarching principles apply:

1. Delivering practical changes locally

London is not alone in so far as facing too little water, too much water and too poor-quality water in the environment; sometimes at the same time! In terms of water, we are looking for London to become more self-sufficient. Where appropriate, the framework adopts a hierarchy of first acting locally, regionally and then nationally.

2. The financial regime should deliver what London needs

The financial regime should deliver what London needs in terms of water infrastructure and services, rather than the infrastructure and services being the outcome of the financial regime.

3. Promoting consumer awareness and participation

People can only act responsibly and sensibly if they understand the issues.

There is a huge opportunity, and need, to educate Londoners about water and the need to use water wisely.

To enable an effective conversation between the GLA and key stakeholders who have been working together to set a way forward a number of questions need to be asked to inform the debate:-

Question 1: Do the GLA agree that these are the right Objectives and Principles to apply to managing water – both the water we want such as drinking water and the water we don't want such as flood water and sewage – in London?

Who manages water?

The number of organisations involved in the management of water – some of which provide services, some are regulatory and some are advisory – is considerable. This section looks at the key organisations and their various roles.

Water companies

We start with the water companies as they are the public face of the water industry in London. Water companies are responsible for providing a wholesome and reliable supply of water, promoting the efficient use of water by their customers

and on behalf of their customers, and producing water resource plans and drought plans. For those companies that provide sewerage they have the duty to provide, improve and extend the system of public sewers and to clean and maintain them to allow effective drainage. Table 1 shows the four water companies serving London.

Table 1 Water companies operating in London

Company	Water and sewerage
Thames Water	Water and sewerage
Three Valleys Water	Water*
Essex & Suffolk Water?	Water*
Sutton & East Surrey Water	Water*

* Thames Water provides sewerage services in these areas

During the first half of the 20th century, the majority of London's water was supplied by the Metropolitan Water Board, with the remainder supplied by a large number of municipal and private water companies. Land drainage and tidal flood defences were the responsibility of the London County Council and subsequently the Greater London Council (GLC). The Water Act 1973 amalgamated the Metropolitan Water Board with many of the municipal and private water companies to form the Thames Water Authority. However, Three Valleys Water, Essex & Suffolk Water and Sutton

& East Surrey Water continued to operate as independent companies.

Responsibility for land drainage was transferred to the Thames Water Authority when the GLC was abolished in 1986. Responsibility for tidal flood defences was transferred to the National Rivers Authority, which was subsumed into the Environment Agency in 1996. Thames Water Authority was privatised in 1989.

Regulators

The *Environment Agency* is the environmental regulator of the water industry and has regulatory and operational responsibilities in other areas of water and environmental management. Specifically the Environment Agency is responsible for water quality and securing the proper use of water resources, including resource planning, the licensing and regulation of water abstractions and the issuing and regulation of discharge consents. It is also responsible, in whole or part, for pollution control, fisheries, navigation and flood defence as well as being responsible for managing the dissemination of flood warnings.

The *Office for Water Services (Ofwat)* is the economic regulator of private water companies and has the duty of ensuring that the appointed companies are able to finance properly the carrying out of their functions. To fulfil this, Ofwat conducts a price review every five years to set a 'price-cap' limit on increases in water service charges to consumers. Ofwat also has duties to facilitate competition, promote efficiency on the part of water utilities, and protect the interests of consumers.

The *Drinking Water Inspectorate* is the regulator for drinking water quality and checks that water companies in England and Wales supply water that is safe to drink and meets the standards set in the Water Quality Regulations. It also investigates complaints from consumers and incidents that affect or could affect drinking water quality.

Customer representation

Consumer Council of Water represents the interests of customers in respect of price, service and value for money. As such it also investigates complaints from customers about their respective water company.

Government

The *Department for Environment, Food and Rural Affairs* (Defra) is responsible for all aspects of water policy in England and Wales. DEFRA sets the framework of operation for the Environment Agency, the Office of Water Services (Ofwat) and the Drinking Water Inspectorate. Defra allocates funds for improving river and coastal flood defences.

Question 2: What are the views of the GLA with regards to the present duties and responsibilities of these organisations adequate and appropriate for meeting London's current and expected future needs?

It is not the role of this Framework to propose the wholesale reorganisation of water management, but there may be practical improvements which could be agreed upon and implemented.

Drivers for change

There are many factors that are leading to changes in the way we manage water in London. This section is not intended to be a complete list but to identify some of the most significant.

Sustainable development

Since the first UN Conference on the Environment held in Stockholm in 1972, there has been a growing realisation that the current modes of development are unsustainable. In other words we are living beyond our means. From the loss of biodiversity with the felling of rainforests or over fishing to the negative effect our consumption patterns are having on the environment and the climate. Our way of life is placing an increasing burden on the planet which cannot be sustained.

Unless we start to make real progress toward reconciling these contradictions, we all face a future that is less certain and less secure than we have enjoyed over the past fifty years. We need to make a decisive move toward more sustainable development both because it is the right thing to do, and because it offers the best hope for securing the future.

The Government strategy for sustainable development *Securing the Future* which was updated last year by DEFRA highlights the renewed international push for

sustainable development. The lead department is DEFRA but all departments of government share responsibility for making sustainable development a reality.

Population and housing growth

Policies of decentralisation following World War II led to a fall in London's population, but since the mid-1980s it has been growing again. The population is not only growing but its composition, particularly in terms of age structure and ethnicity, is changing. Migration has had a rejuvenating effect on London's age structure. People moving to London tend to be young adults, such as students or first time employees, while those moving out are mostly older workers, retired people and young families. The average size of households is declining because many single people now have their own flat or house.

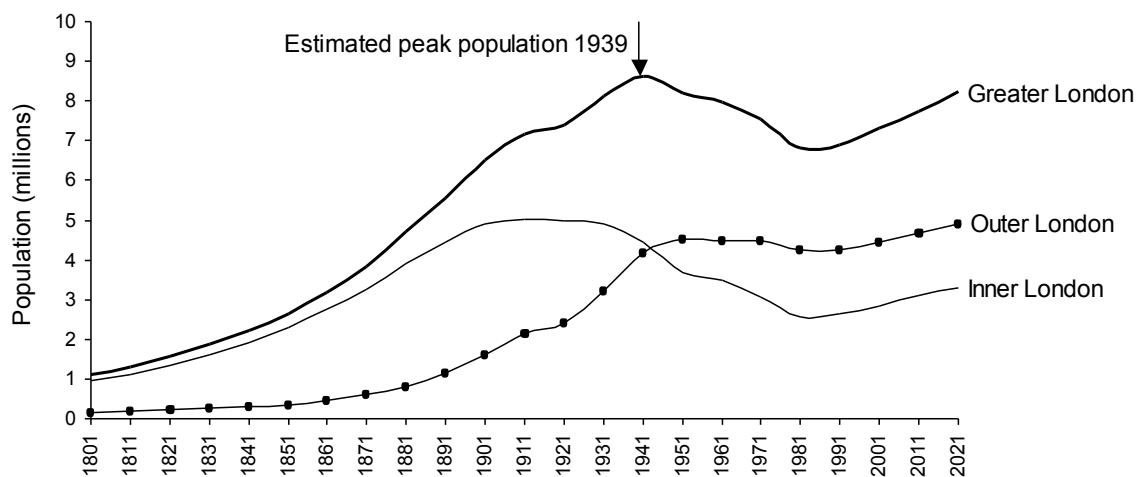


Figure 1 London's population 1801–2021

Future population and housing growth will have an impact on the demand for water resources, water quality and the management of flood risk in London. Recent

studies have revealed that population growth is a more important factor than economic growth influencing household water consumption.

Climate change

The effects of climate change are already being felt, with the Earth's average surface temperature having risen by 0.6°C during the 20th Century and by 0.5°C in London. Overall precipitation has been steady but summer rainfall has decreased and winter rainfall has increased, making the British climate pattern more akin to the Mediterranean (Foresight). The UK Climate Impacts Programme projects that we are committed to further climate change for the next 30-40 years as a result of past greenhouse gas emissions and inertia in the climate system (UKCIP).

Depending on emission levels, sea level in tidal London will rise above the current level.

Climate change will affect resource availability, with less water available in the summer. The increased incidence of droughts could have implications for the supply of water, the maintenance of river flows, and the ability of receiving waters to dilute treated effluent. Although Thames Water have been replacing the cast iron Victorian mains, those that remain are likely to be more prone to cracking, and additional infrastructure will be required for transferring water. Changing rainfall patterns and rising sea level are likely to increase the risk of flooding, particularly when high intensity rains quickly overwhelm inadequate drainage systems. This will carry health risks and have significant environmental impacts on water quality and fisheries. The potential of development sites in fluvial areas could be reduced. The

elderly and other vulnerable groups will be at higher risk why? the risk of flooding relates to the location of the property and will be the same for all groups – the consequences of flooding may be greater for these groups. Drier summers could also lead to increased incidences of subsidence, with implications for homeowners and insurance companies.

Overflow of sewage into the River Thames

The outfall sewer system constructed in the mid-19th century under the direction of Sir Joseph Bazalgette, Chief Engineer to the Metropolitan Board of Works, diverted the vast majority of London's sewage away from the River Thames within London to sewage treatment works downstream. However, it was another hundred years before the river could really be described as clean and fish returned. The cleanliness of the river in the last 20 years has revealed that sewage still flows into the Thames in storm conditions, and can lead to the death of hundreds of fish. Under these conditions it also fails to meet both the technical water quality standard required under the Urban Waste Water Treatment Directive and the more general 'quality of life' standard that Londoners could reasonably expect of their river.

Legislation and national policy

There are many items of legislation, policy statements and best practice guides that are leading to changes in the way that we manage water. Foremost amongst the legislation are the Water Framework Directive and the Water Act 2003

The European Union Water Framework Directive requires the development of statutory River Basin Management Plans (RBMPs), which will set out strategies for achieving 'good' water quality status in line with environmental quality objectives. The plans which have been completed by The Environment Agency need to be met by 2015. The Directive drives forward the integration of planning for land and water through river basin management plans which need to be taken account of by planners. The Water Act 2003 placed water conservation duties on water companies, DEFRA and public bodies, as well as a new duty on the Environment Agency to secure the efficient use of water resources. The implementation of these duties should help to increase awareness about the value of water, water efficiency and the effects of climate change on water.

Question 3: Do the GLA feel that these plans and strategies are sufficient to promote and drive change ?

Changing attitudes

The actions that we take and the choices we make all have direct and indirect impacts on the environment. In turn our anxiety rises relative to whether we have too much, too little or too poor-quality water. Here we look at Londoner's attitudes to water and the possible ways, including policy intervention, to move towards more sustainable patterns of behaviour.

Public attitudes: existing knowledge

There is relatively little information on Londoner's attitudes to water and its relation to quality of life. A national survey of water customers carried out for the review of water price limits (MORI) found that despite a relatively low awareness and concern for water and sewerage services, over a third (36 per cent) considered the water environment to be the aspect in most urgent need of attention, second only to 'litter and household waste' (53 per cent).

Following recent droughts, public attitudes appeared to harden, with the public expecting unlimited supplies at all times regardless of the circumstances. Hosepipe bans and similar restrictions on use were regarded as unacceptable and an infringement upon consumer choices. Yet more recent research suggests that house buyers are increasingly willing to spend more on sustainable homes, including measures to reduce water use (Mulholland), which contrasts with what many developers say.

Our attitudes towards flooding differ depending on our experiences of flooding. It is generally known that people living in areas that have not flooded within living memory tend to underestimate both the chance and consequence of flooding. In contrast those who have experienced flooding tend to overestimate its impacts and can live in continual fear of being flooded again. Research on attitudes towards flooding indicates that people have unrealistic expectations of the role and capacity of the Government and other public agencies to deal with hazards. A widely held view among members of the public is that floods can be eradicated completely or that defences should be erected on all floodplains, regardless of the costs and benefits (Brown and Damery).

The Government and other public agencies need to raise public awareness of the longer-term risks of flooding so that people can make informed choices about the extent they are willing to accept these future risks. It is unclear whether people put more pressure on public agencies to alter their approaches to development and / or strengthen flood defences and flooding warning mechanisms if they had a better awareness of these longer-term risks (Foley).

Policy development in the context of behaviour change is notoriously difficult, as the variety of factors that influence behaviour and lifestyle is enormous.

Nevertheless, there is widespread recognition of the need to engage in this difficult issue and to develop evidence-based policies to support behavioural change.

Changing behaviours is fast becoming the 'holy grail' of sustainable development policy. Understanding how, why and when behaviours change is an important prerequisite for making progress. At the same time, policy needs to influence the social and institutional context of consumer action, as well as attempting to affect individual behaviours (and behavioural antecedents) directly.

Before looking at the arguments of more sustainable patterns, we need to recognise the following three generally accepted viewpoints:

- We are living in a consumer society, and as such policy should not evade the centrality of consumption in modern society
- Material artefacts play important symbolic roles, and as such policy should recognise the this intractable relationship in our lives
- Far from being able to exercise free choice in the selection of services, consumers often find themselves locked in to specific consumption patterns by a variety of social, institutional and cognitive constraints.

Shifting consumption patterns towards more sustainable behaviour relies on a robust understanding not just of what motivates consumers, but also on how behavioural change occurs and how if at all it can be influenced by public sector interventions. Traditionally interventions have flowed from the perspective that policy should:

- Ensure that consumers have access to sufficient information to make informed choices about the available options

- Internalise social costs and make them visible to private choice (as private decisions do not always take account of such costs).

Yet such measures have received criticism for a number of reasons:

- Many of our everyday behaviours are carried out with very little conscious deliberation. Mental 'short-cuts' often become increasingly necessary in our present-day message-dense society.
- Many of our behaviours are routine. Habits often undermine our best intentions to change and are an important structural feature of behavioural 'lock-in'.
- Our behaviours are based more on emotional response than on conscious deliberation.
- Although information campaigns are widely used for achieving public interest goals, they are less effective than other forms of learning.

Persuasion is particularly difficult in a message-dense environment. Effective persuasion relies on observing any number of the following basic principles:

- Understanding the target audience
- Using emotional and imaginative appeal
- Immediacy and directness
- Commitments / loyalty schemes
- Use of retrieval cues to catalyse the new behaviour.

Clearly achieving more sustainable behaviours requires a more sophisticated policy approach. A concerted strategy is needed to make behaviour change easy:

- Insuring that incentive structures (taxes, subsidies, penalties) and institutional rules (regulations, markets and structures) favour sustainable behaviour
- Enabling access to sustainable choice
- Engaging communities in initiatives to help themselves through social and cultural contexts
- Recognising business practices and their impact on consumers and employees
- Exemplifying the desired changes with the Greater London Authority's own policies and practices.

Question 4: To what extent can publicity and media campaigns deliver significant reductions in water use, and be realistically taken into account in resource planning, or are they simply a means of educating people that tighter regulations and higher charges are justified?

Question 5: Can fiscal incentives only be used in relation to water usage, or are there ways that fiscal incentives could be used in relation to other aspects of water, for instance in terms of water quality, the disposal of waste water or flooding?

Securing water supply

A plentiful supply of water is often taken for granted; yet water availability per person in London is low compared to other international cities. Moreover the majority of Londoners currently have insufficient available supplies to meet their water needs in a dry year. In reality, residents face a greater risk of water supply restrictions than elsewhere in the UK. One way of addressing this imbalance is to extend our available supplies by optimising existing supplies and in some cases developing new supplies. Water companies should look at the full range of options for reducing demand for water, including reducing leakage and helping customers to reduce their demands. Only where this demand management approach is clearly insufficient or unjustified in terms of cost should they look to the development of new resources. This is the twin-track approach.

Clearly all such schemes should be subject to greater public acceptability. This section focuses on the possible measures to secure public water supplies.

Current water supply situation

As groundwater stocks take longer to respond to the immediate rainfall events, the relationship between weather, water supplies and the risk of restrictions is less straightforward in London. In general, while Londoners should not face restrictions in the first season of below normal rainfall but, thereafter, we are far more susceptible to resorting to drought measures than elsewhere in the UK. Besides the current below normal rainfall event, the more recent dry periods have been single-season critical and as such we have not seen hosepipe bans but hosepipe bans are

an effective means of conveying the message that rainfall has fallen short and that stocks need to be conserved).

Water companies could increase their resources through building new reservoirs or desalination plants, however under the twin track approach proposed in the Secretary of State's Principal Guidance companies should only develop additional resources when water companies have reviewed all measures to reduce water demand and considered these measures to be insufficient.

Improving water efficiency

Since 1996 all water companies have a duty under the Water Industry Act to promote the efficient use of water by all their customers. A further duty in Section 82 of the Water Act to further water conservation has now been added to this duty.

Water companies promote the efficient use of water in a variety of ways, such as sending out free devices that can save water, or giving advice and information to domestic and business customers on how to conserve the water they use.

It is estimated that water companies collectively spend around £27 Million per annum on promoting water efficiency measures but a large proportion of this relates to the repair and replacement of supply pipes to reduce leakage

Water companies should only develop additional resources when water companies have reviewed all measures to reduce water demand and considered these measures to be insufficient.

Integrating development planning

Finally there is no clear mechanism for integrating water resources management and development planning. If development planning is to take water resources issues into account, greater co-ordination is needed between planners and water managers. Simple improvements could be made through the adoption of shared planning horizons and planning periods. For instance, if development is not to be constrained by water stress or water quality, then water management plans must be developed after development plans have set out the levels of future demand to be serviced. Conversely, if water stress and quality are to be considered in development planning, development plans must follow, or be developed in tandem with, water resources plans. Currently public water supply management is conducted on a rigid five yearly-cycle that often ignores planning periods.

Question 6: Are customer restrictions an appropriate and effective way of managing water supplies? Or should water be available at all times for watering gardens and other uses such as car washing?

Question 7: Is the current mains renewal programme adequate in addressing the problem of leakage rates from the London supply network? Who should cover

any additional costs incurred by private and council residents as a result of changes to water pressure?

Conserving water

Safeguarding public health is of utmost importance. Within this tenet, we set out the hierarchy of optimising water use: reduce waste, improve efficiency and consider options of reuse and recycle. This section looks at the argument for water conservation programmes, including ways that efficient appliances and fittings can do the same function with less water. One possible precursor to the greater uptake of water conservation is the wider penetration of water metering. The issue of metering is discussed in more detail in the section on *Paying for water*.

Water efficiency: the issue

(England and Wales) citizens uses on average about 150 litres of water a day, whereas in London the daily use is nearer 160 litres. This difference is likely to be due to climatic conditions (the south east of England including London being generally drier and warmer than the rest of the UK), household plumbing, and personal behaviours. More so, London's water use compares less favourably with other northern European cities, for instance Berliners use less than 120 litres of water a day.

Clearly there is scope to improve our use of water and reduce our daily consumption. The table below explores current daily water use in a traditional UK home and compares this with best practice use in a water-efficient home.

Undoubtedly lower water consumption will only come about with some intervention; otherwise our water use would already be more comparable with the likes of Berlin?

Table 2 Individual domestic water use

	Current volume (litres)	Frequency / day	Total use (l/day)	Best practice volumes (l)	Total best practice use (l/day)
WC	6.5	4.1	27	4.5	19
Bath	80	0.3	27	70	24
Shower	45	0.6	27	30	18
Washing machine	60	0.2	9	45	7
Dishwasher	20	0.8	16	18	14
Wash hand basin	6	2.0	12	3	6
Kitchen tap	10	1.5	15	5	7
Garden watering and other miscellaneous uses			15		10
Total per capita consumption			149		105
% water saving					29%

This table needs some explanation – about the assumptions eg shower time/flow rate and how best practice target uses going to be achieved?

Case Study - Toronto's Water Efficiency Plan:

Faced with a rapidly growing population, Toronto reviewed its alternatives to a \$220 million capital works expansion of the water and wastewater treatment infrastructure. The research resulted in the development of the city's Water Efficiency Plan, which recommended the following water efficiency measures:

- an ultra-low flush toilet replacement programme
- a clothes washer replacement programme
- indoor and outdoor water audits
- watering restrictions and computer controlled irrigation systems
- system leak detection.

As part of the various efficiency initiatives rebates are offered to residents and businesses to help the City achieve its water consumption targets. The Plan will cost about \$75 million and is expected to reduce peak day water demands by 12 per cent and reduce wastewater flows by 13 per cent by 2011.

Could more be done in London ?

Before continuing, it is worth confronting the scepticism that water savings from conservation programmes are transient and therefore cannot be guaranteed in the future. This is largely down to poorly defining what constitutes an efficient technology. No, it is due to the poor evidence base available to determine the cost

effectiveness of water efficiency options, historically these have been carried out on a very small scale with poorly defined objectives and due to the difficulty in obtaining sufficient resources have failed to provide statistically robust data to indicate savings, costs and the sustainability of the measures undertaken.

Water efficiency: the solution

This needs a proper framework to identify the issues:

Water efficient fittings and appliances

Consumer behaviour/habits

Regulations

Incentives

Water charging

Labelling water products

Question 8: How much reduction in water use per person can we realistically expect to achieve through water efficiency measures? Can these reductions be achieved through education and persuasion or do we need more stringent regulation? Should the Mayor seek the power to set more stringent regulations in London than in the rest of the country?

Protecting water quality

Every year an estimated 20 million cubic metres of untreated sewage is discharged into the river Thames through London's overloaded drainage system. Moreover

there are incidents of wastewater bypassing any treatment before it is returned to the watercourse, through the misconnection of domestic foul sewers. This section looks at the issue of foul water and the sewer system. Within this discussion sits the implicit relationship between quantity, quality and the environment.

Combined sewer overflow problem

While the combined storm water and sewer system can easily cope with London's wastewater, in moderate to heavy rainfall events storm water can overload the system. The excesses of this rainwater and wastewater mix are then discharged, untreated, into the river.

The combined sewers overflow on average once a week into the river Thames.

These discharges cause offensive conditions in the river and on the foreshore, result in an elevated health risk to river users, damage the ecology of the river and occasionally kill large numbers of fish.

In February 2005, the Thames Tideway Strategic Study concluded that a 35km storage-and-transfer tunnel is the preferred solution out of many options considered. The tunnel would run beneath the Thames from Hammersmith and convey the discharges from 36 combined sewer overflows for collection and treatment at the Crossness sewage works.

Wastewater systems

Wastewater is removed from homes and business to treatment plants via a network of pipes. The responsibility for maintaining and cleansing the sewerage network depends whether it is in public or private ownership. Public sewers are normally situated under public highways and usually owned and maintained by the sewerage undertaker which, in the case of London, is Thames Water.

Any pipe that drains a single property or a number of properties or buildings within the same curtilage is defined as a drain and is private regardless of when it was built. When a pipe drains two or more properties in separate curtilages it is a sewer. Any sewer that is not vested in the sewerage undertaker is a private sewer. All drains and private sewers are owned and maintained by the owners of the properties which they serve, up to the connection of the public sewer, even if they are situated in land which is outside the curtilage of those properties.

On housing estates built after 1965, the whole network of drains and sewers will be in private ownership. These systems would then be in the joint responsibility of all the property owners and / or occupiers served by them. When major works are necessary and private sewers have to be re-laid or repaired, the cost is borne by the owners of the properties using the defective part of the sewer.

In the public highway, the gullies in the road are the responsibility of the London Borough Council. Whereas the public surface water sewer in the road is the

responsibility of the sewerage undertaker. In private roads, the road gullies and drains and the surface water drainage in private parking areas are the responsibility of the owner(s) and / or occupier(s). The responsibility extends up to the connection with the public surface water sewer.

London's drainage system is a single hydraulic entity and cannot be separated artificially along the lines of legal responsibility. In particular the causes of flooding can be difficult to assign to individual parts of the system without extensive, and often costly, investigations. There is a need for the rationalisation of the current system of drain ownership and supervision. For instance surface water sewers, culverts, watercourses and highway gullies (including connections to sewers) could all fall under the same ownership, although this may require legislative changes.

There is clear evidence that:

1. The monitoring of the whole of the drainage system is patchy and incomplete.

There is no adequate drainage map for the whole of London. Thames Water has a map of sewers conveying public sewers for which it is responsible, yet rightly this does not cover private, local authority or other drainage systems not maintained by Thames Water.

2. There is often an unwillingness to take responsibility for certain parts of the network

The consideration of development proposals on a case-by-case basis means that no-one stands back at any point to consider the cumulative impact on the sewer capacity.

3. Maintenance and repair of the system suffers as a consequence.

Many sewers are badly silted and found to have the following items that often give rise to blockages and can easily be avoided:

- Disposable nappies
- Cloth, rag or clothes
- Quantities of fat, for example from chip pans
- Incontinence pads
- Plastic toilet block holders.

Question 9: Is it right to call for an extensive interceptor tunnel to deal with the combined sewer overflow problems?

Question 10: Can the other wastewater problems discussed here be treated as routine infrastructure management problems or do they raise significant issues of policy? If yes, what are these policy issues?

Managing storm water

We start this section by looking at the proposed work relating to flooding in the Thames Estuary. This project creates the backdrop for the framework. Clearly a core feature of the framework is our ability to convey storm water away from our homes, while simultaneously making communities on the floodplain more sustainable.

Conveying storm water away from properties

When it rains, some of the storm water that falls in over London soaks into the ground while the rest flows into its combined sewer system. With more and more hard surfaces, such as rooftops and paved gardens, there are fewer places where rainwater can infiltrate the soil, nourish plants and remain part of the natural system.

While the importance of the 'built' water infrastructure is recognised, it alone will not meet all of our needs for managing wastewater and storm water. In fact, much of our drainage system was designed to cope with only high frequency, low severity flood conditions, such as might occur with a 5% annual probability. Growth in London's population combined with the effects of wetter winters will continue to exert pressure on London's ageing drainage system.

Managing storm water and protecting the quality of water will require a combination of upgrading our 'built' infrastructure and creating a 'green' infrastructure. Through this green infrastructure, London will demonstrate

forward-thinking ways to reduce the burden on its sewer system and keep storm water in the environment. Possible green technologies include:

- Green grid of open spaces.
- ‘Green’ design of buildings. Developers should incorporate green design and infrastructure into their site plans. This will reduce the amount of water draining to the sewer system by requiring, where practical, developers to implement best management practices to keep storm water on site.
- Rooftop gardens. Rooftop gardens are beneficial in dealing with storm water in two ways. First, they absorb and store water, thereby reducing the amount that flows to the sewer system. Second, many of the plants have filtering qualities that remove pollution from the water.
- Rain gardens and swales. Rain gardens facilitate the movement of water into the ground through natural drainage and by using native plants that store water in their roots.
- Downspout disconnect programme.
- Paving of front gardens for parking causing increased run-off.

Sustainable drainage schemes

Sustainable urban drainage systems and innovative land management techniques on agricultural land could do much to reduce run-off and the risk of flooding should be explored further.

- Attenuation through ponds and basin, some infiltration
- Hybrid between incumbent water company and local authority

- Water company unwilling to take all SUDS – understandable for surface features
- Local authority has difficulty in securing long-term funding – local authority offered to adopt SUDS with funding through management charge to be levied by developer
- Management company perceived as risky (possible way forward through community management body)
- New entrant water company (insufficient ‘business’ to balance against risk and resources mobilised)
- Environment Agency (configures as a regulator not as infrastructure manager)
- Local development framework core strategy: statements on importance of hydrological planning in delivering sustainable development
- Use of area action plans to secure benefits to areas which suffer flooding or other environmental inequalities
- Opportunity and need for SUDS to be planned within the context of new planning system
- Integrated management of urban drainage
- Integrated drainage management plan as supplementary planning document
- Funding, incentives and capacity building>

Living with the risk of flooded properties

A vast majority of buildings on the floodplain already exist in London. An important aspect of making communities on the floodplain more sustainable is making buildings more resilient to flooding. Incorporating resilience and resistance should ensure that properties recover more quickly than they would otherwise following a

flood event, helping to minimise time out of the building for occupiers, stress and health problems, and repair costs. Yet there is currently little incentive for property owners to make these buildings more resilient to flood risks.

Nevertheless resilience should not be a way to sidestep the necessary planning considerations. Resilience and resistance measures are just one of a number of tools in managing the risk of flooding, and their use may not be appropriate in all circumstances. As such, they will supplement, but not replace, land-use planning arrangements.

Question 11: Should the creation of paved surfaces around buildings be brought under control (under the Building Regulations or by an Article 4 Direction under the Planning Acts) in order to control run-off into the drainage system?

Adapting to climate change

Climate change is the biggest threat to our future. Already in the first years of this century, floods, storms and droughts have shown how vulnerable the UK is to the weather.

Climate change means that extreme weather events will become more frequent and more dangerous. By 2100 we can expect global temperature increases of 1.4 to 5.8°C. At the upper end of this range, changes are likely to be so extreme that it will be difficult to cope with them.

The UK Climate Impacts Programme scenarios indicate that:

- By the 2080s some areas in the southeast of England could warm by as much as 5°C
- Heavy winter rainfall events that occur every two years are expected to increase in intensity by up to 20 per cent
- By the 2080s the sea level in the Thames Estuary could rise by as much as 86 cm.

It is now clear that climate change has been triggered by increases in greenhouse gases, in particular those released from the use of fossil fuels. The carbon dioxide - the most common greenhouse gas - already released has determined the changes for the next 30 to 40 years. But beyond that there is a choice. The European Union has proposed that global temperature rises need to be limited to 2°C to avoid dangerous climate change. To achieve this, society must cut emissions of carbon

dioxide now. At the same time, resilience to current climate variability and extreme weather must be developed.

The most significant impacts of climate change include:

- The strain on water availability for people and ecosystems brought by longer, hotter, drier summers and development in areas where water resources are scarce
- An increase in flood risk caused by wetter winters, great storminess and sea level rise
- An increase in air and water pollution triggered by longer, hotter summers.

The average family of four in England uses 220,000 litres of water a year, which equates to:

- 120 kWh of energy to provide
- 100 kWh of energy to treat it as sewerage
- 200 kg of carbon dioxide.>

Inevitably such changes will have major consequences for the built environment, transport and utilities, as indeed they are beginning to have now. The risk from climate-related events such as flooding, droughts and heat-waves is likely to increase, posing important issues for planning, design and maintenance.

There is a pressing need for wider public understanding of the way that climate change may affect water use.

Paying for water

Actions invariably cost money. The water infrastructure in London is facing substantial investment requirements relative to historic levels, reflecting the need to replace ageing infrastructure, and meet demand for new capacity and environmental obligations. The section focuses on getting right national action on funding provision, fiscal policy and public-private sector funding arrangements.

Funding provision: water and sewerage services

Those who abstract water directly from the environment pay for the Environment Agency's costs of managing water resources. Charges for abstraction reflect volume, source, season, loss factor and location. Those who take water from public water supplies pay more to cover the costs of treating and transporting the water both to and from their property as well as water infrastructure investment requirements. Nevertheless to the user, the direct costs for water are relatively low.

These prices poorly reflect the scarcity of water in London in some years or at certain times of year. It would be possible to treat water like other commodities, making it more expensive when it is scarce and cheaper when plenty is available. As discussed in the section *Conserving water*, we should move towards more sustainable use of water; linking the cost of the amount used is an important step towards this goal. At the same time it is important that everyone is able to afford enough water to meet his or her basic needs.

Yet householders either pay for the volume of water used (referred to as a metered) or pay a fixed charge based on the old rateable value of the property (referred to as unmetered). In London, nearly four in every five households are unmetered.

Clearly universal metering could be implemented through a variety of different tariffs, each with different distributional implications. The impacts of metering on vulnerable and low-income groups could be alleviated through the Government's scheme which caps the bills of those identified as having high essential water use. The assistance was introduced as part of the Water Industry (Charges) Vulnerable Groups Regulations that came into force in April 2000.

The Joseph Rowntree Foundation carried out research into the distributional effects of eleven alternative tariff designs for household water consumption with three variables in mind: the average effect on low-income households; the effect on high-water-using low-income households; and the overall redistributive effect (i.e. the transfer from richer to poorer households). The research found that:

- All the metered tariffs investigated were better for low-income households than the present tariffs, on average helping those in the lowest-income group, some substantially.
- The use of water tends to vary widely within any given income group. All the tariffs made at least six per cent of the lowest-income households (those with the highest water use among these households) worse off by more than £1 per week. Where high water use is not essential, households could reduce their

charges by becoming more efficient in their water usage. Where it is essential, perhaps due to medical reasons, it should be possible to reduce the charges through a specially targeted policy.

- Though all the tariffs were redistributive to some extent, they varied considerably in the degree of redistribution brought about from richer to poorer.