GREATERLONDONAUTHORITY

Mayor of London's

Draft Water Strategy

Sustainability Appraisal Report

Part A: Sustainability Context

August 2009

Prepared for the Greater London Authority
by
Collingwood Environmental Planning
with Centre for Research into Environment and Health (CREH)

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ABBREVIATIONS

ABI	Association of British Insurers
AQMA	Air Quality Management Area
BAP	Biodiversity Action Plan
BAU	Business as usual
BAU+10	Future business as usual in 10 years time
BME	black and minority ethnic
BREEAM	BRE Environmental Assessment Method
CAMS	Catchment Abstraction Management Strategies
CEP	Collingwood Environmental Planning
CFMP	Catchment Flood Management Plan
CREH	Centre for Research into Environment and Health
CCAS	Climate Change Adaptation Strategy
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CSO	Combined sewer overflow
DCLG	Department for Communities and Local Government
Defra	Department for Environment Food and Rural Affairs
EA	Environment Agency
EqIA	Equalities Impact Assessment
EC	European Commission
EDS	Economic Development Strategy
EEC	European Economic Community
ENDS	Environmental Data Services
EU	European Union
FoE	Friends of the Earth
GLA	Greater London Authority
GOL	Government Office for London
GCSE	General Certificate of Secondary Education
GQA	General Quality Assessment
HIA	Health Impact Assessment
HSE	Health and Safety Executive
IIA	Integrated Impact Assessment
IPPR	Institute for Public Policy Research
km	Kilometre
LDA	London Development Agency
LHC	London Health Commission
LSDC	London Sustainable Development Commission
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
OECD	Organisation for Economic Co-Operation and Development
ODPM	Office of the Deputy Prime Minister
OFWAT	Office of Water Services
PM10	fine particulate matter
PPG	Planning Policy Guidance
PPS	Planning Policy Statement
RBD	River Basin District
RBMP	River Basin Management Plan
RICs	Royal Institution of Chartered Surveyors
SA	Sustainability Appraisal
SAC	Special Areas of Conservation
SEA	Strategic Environmental Assessment
SELL	Sustainable Economic Leakage Level
SFRA	Strategic Flood Risk Assessment
SPA	Special Protection Area
SPG	Supplementary Planning Guidance
SSSI	Sites of Special Scientific Interest
SUDS	Sustainable Drainage Systems
TfL	Transport for London
TTSG	Thames Tideway Strategy Group
UK	United Kingdom
WAF	Water Action Framework
WFD	Water Framework Directive
WHO	World Health Organisation
WRMU	Water Resources Management Units
WS	Water Strategy

HOW TO FIND YOUR WAY AROUND THE SUSTAINABILITY APPRAISAL REPORT

Summary of the Sustainability Appraisal and its findings — **Non-Technical Summary**

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- Background
- Appraisal Methodology
- Sustainability Policy Context, Baseline And Key Issues

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- Appraisal of the Draft Strategy
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- Summary of Consultees Comments on the Scoping Report
- Terms of Reference of Sustainability Appraisal Advisory Group
- Sustainability Appraisal Framework
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- Initial Sustainability Appraisal Commentary and GLA Responses (October 2006)
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- Appraisal of the Alternative Scenarios: Business as Usual and BAU plus 10 Years
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- Appraisal Matrices for the Policies Included in the Draft Strategy
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- Overall Appraisal of the Draft Water Strategy

HOW TO COMMENT ON THE SUSTAINABILITY APPRAISAL REPORT

Details on how to comment on the Sustainability Appraisal Report are provided below.

Public consultation on the draft Water Strategy and the Sustainability Appraisal Report runs from **28 August 2009** for **three months**.

All the comments must be received by **5pm on Friday 27 November 2009**.

Comments can be provided by:

Post: Draft London Water Strategy
Post point 19
City Hall
The Queens Walk
London
SE1 2AA

Email: water@london.gov.uk

Web: www.london.gov.uk/mayor/environment/water where copies of this SA Report and a Non-Technical Summary of the SA Report can be downloaded along with the Draft Water Strategy.

When you comment please include:

- Your full name
- Full postal address
- Your email address
- Where possible, the pages, section titles and paragraph numbers (and/or appendix numbers) of the Sustainability Appraisal Report your comments / concerns relate to; and
- Any suggested detailed amendments to the Sustainability Appraisal Report to reflect your comments / concerns and any amendments to the preferred options you think should be made as a result.

NON-TECHNICAL SUMMARY

[see separate volume]

PART A: SUSTAINABILITY CONTEXT

1. BACKGROUND

The Mayor's Draft Water Strategy

Background to the Strategy

1.1 The Strategy aims to promote improved water management in London and consider all aspects of water management and how they interact. It intends to complement the plans and strategies of other organisations, including the Government's Water Strategy for England, but also seeks to influence their future development.

1.2 The Strategy, whilst being led by the Mayor, has been prepared in consultation with the water industry and regulatory organisations and aims to complement the plans and strategies of these other organisations. Its purpose is to promote improved water management – both in terms of the water we want (such as drinking water) and the water we don't want (such as sewage and floodwater in the wrong place).

1.3 The Water Strategy is also intended to be an influencing document and its contents will be delivered by a partnership of organisations which includes the Greater London Authority (GLA), the London Boroughs, water companies and regulators.

Water Strategy Objectives

1.4 The draft Water Strategy has the following overall objectives[1]:

1. To use the water London already has more effectively and efficiently
2. To minimise the release of untreated wastewater and diffuse pollution into the water environment
3. To reduce the threat to people and their property, businesses and essential infrastructure from sewer, groundwater and surface water flooding and to mitigate its effects

Water Strategy Programme

1.5 The key stages in the development of the Strategy are detailed below:

- **Start** of drafting the Water Strategy[2] – spring 2006[3]
- **Evolving drafts** of the initial Water Strategy – July to September 2006
- **Developing the draft Water Strategy** for consultation with the London Assembly and functional bodies – March 2007
- **Consultation with the London Assembly and functional bodies** - March to July 2007
- **Revised draft Water Strategy** which was the subject of an initial draft SA Report – December 2007
- **Further revisions to the draft Water Strategy** for public consultation – during 2008 and 2009
- **Finalising the draft Water Strategy for public consultation** – May to August 2009
- **Public consultation the draft Water Strategy** - August to November 2009
- **Launch of the Mayor's Water Strategy** – to be determined, likely to be 2010

[1] From draft Water Strategy for public consultation August 2009
[2] Note the Water Strategy was previously referred to as the Water Action Framework (WAF)
[3] The GLA initially called for tenders for the Sustainability Appraisal of the WAF (now Water Strategy) in June 2006

Outline of Contents of the Draft Water Strategy

1.6 The main sections of the draft Water Strategy are set out below:

- Introduction (section 1)
- Pressure on water resources (section 2)
- Managing water use (section 3)
- Managing rainwater (section 4)
- Disposal of wastewater in London (section 5)
- Paying for water services (section 6)

1.7 Chapters 2, 3, 4 and 5 of the draft Strategy focus on particular water management themes for London: water resources, drainage and wastewater disposal. A **policy** for each of these themes is included at the beginning of Chapters 3, 4 and 5 (see Table 1). In some cases the items in the policies are not mutually exclusive and in others they are hierarchical. Chapters 2, 3, 4 and 5 also contain a series of **proposals**, twelve in total, which should support the achievement the objectives and policies for water in London (see Table 2). The text in each of the chapters also contains details of what the Mayor expects in relation to water management in London.

Table 1: Policies included in the draft Water Strategy

Policy 1: Water use in London
The Mayor believes that we should apply the following hierarchy for managing water supply and demand in London: 1=. Reduce the loss of water through better leakage management 1=. Improve the efficiency of water use in residential, commercial and public buildings 3. Use reclaimed water for non-potable uses (rainwater harvesting and grey water recycling) 4. Develop, as necessary, those water resources that have the least climate change and environmental impact.
Policy 2: Drainage in London
The Mayor proposes the following hierarchy for the drainage of rainwater: 1. Store rainwater for use later 2. Use porous surfaces to let rainwater to soak into the ground where soil conditions allow 3. Slow the runoff by directing rainwater into ponds or open water features for gradual release to a watercourse 4. Slow the runoff by directing rainwater into tanks or sealed water features for gradual release to a watercourse 5. Discharge rainwater direct to a watercourse 6. Discharge rainwater to a surface water drain 7. Discharge rainwater to the combined sewer, as a last resort.
Policy 3: Disposal of wastewater in London
The Mayor proposes the following hierarchy for the disposal of wastewater: 1. Discharge wastewater to a foul sewer 2. Discharge wastewater to the combined sewer, as a last resort. This is the ideal hierarchy but it is recognised in many areas there is limited choice

Table 2: Proposals in the draft Water Strategy

Pressure on water resources
1. The Mayor will work with the water companies, the Environment Agency and other partners in seeking the effective management of London's existing and future water resources to meet the needs of the growing population whilst protecting the natural environment.
Managing water use
2. Thames Water should, through its Water Resources Management Plan, aim to achieve the best UK industry standard for leakage by 2035, in order to bring London in line with the best standards of world cities.
3. The Mayor will work with water companies and other partners to support the rapid introduction of water metering throughout London. The Mayor considers that all houses in London should have meters installed by 2015, and all blocks of flats by 2020. All new flats in London should have an individually metered water supply. Tariff arrangements should encourage the efficient use of water but protect vulnerable and low-income households.
4. The Mayor believes that, where possible, all new homes should meet the highest level of the Code for Sustainable Homes for water consumption.
5. The Mayor has announced a commitment to improve the energy efficiency of London homes. This strategy highlights the need for existing homes to become more water efficient. Improving energy and water efficiency at the same time is both sensible and the least cost way of helping Londoners to control their energy and water bills as well as to reduce their greenhouse gas emissions
6. The Mayor will work with the water companies, the Environment Agency, and other partners in joint programmes to raise awareness of the benefits of water efficiency, including the possible savings that they can achieve through their water and energy bills.
7. The Mayor will work with the water companies and other partners to raise awareness of the high quality of London's tap water, the contribution of bottled water to climate change, and the benefits of drinking water to health and well-being. He will also encourage restaurants, bars and hotels across London to serve tap water to customers.
Managing rainwater
8. The Mayor will encourage green roofs, rainwater harvesting, grey water recycling and sustainable drainage through planning policies in his new London Plan.
9. The Mayor will work with partners through the Drain London Forum to create a strategic-level surface water management plan for London by 2012. This plan will assist Boroughs in producing their Surface Water Management Plans, will prioritise strategic actions and enable a regional submission for government funding to manage surface water flood risks in London.
Disposal of wastewater in London
10. The Mayor will work with Thames Water and other partners to support the construction of the Thames and Lee Tunnels, in a cost-effective way and minimising disruption, as a means of greatly reducing storm discharges from the combined sewer system and improving the quality of the water in the River Thames.
11. The Royal Institution of Chartered Surveyors should consider including a survey of sewer misconnections as part of the surveys at the time of sale of a property.
12. The Mayor will work with Thames Water and other partners to identify ways in which the management of sewage can provide renewable energy and reduce emissions of greenhouse gases. The Mayor encourages Thames Water and other partners to identify opportunities to use new technologies to contribute towards the Mayor's targets for decentralised energy, particularly through the production of biogas, and greenhouse gas emissions reduction.
Paying for water services
No proposals

The Sustainability Appraisal and the Sustainability Appraisal Report

Sustainability Appraisal of the Draft Water Strategy

1.8 The Greater London Authority (GLA) commissioned Collingwood Environmental Planning (CEP), in association with Centre for Research into Environment and Health (CREH), in August 2006 to undertake the Sustainability Appraisal (SA) of the Mayor's draft Water Strategy.

1.9 At the same time CEP was also commissioned by the GLA to undertake the SA of the Mayor's Climate Change Adaptation Strategy which is being developed simultaneously, with the Water Strategy. As there has been a degree of overlap with the programmes, whilst being separate SAs, some efficiencies have been realised by combining meetings and other tasks as appropriate during the appraisals. This is also discussed in the methodology section below.

1.10 The first stage of the SA, the scoping stage, (see methodology in Section 2) was undertaken in-house by the GLA. A Scoping Report was produced in June 2006 and consulted upon for five weeks. The subsequent steps of the SA of the draft Water Strategy have been undertaken by CEP independently of the GLA, whilst working closely with them.

1.11 The overall purpose of the SA is to ensure that sustainability considerations are fully taken into account as part of developing the Strategy. The SA considers the implications of the draft Water Strategy, from a social, economic and environmental perspective, by assessing alternatives and the draft Strategy against available baseline data and sustainability objectives.

1.12 When the GLA commissioned this work in 2006 the GLA required that the Water Strategy be assessed using SA, incorporating Strategic Environmental Assessment (SEA) and Health Impact Assessment (HIA). In part due to the passing into law of the GLA Act in 2007, which required the GLA to consider effects on a broader range of issues (including community safety, health inequalities etc.) strategies developed by the GLA since 2007 have tended to be subject to Integrated Impact Assessment (IIA), including Equalities Impact Assessment and Community Safety as well as SA, SEA and HIA. As the appraisal of the Water Strategy pre-dated this more integrated approach, it is being completed as originally proposed using SA (incorporating SEA and HIA) with an Equalities Impact Assessment being completed separately by the GLA.

1.13 The approach adopted for the SA followed the Department for Communities and Local Government's (DCLG)[4] SA guidance[5] which integrates the requirements of the SEA Directive[6] and Regulations[7]. The Water Strategy is a non-statutory strategy but the approach to the appraisal incorporates the requirements of the SEA Directive and Regulations as part of good practice.

1.14 The SA approach was adapted where necessary to meet the GLA's requirements and programme and to reflect the differences between the Water Strategy and spatial planning documents. The SA also integrates health and equality of opportunity and in particular addresses the following issues:

- health and equality determinants and effects;

[4] Formerly the Office of the Deputy Prime Minister (ODPM)
[5] ODPM (2005) *Sustainability Appraisal of Regional Spatial Strategies and Local Development Documents* and ODPM et al (2005) *A Practical Guide to the Strategic Environmental Assessment Directive*
[6] European Directive 2001/42/EC
[7] Environmental Assessment of Plans and Programmes Regulations 2004 No. 1633

- positive and negative health and equality effects;
- effects on particularly vulnerable groups; and
- the implications for the attainment of national and international goals.

1.15 The approach to the SA is described in more detail in Section 2.

Purpose and Scope of the Sustainability Appraisal Report

1.16 The purpose of the Sustainability Appraisal Report is to set out the findings of the SA process and set out the proposed next steps. It provides information on draft Strategy sustainability implications for stakeholders and consultees responding to the consultation.

1.17 The purpose of the SA Report is also to ensure compliance with the requirements of different forms of appraisal (SA, SEA and HIA) which include the requirement for a report to be prepared. Furthermore, the SA Report incorporates the requirements for an Environmental Report under the SEA Regulations (see Table 3 below).

1.18 The SA Report sets out an assessment of:

- the relationship of the draft Strategy to other relevant policies, plans, programmes and strategies;
- the relevant sustainability objectives established at the national, regional or local level;
- the current sustainability baseline and likely evolution thereof (i.e. the evidence used as part of the assessment);
- the characteristics of the area which are most likely to be affected by the draft Strategy;
- the key sustainability issues for London relating the Water Strategy and its potential areas of impact;
- the compatibility of the draft Strategy objectives and sustainability objectives;
- the potential effects of different draft Strategy alternatives to deliver its objectives;
- the potential effects of the draft Strategy, including potential health effects;
- the measures to mitigate adverse effects and maximise beneficial effects of the draft Strategy; and
- measures to monitor the significant effects of implementing the Strategy.

Structure and content of the Sustainability Appraisal Report

1.19 See the diagram at the beginning of this document on "*How to Find Your Way Around the Sustainability Appraisal Report*" for a summary of the contents. Part A of the SA Report provides the sustainability context and the evidence base for the appraisal. Part B details the appraisal of draft Strategy.

1.20 This SA Report is made up of four main parts:

- **A Non-Technical Summary**, which sets out in relatively simple language and in a précis form, the key findings and recommendations of the Sustainability Appraisal, and is available as a stand-alone document.
- **Sustainability Context (Part A of the SA Report, Sections 1 to 3)**, which provides background information relevant to the appraisal, such as baseline data, key sustainability issues and the policy context for the draft Water Strategy. This part/section also sets out the methodology and other issues.
- **Sustainability Appraisal of the draft Water Strategy (Part B of the SA Report, Sections 4 to 7)**, which presents the evolution of the baseline without the strategy and the findings of the appraisal of the draft Strategy, including the policies and proposals it

contains. This includes details of mitigation and enhancement and recommendations for monitoring.

- **Appendices**, which provide detailed information and supporting documents relevant to the report. This ensures that important information and messages are as accessible as possible, while providing detailed evidence and background for all assertions and comments made.

1.21 As outlined in Table 5 below close liaison took place throughout the SA process with GLA officers, including frequent telephone and email communication as well as formal and informal meetings in City Hall and at CEP's offices. This SA Report is the final output from this process.

Compliance with the SEA Directive and Regulations

1.22 This Sustainability Appraisal Report incorporates the requirements for an Environmental Report under the Environmental Assessment of Plans and Programmes Regulations 2004 No. 1633 which implements the requirements of the European Directive 2001/42/EC, known as the SEA Directive. The place or places in the Sustainability Appraisal Report where the components which are required in relation to the Environmental Report, in particular under Regulation 12 and Schedule 2, are sign-posted in the table below. This approach to meeting the requirements for an Environmental Report is recommended in Government guidance on Sustainability Appraisal[8].

Compliance with Health Impact Assessment Requirements

1.23 The Mayor of London is committed to undertake a health impact assessment (HIA) on all his strategies. As noted in paragraph 1.12, the GLA required that the draft Water Strategy be assessed using Sustainability Appraisal incorporating Strategic Environmental Assessment (SEA) and Health Impact Assessment (HIA) within a single appraisal.

1.24 In order to ensure that health was fully integrated in this appraisal, a health specialist[9] was involved in all stages of the SA (see section on methodology below). Additionally, a member of the London Health Commission's Urban Development and Regeneration Forum[10] sat on SA Advisory Group (see methodology section) and was involved in the SA process.

1.25 In 2005 – 2006 the London Health Commission's Urban Development and Regeneration Forum undertook an integrated impact assessment (IIA) of the Sub Regional Development Frameworks in London. This pilot project integrated health impact assessment into the statutory process of Sustainability Assessment and Strategic Environmental Assessment. This integrated approach was adopted for the SA of the draft Water Strategy. In addition, the appraisal follows the principles for integrating health in SEA set out in the draft Department of Health SEA guidance[11].

1.26 The appraisal also benefited from the findings of a wider health stakeholder workshop that took place in London in March 2007. The aims of this workshop are included in Section 2 and a separate report on the workshop is available from the GLA.

[8] ODPM (2005) *Sustainability Appraisal of Regional Spatial Strategies and Local Development Documents* and ODPM et al (2005) *A Practical Guide to the Strategic Environmental Assessment Directive*
[9] Professor Ian Matthews from the Centre for Research into Environment and Health (CREH), University of Cardiff
[10] The London Health Commission (LHC) was set up by the Mayor in October 2000 with the specific aims of reducing health inequalities and improving the health and well being of all Londoners
[11] DoH (2007) Draft Guidance on Health in Strategic Environmental Assessment, Draft for consultation

Table 3: Components that make up the Environmental Report

Information to be included in an Environmental Report under the SEA Regulations (Regulation 12 and Schedule 2)	**Relevant sections in the Sustainability Appraisal Report**
An outline of the contents, main objectives of the plan, and its relationship with other relevant plans and programmes;	Section 1 (para. 1.1-1.7), Section 3 and Appendix 6
The relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan;	Section 3, Section 4 and Appendix 9
The environmental characteristics of areas likely to be significantly affected;	Section 3
Any existing environmental problems which are relevant to the plan including, in particular, those relating to any areas of particular environmental importance, such as areas designated pursuant to Directives 79/409/EEC and 92/43/EEC;	Section 3 (including boxes 3, 5, 7, 9 and 11), Section 4 and Appendix 9
The environmental protection objectives, established at international, Community or Member State level, which are relevant to the plan and the way those objectives and any environmental considerations have been taken into account during its preparation;	Section 3, Section 4 and Appendix 6
The likely significant effects on the environment, including short, medium and long-term effects, permanent and temporary effects, positive and negative effects, and secondary, cumulative and synergistic effects, on issues such as: biodiversity; population; human health; fauna; flora; soil; water; air; climatic factors; material assets; cultural heritage including architectural and archaeological heritage; landscape; the interrelationship between the above factors;	Section 5, Section 6 and Appendices 10, 11, 12 and 13
The measures envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment caused by implementing the plan;	Section 5, Section 6 and Appendices 10, 11, 12 and 13
An outline of the reasons for selecting the alternatives dealt with, and a description of how the assessment was undertaken including any difficulties (such as technical deficiencies or lack of know-how) encountered in compiling the required information;	Section 2, Section 5 and Section 6
A description of measures envisaged concerning monitoring in accordance with Regulation 17;	Section 7
A non-technical summary of the information provided under paragraphs 1 to 9.	In a separate volume

Compliance with Equality Impact Assessment Requirements

1.27 The Mayor also requires that the impacts of any of his Strategies on equality of opportunity are taken into account through an Equalities Impact Assessment (EqIA). In this case the EqIA is being undertaken in-house by the GLA.

1.28 The GLA is committed to improving the lives of the people in London and one way it can achieve this is through its commitment to being an equality and diversity champion and leader. It uses EqIAs as a tool to help to integrate achieving positive outcomes for the people of London into its strategies, policies, services and major projects. EqIAs provide a framework for assessing whether what they do, or intend to do, has, or will, have a negative or positive impact on equality target groups and meeting their needs. EqIAs help the GLA meet its legal requirements under the Greater London Authority Act 1999 and other legislation such as Race Relations Act 1976 (statutory duties) Order 2001 and both amendments to the Disability Discrimination Act and the Equality Act.

1.29 The GLA, and the other organisations in the GLA group, have specified Equality Target Groups as: women; Asian or Asian British; Black or Black British; people of mixed race; Irish people; Chinese and other minority ethnic communities; disabled people; older people (60+); children and young people (0 – 17); young adults (18 – 25); lesbians, gay men and bisexual people; trans people; and, faith groups.

1.30 The GLA's EqIA process includes all the specified equality target groups.

1.31 In the case of the Water Strategy the GLA will undertake and publish the results of an EqIA separately to the Sustainability Appraisal. However as part of the SA, the target groups above have been considered as far as possible within the appraisal of effects, to consider whether they will be differentially affected by the implications identified.

Consultation on the Sustainability Appraisal Report

1.32 Consultation on this SA Report is being undertaken alongside consultation on the draft Water Strategy. Comments on this SA Report have been invited from the three consultation bodies[12] required by the SEA Regulations together with other key consultees representing sustainability interests in London, including non-governmental organisations, and the general public.

[12] Note that English Nature and the Countryside Agency were merged in October 2006 to create Natural England

2. THE APPRAISAL METHODOLOGY

Overview of approach adopted

2.1 The Government's guidance on SA for Regional Spatial Strategies and Local Development Documents advocates a five stage process to undertaking SA, with each stage divided into a number of tasks. The approach adopted for the SA of the draft Water Strategy broadly followed these stages and tasks (see Table 4). However the approach was adapted where necessary to meet the GLA's requirements and programme. For instance, an intermediate stage was introduced which consisted of a preliminary appraisal of an early version of the draft Strategy and the production of an initial SA commentary in October 2006. This output provided the GLA with some initial comments on the strengths and weaknesses of the proposals and policies included in the emerging draft Strategy.

2.2 The Scoping Stage (stage A) of the SA was undertaken in-house by the GLA and resulted in the production of a Scoping Report in June 2006 which was consulted on over a five week period (note at this stage the Water Strategy was being referred to as the Water Action framework, but its name was subsequently changed). Stage B of the SA process started in August 2006 and was on-going through to stage C until the draft Water Strategy was published for consultation with the London Assembly and functional bodies between March and July 2007.

2.3 Following this consultation, a revised draft strategy was produced in October 2007 and a draft of the SA report prepared. The original intension was to respond to comments and prepare a final draft Water Strategy, and final SA Report, for public consultation in early 2008. However, with the London Mayoral elections taking place in May 2008 and the need to allow three months for consultation, it would not have been appropriate to have concluded the consultation and publication of the final draft Strategy during the pre-election period.

2.4 Following the election and change in administration, there were inevitable further delays while a new Environment Advisor was appointed and for the draft Water Strategy to be reviewed and revised in light of the new administration's priorities, as well as other external policy developments. The final draft Strategy for public consultation was therefore delayed and not published, along with this SA Report, until August 2009.

2.5 Stage D of the SA process, "Consultation and post adoption", includes the period of public consultation on the draft Strategy and SA Report, and subsequent amendments to the SA and SA Report as necessary following any significant changes to the Strategy, the review of comments and the preparation of Post Adoption Statement. Stages D and E (see Table 4) will be undertaken in the future after the draft Strategy and SA Report have been consulted upon.

2.6 The SA of the Mayor's draft Water Strategy has been undertaken alongside the SA of the Mayor's Climate Change Adaptation Strategy (CCAS). This approach was adopted because the GLA identified some overlaps between the Strategies and therefore some synergies in the SA process. The Health Stakeholder Workshop in March 2007, for example, covered aspects of the appraisal of both strategies.

Table 4: SA Stages and Tasks

Stage A: Setting the context and objectives, establishing the baseline and deciding on the scope
Task A1: Identifying other relevant policies, plans, programmes and sustainability objectives. **Task A2**: Collecting baseline information. **Task A3**: Identifying sustainability issues and problems. **Task A4**: Developing the SA framework. ***Output 1: SA Scoping Report*** **Task A5**: Consulting on the scope of the SA.
Stage B: Developing and refining options and assessing effects
Preliminary SA tasks • Analysis of consultees responses to SA Scoping Report • Revision of SA method and framework, including Sustainability Objectives and Criteria • Initial review of the strengths and weaknesses of the draft Strategy • Prepare SA commentary ***Output 2: SA Commentary on the draft Strategy*** **Task B1**: Test the compatibility of the draft Strategy and SA objectives **Task B2**: Review (develop) the Strategy options **Tasks B3 and B4**: Predict and evaluate the effects of the draft Strategy, including options, which included • Advisory group meetings • Workshop with key health stakeholders ***Output 3: Health Stakeholder Workshop report***[13] ***Output 4: Draft appraisal of the draft Strategy and the key options (pilot appraisal of original 'hierarchies')*** **Task B5**: Develop mitigation measures **Task B6**: Develop the proposed monitoring measures
Stage C: Preparation of the SA Report
Task C1: Prepare draft and final SA Report (with involvement of Advisory Group) ***Output 5: Draft SA Report on the draft Strategy of December 2007*** ***Output 6: SA Commentary on the revised draft Strategy of May 2009*** ***Output 7: Final SA Report*** *[this report]*
Stage D: Consultation and post adoption
Task D1: Consultation on the draft Strategy and SA Report (this report) Task D2: Appraisal of any significant changes to the Strategy and preparation of revised / addendum to SA Report Task D3: Preparation of Post Adoption Statement ***Future output 7: Revised / Addendum to SA Report (if necessary)*** ***Future output: SA Post Adoption Statement***
Stage E: Monitoring and review
Once the Water Strategy is adopted and launched by the Mayor, there will need to be ongoing monitoring of the sustainability implications of its implementation. This should include the periodic reporting as part of the monitoring process. The results of monitoring should be considered as part of future reviews of the Water Strategy. ***Future outputs: periodic monitoring reports***

[13] Combined workshop for both the Climate Change Adaptation and the Water Strategies

Programme and responsibility

2.7 Table 5 sets out the tasks and outputs of the SA processes for the draft Water Strategy to date, with a timetable showing when these tasks were undertaken. Table 5 also identifies the key SA outputs and provides details of the consultation and engagement processes undertaken, which formed a fundamental part of the SA. Further details on the preparation of the key SA outputs is provided in the subsequent sections.

2.8 A Scoping Report was issued in June 2006 for a five week consultation period. Stages B and C of the SA of the draft Water Strategy were undertaken by CEP independently of the GLA, whilst working closely with them.

2.9 Comments were received following the London Assembly and functional bodies' consultation on a draft Strategy (March-July 2007). In late 2007 a revised Strategy (following receipt of comments) was provided by the GLA to CEP and the SA undertaken accordingly. Originally, the intension was to publish the draft Water Strategy in early 2008, but as noted above, due to the Mayoral elections and a change in administration this was delayed until 2009.

2.10 In July 2009 CEP received a revised version of the draft Water Strategy and updated the SA accordingly with the final draft Strategy for public consultation received in early August 2009. The final draft Water Strategy, and the accompanying SA Report, were made available for public consultation on 13 August 2009.

Table 5: SA programme - key tasks, events and outputs

Date	Tasks, events and key outputs
Stage A: Setting the context and objectives, establishing the baseline and deciding on the scope	
Spring 2006	Preparation of SA Scoping Report
12 June - 14 July 2006	Consultation on Scoping Report
23 June 2006	Scoping Workshop (joint with Climate Change Adaptation Strategy)
Preliminary appraisal of the draft Strategy	
16 August 2006	GLA/CEP Inception Meeting
5 October 2006	Initial SA commentary on the draft Water Strategy
7 November 2006	Progress meeting to discuss SA commentary
Stage B: Developing and refining options and assessing effects	
4 December 2006	Draft pilot appraisal (water supply hierarchy) sent to SA Advisory Group
6 December 2006	SA Advisory Group meeting
9 January 2007	Internal team meeting to discuss health issues
16 January 2007	SA Advisory Group meeting
9 March 2007	Workshop with health stakeholders
5 April 2007	Draft health workshop report sent to participants
March – July 2007	Assembly and functional bodies consultation on draft Water Strategy; Roll out of pilot appraisal to the remaining Water Strategy preferred sets of management options
Stage C: Preparation of the SA Report	
22 August 2007	Progress meeting with GLA officials to discuss changes to the draft Water Strategy resulting from Assembly consultation and to update on timings
3 September 2007	Revised draft Water Strategy received by CEP
11 December 2007	Draft of the SA Report sent to GLA and SA Advisory Group for comment
January 2008	Comments on the draft SA Report received from GLA and SA Advisory Group.
February 2008	CEP prepare draft SA Report of draft final Water Strategy

Date	Tasks, events and key outputs
11 May 2009	Revised draft Water Strategy received by CEP
19 May 2009	CEP meet GLA to discuss revised draft Water Strategy
May-June 2009	CEP prepare SA Commentary on the revised draft Water Strategy
22 July 2009	Near final draft of Water Strategy received by CEP
7 August 2009	Final draft of Water Strategy for public consultation received by CEP
11 August 2009	Draft of the SA Report sent to the GLA and SA Advisory Group for comment
28 August 2009	Final SA Report produced and start of public consultation on the draft Water Strategy and SA Report

Stakeholder involvement - who was involved, when and how?

2.11 Stakeholder involvement is a fundamental part of SA. It enables those potentially affected by, or with a professional or personal interest in, the sustainability effects of the strategy in question to engage with and input into the SA process.

2.12 Engagement and consultation during the Scoping Stage included:

- Formal consultation on the Scoping Report for five weeks in June – July 2006. A full list of those consulted at the scoping stage and a summary of comments received are included in Appendices 1 and 2. The GLA revised the Scoping Report in the light of the comments received.
- A scoping workshop held on 23 June 2006 with key statutory stakeholders, the London Health Commission and the London Sustainable Development Commission (LSDC) facilitated by Forum for the Future. The key objectives of this workshop were to:
  - Agree a common set of sustainability objectives and appraisal criteria;
  - Review the objectives, indicators, targets and evidence base to be used during the SAs of the Climate Change Adaptation Strategy and Water Strategy;
  - Review the significant environmental, economic, social and health issues for both strategies;
  - To give stakeholders an opportunity to shape the Scoping Report.

2.13 Engagement and consultation during stages B and C of the SA process up to the publication of the SA Report included:

- Meetings with GLA officers. Formal and informal meetings have been held throughout the SA process.
- The SA Advisory Group met twice during the process and were invited to the Health Stakeholder Workshop (see Table 3 above). The Advisory Group members were also asked to comment on the December 2007 and the August 2009 drafts of the SA Report, SA Report. The terms of reference of the advisory group have been included in Appendix 3.
- A Health Stakeholder Workshop was held in London on 9 March 2007. This workshop considered both the potential health effects of the Water Strategy and of the Mayor's draft Climate Change Adaptation Strategy. A workshop report has been produced as a separate output[14] (see separate report available from the GLA). Key objectives of the workshop were to:
  - Raise awareness among key health stakeholders about the Climate Change Adaptation and Water Strategies;

[14] *Sustainability Appraisals of the GLA's Climate Change Adaptation Strategy and Water Strategy: Write-up of the Health Stakeholder Event 9 March 2007*, Final Report September 2007 (CEP/CREH)

- Provide an opportunity for stakeholders and experts to consider the potential impacts of key aspects of the strategies on health determinants, health outcomes and health inequalities;
- Identify gaps in evidence and ways of addressing these gaps; and
- Provide some clear recommendations that will guide the SAs of the strategies.

- Formal consultation on this SA Report is being undertaken alongside that for the draft Water Strategy.

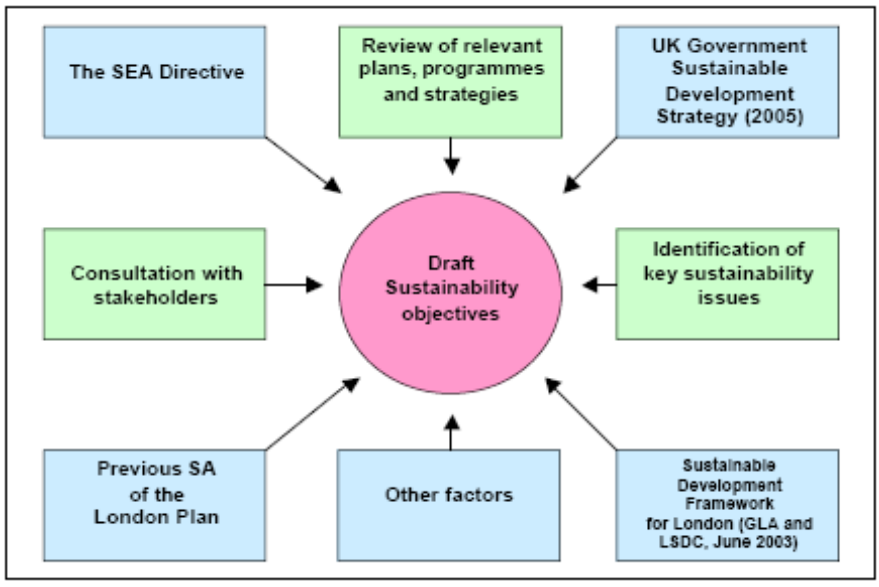
Sustainability Appraisal Framework

Sustainability objectives and criteria

2.14 The establishment of SA objectives and criteria provides a mechanism by which sustainability effects of a strategy or plan can be described, assessed and compared. The SA objectives were originally derived from a number of sources (see Figure 1) and a draft set were included in the SA Scoping Report (June 2006) under the four headings of the London Sustainable Development Framework which was used to help inform the sustainability priorities in London[15]:

- Taking responsibility
- Developing respect
- Managing resources
- Getting results

Figure 1: Sources of draft Sustainability Appraisal Objectives[16]



2.15 The SA objectives and criteria have been modified through the SA process to reflect the particular needs and issues identified as the draft Strategy evolved, consultees comments received on the Scoping Report, meetings held with the GLA and comments received from the SA Advisory Group. The final set of SA objectives for the SA of the draft Water Strategy

[15] London Sustainable Development Commission (2003) A Sustainable Development Framework for London, available: http://www.london.gov.uk/mayor/sustainable-development/susdevcomm_framework.jsp Accessed: 02/07/09
[16] From SA Scoping Report, June 2006

is included in Table 6. A full list, including the SA criteria under each SA objective, can be found in Appendix 4.

2.16 The final SA framework was made up of 17 SA Objectives. In order to simplify this framework and make this report more relevant to the SA of the draft Water Strategy, the SA objectives have been grouped into the following six topics for the description of the policy context and baseline data (see Table 6):

- People and health
- Place and quality of surroundings
- Climate change
- Water management
- Waste and resources
- Economy

Table 6: Sustainability Appraisal Objectives

People and health
1. Governance To deliver objectives transparently and effectively over the long-term, focussing on outcomes and informed by good evidence
2. Education and Awareness To maximise the education and awareness levels of the population in order to empower individuals to take responsibility
3. Health and Well Being To maximise the health and well being of the population and reduce inequalities in health
4. Equality and Diversity To ensure equitable outcomes for all communities and to celebrate the unique ethnic and cultural diversity of London's citizens as London's key strength
5. Safety and Security To have a place where everyone feels at ease and is able to enjoy life and to enhance community safety
Place
6. Liveability and Place To create and sustain liveable, mixed use physical and social environments that promote long-term social cohesion, sustainable lifestyles and a sense of place
7. Accessibility and Availability To maximise accessibility to key services and amenities and to increase the proportion of journeys made by public transport, walking and cycling
8. Landscape, Historic and Cultural Environment To enhance and protect the landscape and built and cultural environment, including buildings, townscape and the public realm
9. Biodiversity To conserve and enhance natural and semi-natural habitats and wildlife
10. Air Quality To improve both indoor and outdoor air quality
Climate Change
11. Climate Change 11i) To mitigate the causes of climate change 11ii) To adapt to the effects of climate change
Water management
12. Water Quality To improve the quality of surface waters and groundwater
13. Water Resources To improve the security of supply and to achieve the prudent management and efficient use of water resources
14. Drainage To promote sustainable urban drainage

15. Flood Risk To minimise the risk of flooding
Waste Management and Resource Use
16. Waste Management and Resource Use[17] To minimise the production of waste across all sectors in line with the waste hierarchy and minimise the use of non-renewable materials
Economy
17. Economy To develop the economy in ways which meets society's present and future needs

Appraisal of the Draft Water Strategy

Appraisal of alternatives

2.17 Given its strategic nature and the policy context, in particular the fact that the Mayor does not have powers in most issues concerning water management, the Water Strategy is largely limited to being an "influencing" document. As a result, the range and scope of alternatives that could be considered as part of the strategy development and the SA process were potentially limited. However, the SA has assessed strategic alternatives as well as specific alternatives in relation to policies.

2.18 From the strategic point of view the appraisal has considered the following alternatives:

- Business as usual (BAU) which represents the current status of water management and issues in London;
- Future business as usual in 10 years time (BAU+10) without a Water Strategy; and,
- The post-London Assembly consultation version of the draft Water Strategy (October 2007).

2.19 Considering the BAU scenario was particularly useful in assessing whether Mayor's Water Strategy is likely to make a significant difference to the sustainability of London. The October 2007 draft of the Strategy had a number of significant differences compared to the final draft and provided a realistic (and therefore reasonable) strategic alternative for comparison.

2.20 As part of the appraisal of alternatives, the SA also considered the sustainability effects of each of the policies (Table 1) individually and as part of a package of measures. This distinction was necessary as while some sets of policies are intended to operate in parallel, others are hierarchical and represent alternative policies. For example, some policies while in principle forming part of a hierarchy may only be a practical option in certain circumstances and areas, thus considering each set of policies as an overall set, and as individual policies was considered important.

Key steps in the appraisal of the draft Water Strategy

2.21 The SA of the draft Water Strategy was undertaken in a series of iterative steps shown in Figure 2.

Sustainability appraisal commentary on the draft Water Strategy

2.22 In the 2006 and 2007 versions of the draft Water Strategy, "*policies*" were referred to as "*preferred management options*". The content of the "*policies*" in the August 2009 draft are largely the same as were contained in the *"preferred management options"* of the 2006 and 2007 versions of the draft Water Strategy. An initial SA commentary was produced for the GLA in October 2006. The aim of the October 2006 output was to provide comments on the

[17] Note that this Sustainability Appraisal Objective does not include water resources, which is specifically covered by SA Objective 13.

sustainability issues, strengths and weaknesses raised by the proposals and policies contained in an early draft of the Water Strategy. The commentary was used by the GLA to review the draft Water Strategy and to prepare the draft version upon which the London Assembly and the functional bodies were consulted and to further develop and refine the proposals and policies.

Appraisal of the policies included in the draft Water Strategy

2.23 A 'pilot appraisal' of the policies for water supply was undertaken by CEP and discussed at the SA Advisory Group meeting on 6th December 2006. This pilot appraisal used 'causal chain' analysis in order to identify potential effects, key pathways and receptors of the policies included in that chapter (see section on Identification of effects and Figure 1 below). The sustainability context (policy, baseline and trends in Section 3) provided the evidence base for the causal chain analysis and the appraisal. The causal chains also benefited from the findings of the Health Stakeholder Workshop, comments from the SA Advisory Group and expert input.

2.24 The pilot appraisal was then rolled out to the other 'policies' in the London Assembly and functional bodies draft Strategy (March 2007): water use[18], rainwater drainage and wastewater disposal. As noted above, individual policies were considered as alternatives.

2.25 Key findings from this pilot appraisal were discussed at the 22 August 2007 meeting with GLA officials. Following this discussion, a revised draft Water Strategy was sent to CEP on the 3 September 2007. The draft SA Report was updated, and was sent to the GLA and SA Advisory Group for comment on the 11 December 2007. The original intention was for the final Water Strategy to be published for public consultation in early 2008, but this was delayed as discussed above. On the 22 July 2009 CEP received a revised near final draft of the Water Strategy. This revised draft, and the policies and proposals therein, was subsequently appraised. The detailed appraisal of the policies was recorded using appraisal matrices. The section below (starting at paragraph 2.38) provides an explanation on how the effects were evaluated against SA objectives and criteria.

2.26 The detailed findings of the appraisal of the policies are included in Section 5 (Part B of this report).

Appraisal of the proposals included in the draft Water Strategy

2.27 Each of the proposals included in the draft Strategy were appraised to identify potential positive and negative effects. Recommendations were made for potential changes or additions to mitigate for any negative effects or enhance any positive effects that were identified. The appraisal was undertaken by considering the likely effects of implementing each proposal against each of the SA objectives and criteria (see Appendix 4). A summary of the appraisal of each proposal was presented in a summary appraisal table and the results of the evaluation against each SA objective presented in a summary matrix combining all the proposals.

2.28 During the appraisal of the previous draft Water Strategy (December 2007) use was made of screening criteria in order to help the appraisal focus on the proposals which were likely to give rise to the most significant effects. This distinguished between proposals which were predominately enabling actions and in themselves were unlikely to have direct sustainability effects, for instance proposals that involve carrying out research, gathering data, setting up partnerships or developing plans, in contrast to those proposals that could have more direct

[18] Water supply and water use chapters were merged into one chapter, water resources, and one set of management options in the early 2008 draft Strategy.

effects by, for example, establish targets, objectives, etc for development or organisations to meet or achieve. These may reflect what is already included in other legislation, policies or strategies or more significantly have targets that go beyond what is required elsewhere. As a result of the screening, more detailed appraisal matrices were complete for five of the previous proposals, and these are included in Appendix 12. However, applying the same criteria to the proposals in the current draft Water Strategy (August 2009), only one proposal was considered likely to have more significant sustainability effects (proposal 3). As a result it was decided not to complete full appraisal matrices for the proposals in the latest draft Strategy, but to provide summary appraisal tables for all the proposals instead. This was considered to provide a proportionate level of appraisal for the proposals. Given the likelihood of significant effects identified by the screening, proposal 3 is considered in more detail than other proposals.

2.29 The findings of the appraisal of the proposals are described in detail in Section 5 of Part B of this report.

Overall appraisal of the draft Water Strategy

2.30 The overall appraisal of the draft Water Strategy brings together the appraisals of the proposals and the policies for water management and considers them in combination and in the context of the whole draft Strategy. An appraisal matrix records the results of the overall appraisal of the whole draft Water Strategy against the sustainability appraisal objectives. The matrix also includes a commentary on the potential effects and recommendations for mitigation and enhancement (see Section 5 in Part B)

2.31 In order to gauge if the draft Water Strategy will make a significant difference to current and future water management comparisons were made with the current situation or business as usual (BAU) and future situation in ten years or business as usual plus 10 years (BAU+10). More information on these scenarios is included in section 4. As noted above the BAU and future BAU+10 scenarios were considered as strategic alternatives to the final draft Strategy (August 2009), together with the previous draft Strategy (December 2007) (see Section 5, Part B):

- **Business as usual** (BAU) – the current situation of water management in London and key existing sustainability issues. This scenario was constructed using the baseline information and policy context presented in Section 3.
- **Future business as usual** (BAU+10) – the predicted future situation of water management and key sustainability issues in London in 10 years time. This timescale was chosen because it is also the duration of the draft Water Strategy. This scenario was constructed using trends and predictions identified in Section 3 to present an estimate of the future situation without the implementation of the draft Strategy.

2.32 The sustainability effects of the BAU and future scenarios without the draft Strategy were appraised and the results recorded in appraisal matrices (see Section 5 in Part B). The results of these appraisals were then used to compare the current and future situations with the policies and proposals included in the draft Strategy as well as the October 2007 draft of the Strategy which had a number of significant differences compared to the final draft. Section 6 (Part B) includes a commentary on the difference that the draft Strategy could make.

2.33 This approach to the appraisal enabled an iterative and co-operative approach both to the appraisal and to the development of the draft Water Strategy.

2.34 The different phases and outputs of the appraisal and the health workshop and other meetings have influenced the drafting of the Strategy. The key changes as a result of this influence have been included at the end of Section 6 in Part B.

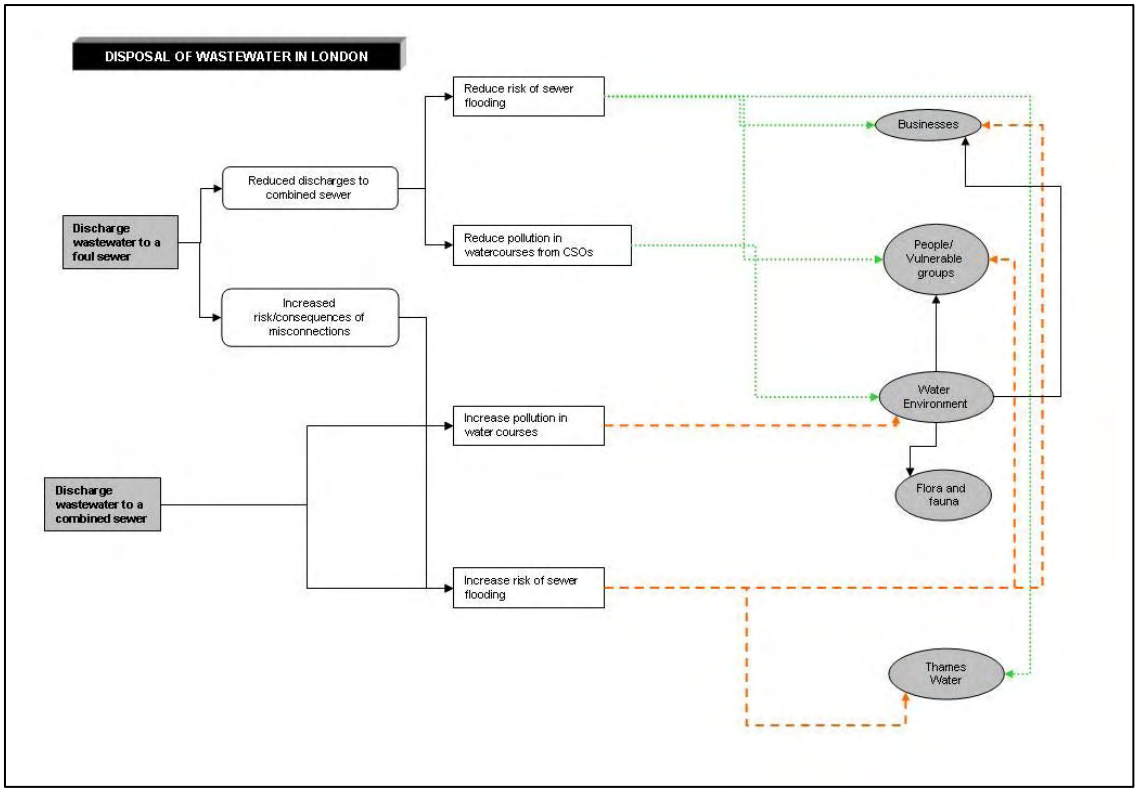
Identification of effects

2.35 In order to assist the process of identifying the effects that could arise from the policies in the draft Water Strategy, and which receptors could be affected, network or causal chain analysis was used as a mechanism for tracing the links and for identifying cause and effect pathways. This was considered to be particularly appropriate given the strategic nature of the Water Strategy and because all the potential effects of the policies are not immediately apparent. In addition, causal chain analysis can help the process of identifying potentially significant cumulative effects.

2.36 Figure 1 shows an example of a causal chain analysis diagram. The complete set of causal chains analysis diagrams can be found in Appendix 10. These are intended to be working illustrations to capture the potentially key pathways and receptors. Although they are not intended to be comprehensive, the causal chains have benefited from input from the SA Advisory Group and other stakeholders, e.g. at the Health Workshop, and other experts to ensure the key significant effects, receptors and the key relationships have been identified. The causal chain analysis also drew on the evidence and data collected for Section 3 (Sustainability Context).

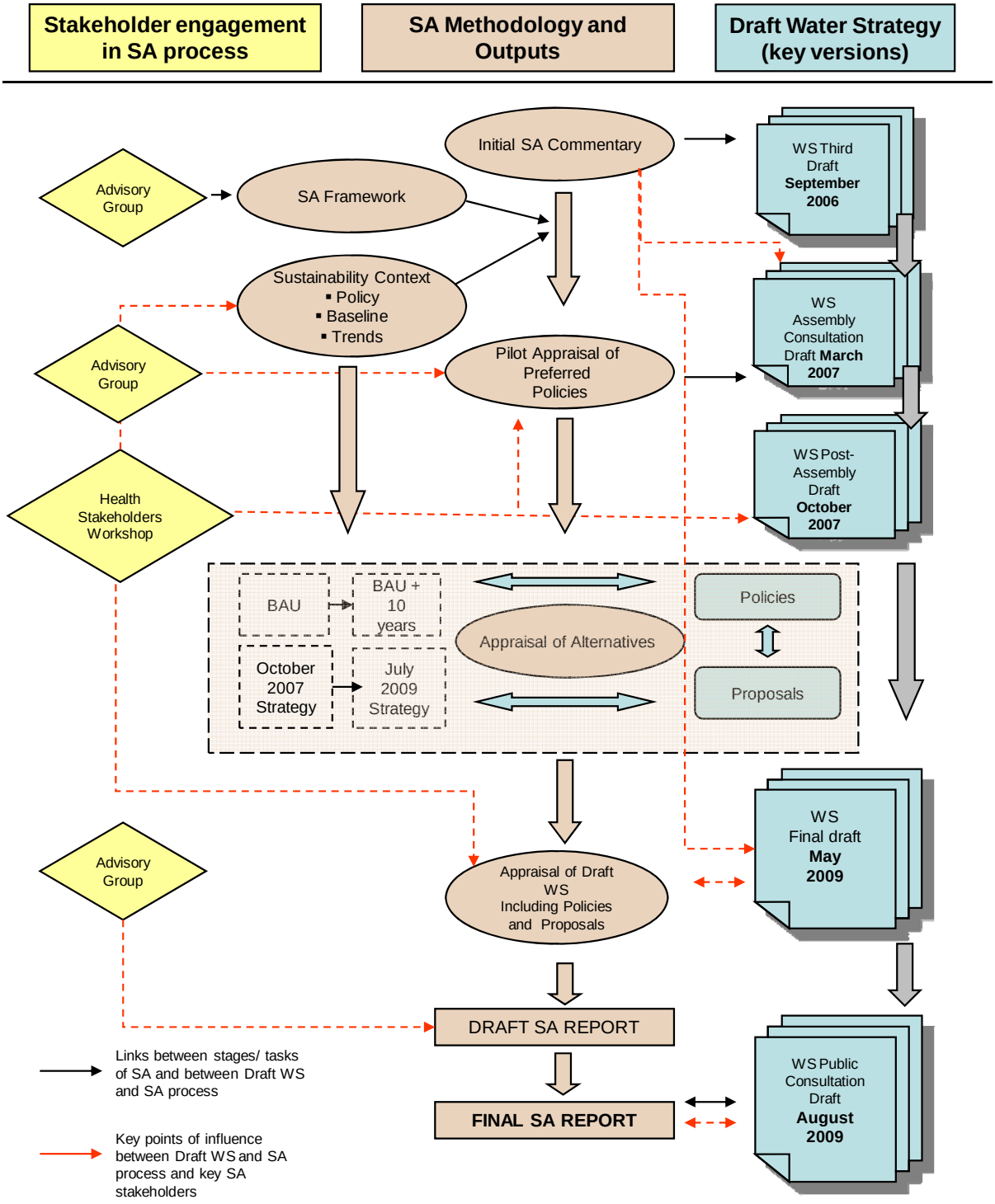
2.37 Note that only the effects that were considered to be the most significant are shown in the diagrams. In some instances where a likely effect is not considered to be significant, the causal chain was not followed through to subsequent effects / the relevant receptor(s).

Figure 1: Example of Causal Chain Analysis Diagram



Note: potentially positive effects are in green and negative effects in red

Figure 2: Diagram of the Sustainability Appraisal of the draft Water Strategy



Evaluation of effects

2.38 The potential effects of the proposals and policies included in the draft Water Strategy were initially identified by using causal chain analysis diagrams (included in Appendix 10). The causal chains analysis allowed the identification of potential effects, pathways and receptors. The effects identified were then appraised against the SA objectives and criteria (in Appendix 4). In order to assess the significance of the effects, a set of significance criteria tailored specifically to the SA of the draft Water Strategy was used (see Appendix 5).

2.39 The significance of the effects was rated against each SA objective and criteria using a qualitative 5-point scale: major positive (++), minor positive (+), neutral (0), minor negative (-) and major negative (--). The methodology also allowed uncertain (?) and mixed scores (e.g. +/-) to be used. The identification and evaluation of effects was informed by the baseline and evidence (see Section 3), the review of plans and policies (see Section 3 and Appendix 6), stakeholder engagement and expert judgement.

2.40 The prediction and evaluation of effects was recorded in matrices using the SA objectives and criteria with a scoring and commentary to describe the potential effects of a single preferred alternative or a series of alternatives for comparison. This has the advantage of allowing large amounts of information to be structured in a relatively clear and transparent way. The commentary seeks to explain how each of the scores has been arrived at, with for example reference to baseline data and criteria to explain significance.

2.41 CEP's approach to evaluating the significance of effects was agreed with the SA Advisory Group of 16 January 2007. The SA Scoping Report had originally proposed a different approach to assessing the significance of effects, but this was modified to tailor the scoring system better to the type of strategy being considered (see Appendix 5 for details).

Cumulative effects

2.42 There are different types of cumulative effects, but what was of principle concern as part of the SA of the Water Strategy was the total effects of multiple actions on a single 'receptor', which could be certain groups within the population or people living in a particular locality, the water environment or flora and fauna for example, as well as effects that may be cumulative over time. However, given the strategic level of the draft Water Strategy there was limited spatially differentiation that can be predicted between effects, in particularly, so inevitably the potential cumulative effects identified were relatively generic.

2.43 Certain impacts likely to arise from the draft Water Strategy could potentially be cumulative (e.g. impacts on the water environment, impacts on certain vulnerable groups etc). Some of the effects that have been identified by the appraisal (see Part B) could be cumulative in character. The use of the causal chain analysis in particular helped emphasise where several proposals and/or policies were predicted to impact upon the same sustainability objective and / or receptor. It was not possible to identify an exhaustive list of potential cumulative effects, as predicting the interactions and additive effect of policies is complex and uncertain, however the cumulative effects considered the most significant have been identified in Section 6 (Part B).

Mitigation and enhancement

2.44 Comments on the overall effects of the draft Strategy and recommendations for 'mitigation and enhancement' have been included in Section 6 (Part B). Recommendations to mitigate significant adverse effects and improve positive effects were identified.

2.45 The types of enhancement and mitigation identified take a wide range of forms, including:

- Changes to the wording of specific proposals or policies, e.g. to strengthen the requirements or to make them clearer.
- Implementing certain proposals or policies in tandem, e.g. metering of all properties should be accompanied by appropriate tariffs, leakage reduction and water efficiency should happen in parallel.
- Providing more detail on how a proposal, standard or policy will be implemented, in order to enhance the positive effects of the draft Water Strategy, many of which are positive but their significance uncertain, how the Strategy is implemented will be key.
- Having particular regards to vulnerable groups or other sensitive receptors, e.g. biodiversity.

Difficulties encountered in compiling information or carrying out the appraisal

Level of detail and scope

2.46 As a relatively strategic appraisal, the SA of the draft Water Strategy cannot be expected to provide a very detailed and quantified assessment of the sustainability effects of the strategy and the policies/proposals it contains. However, the SA has attempted to provide a largely qualitative assessment of the broad implications of the draft Water Strategy against the sustainability appraisal objectives and criteria and has sought to ensure that all the dimensions of sustainability were considered throughout the development of the draft Water Strategy. In turn, more detailed proposals and implementation plans will need to be subject to more detailed appraisal as appropriate.

2.47 At the strategic level, in particular, there are inevitable uncertainties associated with undertaking an appraisal of the sustainability implications of a water strategy. There are limitations, including data availability and the need to rely on qualitative as well as quantitative data and appraisal. The SA Report seeks to be transparent about any assumptions that have been made and clearly states the uncertainties associated with any predictions.

Baseline data

2.48 There were some gaps identified in the baseline information that ideally would have been collected to inform the appraisal. In some instances, only regional or national level data was available rather than data specifically relating to London. Lack of historical/trend data was another key issue as, in many cases, it was difficult to assess whether the situation is improving or worsening. Lack of trend data also makes predicting the future baseline more difficult.

Timescales

2.49 As described above, the draft Water Strategy was prepared over an extended period. There were several delays in the Water Strategy preparation process. This meant that the SA had to be undertaken intermittently over an extended period and it was not possible to undertake the SAs of the Water Strategy and Climate Change Adaptation Strategy as closely as originally planned. The baseline data and review of policies, plans and programmes also had to be updated several times as a result. There were several versions of the draft Strategy prepared for the SA to comment upon and therefore the appraisal had to be revised to reflect changes made to the proposals and supporting text.

3. SUSTAINABILITY POLICY CONTEXT, BASELINE AND KEY ISSUES

Introduction

3.1 This section presents background information relating to London's environmental, social and economic context relevant to the SA of the draft Water Strategy. It corresponds to Tasks A1 – A3 of the SA process (see Table 4) and provides background information and the evidence base to inform and assist the appraisal process.

3.2 The information has been structured into six broad topics, by grouping the 17 sustainability appraisal objectives (see Section 2), together with a section on cross-cutting issues. These topics were specifically selected for the purposes of the SA of the draft Water Strategy, as they provide a simplified structure for presenting the relevant contextual information. The information included in this section has been specifically selected to inform the appraisal of the potential sustainability effects of the draft Water Strategy and therefore some topics contain more information than others. Interactions between the topics are also considered.

3.3 The topics, and how they relate to the SA objectives, are set out in Box 1 below. The SA objectives correspond to those detailed in Table 6 of this report.

3.4 Each topic includes information on the:

- **Policy context, relevant baseline and key trends**:
  - key findings of a review of relevant policies, plans and programmes, see Table 7 and Appendix 6 for further detail;
  - key research and data related to the topic;
  - information on future trends, where available.
- **Sustainability problems and opportunities:**
  - drawing on the review of other policies, plans and programmes, and the baseline data, the key issues for the SA and the Water Strategy to consider. Including problems which the Water Strategy should seek to address and opportunities which the Water Strategy can encourage or take advantage of.
- **Evolution of the sustainability baseline in the absence of the Water Strategy**
  - an assessment of the likely future trends relating to each topic, based on reviewing the baseline information and existing trends, and the likely influence of existing external plans, strategies and processes.

Box 1: Coverage of SA objectives under topics within context section

1. People and Health
- Governance
- Education and Awareness
- Health and Well Being
- Equality and Diversity
- Safety and Security

2. Place
- Liveability and Place
- Accessibility and Availability
- Landscape, Historic and Cultural Environment
- Biodiversity
- Air Quality

3. Climate Change
- Climate Change

4. Water management
- Water Quality
- Water Resources
- Drainage
- Flood Risk

5. Waste and Resources
- Waste Management and Resource Use

6. Economy
- Economy

7. Cross-cutting

3.5 Table 7 below lists policies, strategies, plans and programmes documents which are relevant to the SA of the draft Water Strategy and were reviewed (see also Appendix 6). This sought to draw out:

- Areas where there is policy overlap between the Water Strategy and other plans or policies;
- Targets, guidelines and parameters set out in other relevant strategies and plans, particularly those at a higher level (e.g. UK Government or EU level);
- Key issues for the Water Strategy and the SA to consider.

3.6 The review focused on London level policies, strategies, plans and guidance, as well as those at a national level which are particularly relevant to the SA of the Water Strategy or are relatively recent and therefore may not yet be reflected in London level policies, strategies, plans and guidance. No European Directives or other international documents have been reviewed as any targets and legislation they contain should have already been included in National and London level plans and programmes.

3.7 This information and analysis was used to inform the appraisal of the draft Water Strategy. It builds on and updates the SA Scoping Report completed in 2006 (Water Action Framework Sustainability Appraisal Scoping Report, July 2006).

Table 7: Policies, strategies, plans and programmes reviewed

Government	
• Department for Environment , Food and Rural Affairs (Defra) (2008) *Future Water – The Governments Water Strategy for England* • Defra (2009) *Draft Flood and Water Management Bill (Consultation Draft)* • Her Majesty's Government (2008) *The Planning Act* • Defra (2007) *The Water Supply (Water Quality) Regulations 2000 and (Amendment) Regulations 2007* • Defra (2003) *The Water Environment (Water Framework Directive) (England and Wales) Regulations* • Defra (2006) *River basin planning guidance* • Defra (2005) *Making space for water.* And *Taking forward a new Government strategy for flood and coastal erosion risk management in England. First Government response to the autumn 2004 Making space for water consultation exercise* • Defra (2007) *Consultation on proposed changes to powers to restrict non-essential uses of water* and Defra (2007) *Summary of Consultation Responses* • Defra (2007) *Consultation on water metering in areas of serious water stress* and Defra (2007) *Government response to consultation on water metering in areas of serious water stress* • Defra (2005) *Water charging: reductions for vulnerable groups. Response to consultation* • Defra (2005) *Drought orders and drought permits* • DCLG (2006) *Code for sustainable homes,* and DCLG (2008) *Code for sustainable homes – Technical Guide* • DCLG (2006) *Planning Policy Statement 25: Development and Flood Risk* and CLG (2008) Development and Flood Risk: A Practice Guide Companion to PPS25.	• DCLG (2007) *Planning Policy Statement: Planning and Climate Change: Supplement to PPS1* • DCLG PPG13: Transportation • DCLG PPS 23: Planning and Pollution Control and Annex 1: Pollution Control, Air and Water Quality • Defra (2004) *Review of existing private sewers and drains in England and Wales: Response to consultation* • Defra (2002) *Directing the flow: Priorities for future water policy* • DCLG (2006) *Mandating Water Efficiency in New Buildings - A Consultation* and *DCLG (2007) Water Efficiency in New Buildings: a joint Defra and DCLG policy statement* • Climate Change Act (2008) • Her Majesty's Government (2005) *Securing the future – the UK Government Sustainable Development Strategy* • ODPM (2005) *Diversity and Equality in Planning, a good practice guide* • House of Commons: Environment, Food and Rural Affairs Committee (December 2004) *Climate change, water security and flooding: Government reply to the Committee's report* • Environment Agency (2008) *The Pitt review: learning lessons from the 2007 flood. Final Report* and Defra (2008) *The Governments Response to Sir Michael Pitt's Review of the Summer 2007 Floods* • DCLG (2007) *Homes for the future: more affordable, more sustainable* – Housing Green Paper • Foresight (2007) *Tackling Obesity: Future Choices*

London

- GLA (2008)*The Mayor's London Plan: Spatial Development Strategy for Greater London; consolidated with alterations since 2004*,
- GLA (2009) *A New Plan for London*
- GLA (2007) *Planning for Equality and Diversity in London. London Plan Supplementary Planning Guidance (SPG),*
- GLA (2006) *Sustainable Design and Construction: London Plan SPG,*
- London Sustainable Development Commissino (2003) *A Sustainable Development Framework for London,*
- GLA (2004) *The Mayor's Transport Strategy Revision* (2004) and *Transport Strategy Implementation Targets* (2004),
- GLA (2008) *Transport Way to Go!*
- GLA (2005) *Sustaining Success – the Mayor's Economic Development Strategy,*
- GLA (2003) *The Mayor's Municipal Waste Management Strategy,*
- GLA (2002) *Connecting with London's Nature. The Mayor's Biodiversity Action Plan (BAP),*
- GLA (2004) *Sounder City: the Mayor's Ambient Noise Strategy*,
- GLA (2002) *Cleaning London's Air; The Mayor's Air Quality Strategy,*
- GLA (2004) *Green Light to Clean Power. The Mayor's Energy Strategy*,
- GLA (2005) *Adapting to Climate Change: A Checklist for Development. Guidance on Designing Developments in a Changing Climate,*
- GLA (2008) *The Mayor's Draft Climate Change Adaptation Strategy (CCAS) for London – Consultation Draft,*
- GLA (2007) *Action Today to Protect Tomorrow. The Mayor's Climate Change Action Plan,*
- London Housing Board (2005) *London Housing Strategy 2005 – 2016,*
- GLA (2008) *The London Housing Strategy, consultation draft* and GLA (2008) *Housing in London: the evidence base for the London Housing Strategy*
- Mayor's Public Realm Strategy (in preparation),
- London Assembly (2006) *The Blue Ribbon Network, The Heart of London*,
- GLA (2004) *London: Cultural Capital – realising the potential of a world-class city, the Mayor's Culture Strategy*,
- GLA (2008) *London Plan SPG: East London Green Grid Network* London Health Strategy, Health in London. Review of the London Health Strategy and High Level Indicators (2004),
- GLA (2008) *Equality in our Lifetimes – The Mayor's Annual Equalities Report 2007/08,*
- GLA (2006) *General Conformity with the London Plan: Principles and Procedures Guidance Note,*
- GLA (2007) *Evidence base: Climate Change in the Further Alterations to the London Plan*
- GLA (2008) *Living Well in London: the Mayor's draft Health Inequalities Strategy*
- GLA (2008) *Planning for a Better London Consultation, and Mayor's Response*

Regulators and Public Bodies

Thames / London

- Environment Agency (2009) *Water Resources Strategy for England and Wales*
- Environment Agency (2007) *Thames Region catchment flood management plan- Consultation document*
- Environment Agency (2007) *Drought Plan for Thames region*
- Environment Agency (2004 and annual updates) *The Thames Corridor catchment abstraction management strategy (CAMS). / The London CAMS Final Strategy (2006)*
- Environment Agency (2006) *Bringing your rivers back to life – A strategy for restoring rivers in North London*
- Environment Agency (2002) *River restoration: A stepping stone to urban regeneration highlighting the opportunities in south London*
- Environment Agency (2001) *Water resources for the future: A strategy for Thames Region*
- Environment Agency (2009) *Water for Life and Livelihoods – A consultation on the Draft River Basin Management Plan Thames River Basin District*
- Environment Agency (2007*) Thames River Basin District 'Summary of Significant Water Management Issues' Consultation*
- Thames Estuary 2100 (1999), *Management Guidance for the Thames Estuary (Strategy)*
- Environment Agency (2009) *Thames Estuary 2100 – consultation draft*
- Thames Water (2008) *Draft Water Resources Management Plan*
- Three Valleys Water (2009) *Revised Draft Water Resource Management Plan*
- Sutton and East Surrey Water Company (2009) *Final Draft Water Resources Management Plan*
- Essex and Suffolk Water Company (2008) *Draft Water Resources Management Plan*

National / other

- Environment Agency (2007) *Consultation on Identifying Areas of Water Stress*
- Environment Agency (2006) *The water framework directive (WFD) and planning: Initial advice to planning authorities in England and Wales*
- Environment Agency (2007) *Water services infrastructure guide*
- Environment Agency (2005) *Water company drought plan guidance Version 2.0, 2005*
- Environment Agency (2007) Water company drought plans – general recommendations for water companies in England
- Environment Agency (2005) *The climate is changing: Time to get ready*
- Environment Agency (2004) *Maintaining water supply*
- Office of Water Services (2008) *Service and delivery – performance of the water companies in England and Wales 2007 -2008 report*
- Office of Water Services (2009) *Relative efficiency assessments 2007 – 08, and supporting information*
- Office of Water Services (2007) *Water and Sewerage Charges: 2007 – 08 report*
- Office of Water Services (2009) *Future water and sewerage charges 2010 – 15: Draft determinations*
- Defra (2008) *Review of Household Charging for Sewerage Services Call for Evidence*
- Defra (2007) *Conserving biodiversity in a changing climate: guidance on building capacity to adapt*
- Defra (2008) *Adapting to climate change in England. A framework for action*

People and Health

3.8 This topic includes information on a number of social and health issues. The people of London make it the city it is: diverse, vibrant, dynamic, colourful and exciting. However there remains considerable inequity in many aspects of life in London. Many determinants of health and quality of life, such as access to open space and overcrowding in the home, effect particular groups and areas more than others. Equally, certain socio-economic groups can have a greater voice in local decision making or be at lower risk from negative issues such as crime or road accidents. Such issues all relate to the people of London and their health. The SA Objectives relevant to this context topic are: **Governance**; **Education and Awareness**; **Health and Well Being**; **Equality and Diversity**; and **Safety and Security**.

Policy context, relevant baseline and key trends

3.9 Box 2 presents the key messages from the review of policies, plans and programmes included in Appendix 6:

Box 2: Key messages from the review of policies, plans and programmes - people and health

Relevance to the Strategy:

- Requirements of national water regulations relevant to People and Health. These include regulations related to water charging, water metering and restrictions on non-essential uses.
- The Making Space for Water process sets out a "wide ranging" programme (including timeline) of actions relating to all aspects of managing flood risk, including issues such as integrated urban drainage management and living with flood risk.
- The Pitt Review (and the Governments Response) includes key recommendations about how flood risks should be managed and communicated, and recommendations to ensure that flood resilience measures are adequately funded. The Government's response to the Review gave the Environment Agency a new strategic responsibility for all forms of flood risk, and charged local authorities with leading and co-ordinating local flood management activity.
- The Water Resources Strategy for England and Wales (Environment Agency 2009) sets the policy context for how water resources will likely be managed in the future. There are several sections related to reducing demand for water and the predicted impacts of population increase and climate change on water quality. This strategy is closely linked to the outcome of the Pitt Review, and reflects a change in how water resources will be managed in England and Wales.
- The Code for Sustainable Homes and Development and Flood Risk, include several standards for new homes some of which are specifically related to water. While the detailed standards may be too specific for the Water Strategy to explicitly consider, these standards and emphasising the need to build homes to Code standards in London should be highlighted.
- There is specific guidance on diversity and equality such as ODPM (now CLG) guidance on Diversity and Equality in Planning which sets out good practice and includes case studies on how equality and diversity issues can be addressed through planning.
- Ofwat, through their draft determinations on future water and sewerage charges 2010 – 15 – which set limits on the prices which water and sewerage companies can charge their customers, are seeking to ensure that household bills remain broadly stable over the period 2010 – 2015.
- The London Plan and its Further Alterations contain several policies which are relevant to the Strategy and are listed in Appendix 6. The London Plan Supplementary Planning Guidance (SPGs) and other Mayoral Strategies contain other relevant priorities and targets.
- A New Plan for London, containing proposals for a new London Plan, does not contain any specific revisions but does outline the Mayor's intentions related to policies of the London Plan.

There are proposals related to minimising flood risk in the capital and improving the water quality of London's water bodies.

- There are several relevant social and health related strategies for London, particularly the London Housing Strategy (consultation draft) and draft Health Inequalities Strategy. In particular, the (consultation draft) London Housing Strategy contains housing development projections which will affect water resources and use.
- Key Environment Agency Plans in the London area, such as the Drought Plan and Catchment Abstraction Management Strategy for the Thames Region set out frameworks for the management of drought and abstraction in the Thames region. The draft River Basin Management Plan Thames River Basin District contains information related to likely future pressures on the region's water bodies, and describes the actions necessary over the next 20 years to improve the water environment.

Relevance to the SA:

- Specific targets relating to water and people and health have not been identified during the review. However, conformity with the goals of Government and Regional strategy has been reflected in the SA Objectives and Criteria.
- The policies, plans and programmes contain relevant baseline and key issues which have been drawn on in this context chapter. These are referred to, as appropriate in the context text below.
- The Water Supply (Water Quality) Regulations 2000 and 2007 (Amendment) are important as they provide detailed information on the requirements for water quality in supply and monitoring arrangements.

3.10 Relevant baseline and key trends for the sustainability appraisal objectives relevant to People and Health are presented below.

Governance

3.11 Involving citizens in decisions that affect them is a priority for government. In 2005 the Government launched the 'Together We Can' action plan[19], which set a clear agenda to increase the opportunities for people to influence public policy decisions that affect their lives and their communities. However, the onus to involve residents at a local level needs to be balanced against the need to make decisions in London at a strategic level that will benefit London as a whole, and this is particularly the case in the use, management and supply of resources, such as water.

3.12 The governance of water in London is the topic of a chapter in the current draft Water Strategy (July 2009). The governance of water can be divided into three broad groupings: water supply and sewerage companies; water consumers and households and regulators and government agencies/departments.

Water supply and sewerage companies:

3.13 Water supply is the responsibility of four companies in London (Thames Water, Three Valleys Water, Essex and Suffolk Water and Sutton and East Surrey Water). Thames Water is the largest supplier in London, and has sole responsibility for sewerage in Greater London.

3.14 The water industry was privatised in 1989. Environmental improvements, e.g. river water quality, for example, due to reduced point source pollution are seen as a key successful outcome of privatisation. However, success with improving efficiency of water use in households, for example by installing water meters, has not been as successful[20].

[19] http://togetherwecan.direct.gov.uk/ : Accessed 11/06/09
[20] Draft Water Strategy, GLA August 2009

Consumers and households:

3.15 A survey in 2002[21] found that people showed "*relatively low awareness and concern*" for their water and sewerage services, but higher levels of concern were shown for the water environment. Qualitative research carried out during the same survey concluded that respondents "*often fail to make the link between the water that goes in and out of their home and the impact this can have on the water environment*". It also revealed that many participants failed to see the connection between their water and sewerage bills and the source of money needed to fund improvements.

3.16 Water restrictions and hosepipe bans tend to be the focus of considerable media and public attention. However, water company customers place low priority on measures to reduce the frequency of hosepipe bans, preferring for example, to pay for measures to reduce leakage from water mains[22]. What this means is that if customers have to pay higher water bills, they would rather the money be spent on fixing leaks rather than reducing the need for hosepipe bans (although the two could be said to be inexorably linked).

3.17 The flood events of summer 2007 have again highlighted many issues around public perceptions of flood risk and flood defences, and the governance of these issues. Many media reports emphasised the opinion of the public that their homes should have been protected entirely from the threat of flooding, yet in practice this is rarely possible, and the public may also fail to appreciate the cost of erecting defences which might offer total protection. In addition, the summer 2007 highlighted that flooding can occur from different sources, e.g. flooding from drains, surface water or sewers, and that there are important issues and gaps in the governance and responsibility for different sources of flooding. For instance ownership and responsibility for maintenance of drains is not always clear, often leading to inadequate maintenance and repair[23], which can increase flood risk.

Regulators and government agencies:

3.18 The Environment Agency has responsibility for the quality of water bodies (monitoring, enforcement) and flood protection from main rivers and watercourses. It also regulates water taken from sources through the management and issuing of abstraction licences. The Agency has responsibility to prepare various water management plans, such as Catchment Abstraction Management Strategies, Drought Plans, and River Basing Management Plans. All of these plans relevant to the London Water Strategy are reviewed in Appendix 6.

3.19 Ofwat is the water service regulation authority. It monitors and regulates the economic aspects of the water industry, setting limits on charges water companies can make, protecting consumers rights, encouraging company efficiency and so on. Ofwat has the powers to take action against water companies should they not meet agreed outcomes.

3.20 Other organisations and government departments with responsibilities in the governance of water are listed below:

- The Drinking Water Inspectorate ensures that water companies comply with their duty to supply wholesome water, by administering checks, tests and site visits.
- Natural England has responsibility for enhancing biodiversity, landscapes and wildlife (particularly in rural areas), promoting access and recreation and contributing to the management of natural resources.

[21] *The 2004 Periodic Review: Research into Customers' Views*.
Mori, 2002 for Defra. http://www.ipsos-mori.com/content/polls-02/the-2004-periodic-review-research-into-customers-v.ashx : Accessed 11/06/09
[22] Draft Water Strategy, GLA August 2009
[23] Ibid.

- Consumer Council for Water represents (since 2005) consumer interests in England and Wales.
- Department for the Environment Food and Rural Affairs (Defra) has overall policy responsibility for water. Key strategic documents developed by Defra are reviewed in Appendix 6.
- Communities and Local Government[24] (CLG) has responsibility for planning matters. Relating to water it has responsibility for Building Regulations, and in 2006 launched its Code for Sustainable Homes (and Technical Guide in 2008), which encourages and sets standards for environmental standards in the construction of homes. CLG has also produced a number of Planning Policy Statements (PPSs) which set out statutory provisions and provide guidance to local authorities and others involved in planning. Relevant PPSs and the Code for Sustainable Homes are reviewed in Appendix 6.
- The European Union has developed a large number of environmental directives related to water, such as the Water Framework Directive and the Urban Waste Water Treatment Directive. These are required to be passed into national legislation, regulations and/or administrative provisions.

Education and Awareness

3.21 In London in 2007 60.5% of 15 year olds achieved 5 or more GCSEs with grades A* - C compared to 59.8% in England as a whole. However the level varies significantly between income groups, with pupils in families earning low amounts (c.£18,000/year) achieving results of 39.5%, and those from families earning higher amounts (c.£54,000/year) obtaining results of 70.5%. In addition, the level also varies between boroughs, with results ranging from 34% in Greenwich to 65% in Sutton[25]. There are also large variations in achievement between different ethnic groups, for example Black, Asian and minority ethnic groups achievement was on average 14.3% below that of white ethnic groups[26].

3.22 In terms of higher education, London has the highest percentage of degree level qualifications among the adult population of all the English regions, with 28.4% compared to 23.7% for England as a whole. However the level of other higher qualifications is lower in London. For example 15.3% of Londoners on average hold two GCE A Level or equivalent compared to 19.7% for England as a whole. This suggests a high number of university graduates moving to London for work, but possibly relatively low levels of attainment among certain groups within the stable London population.

3.23 The Learning and Skills Council in London identify the need to increase progression to higher education and improve the skill levels of young Londoners to meet employer needs as a key priority. In 2007, around 13% of London employers reported having skill gaps, representing in the region of 219,000 workers[27]. A further key priority for the LSC is to integrate skills within economic development and local and regional regeneration.

3.24 The London Plan (consolidated with alterations since 2004) and the London Blue Ribbon Network plan: The Heart of London[28] acknowledges the educational value of waterways. A principle set out in section 4C of the London Plan is to protect and enhance the Blue Ribbon Network as part of the public realm and London's open space network, and promoting sport, leisure and education. This may take the form of formalised events, such as the Mayor's Thames Festival (http://www.thamesfestival.org/) which is a celebration of London's river, to

[24] Formerly DCLG, Department for Communities and Local Government
[25] GLA, 2008, Focus on London 2008: http://www.london.gov.uk/gla/publications/factsandfigures/fol2008/
[26] Ibid.
[27] LSC, 2007, *The London Learning and Skills Plan*: http://readingroom.lsc.gov.uk/lsc/London/The_London_Learning_and_Skills_Plan_-_Our_regional_commissioning_plan_for_London_2007-08.pdf
[28] London Assembly Planning and Spatial Development Committee, 2006, *The Blue Ribbon Network – The Heart of London*: http://www.london.gov.uk/assembly/reports/plansd/blue-ribbon.pdf

school visits and community involvement through maintaining or just visiting waterways. The 2012 Olympics and Paralympics may present other specific water related educational and training opportunities, as might specific infrastructure developments.

3.25 The information given to the public in relation to everyday water use, as well as during events such as drought, flooding or contamination may affect significantly the success of response to these, and the ability of water companies and regulators to communicate effectively. The London Assembly Health and Public Services Committee report into drought in London[29] identified that during recent droughts customers have been "*confused about what water restrictions are in place*" and what these restrictions mean for them. Improving information given to customers was among their key recommendations.

3.26 Changing people's behaviour and attitudes is key to promoting water conservation but achieving the change is far from straightforward. Jackson (2005)[30] provides a comprehensive review of evidence on consumer behaviour and behavioural change and highlights that '*for much of the time people find themselves 'locked in' to unsustainable consumption patterns. Consumer 'lock- in' occurs in part through the architecture of incentive structures, institutional barriers, inequalities in access, and restricted choice. But it also flows from habits, routines, social norms and expectations and dominant cultural values'*.

3.27 An Environment Agency report[31] makes a series of recommendations to promote retrofitting behaviour to achieve energy and water efficiency and minimise waste in households which could also be applied to promoting water savings:

- *'The best way to change behaviour is through communities and special interest groups, where positive behaviour can be encouraged by social pressure and conversations and unsustainable behaviour is discouraged.*
- *Providing practical 'on-the-ground' support for behaviour change, tailored to specific audiences and localities is more effective than raising awareness. Here support and information are crucial to enable the behaviour change and develop it sustainably within the community.*
- *Providing a combination of prolonged support, coupled to a convenient system and community participation, a significant and sustainable behaviour change can be influenced.*
- *Convenient infrastructure should be in place before engaging to encourage action. However, there may be a need to "warm up" the audience as infrastructure is coming on line.*
- *Incentives can reflect the shared social responsibility of householders and others and are important where behaviour is not a social norm and convenience is compromised. They are considered essential to encourage early adopters and to build presence of pro-environmental behaviour in the community'.*

3.28 An additional issue is people's underestimation of their own water consumption: a customer survey for Thames Water[32] showed that people underestimated average water use as much as by 68 litres per day.

Health and Well Being

3.29 The World Health Organisation (WHO) defines health as

[29] London Assembly Health and Public Services Committee, 2006 – *Drought in London*: http://www.london.gov.uk/assembly/reports/health/londons-drought.pdf
[30] Tim Jackson, 'Motivating Sustainable Consumption, a review of evidence on consumer behaviour and behavioural change', 2005, University of Surrey
[31] Environment Agency 'Marketing Strategies to Promote Retrofitting Behaviour', 2006, p.3
[32] Cited in London Assembly Environment Committee 'Down the Drain, London's Water Usage and Supply', 2005

"*a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity*". A healthy city is one that "*is continually creating and improving the physical and social environments and expanding the community resources that enable people to mutually support each other in performing all the functions of life and in developing their maximum potential*"[33].

3.30 The London Health Commission reports[34] that overall Londoners' health is improving and life expectancy in increasing for both males and females, and infant mortality is decreasing. Londoner's self-reported health in 2001 was slightly better than the national average for England, with 70.8% compared to 68.7% reporting that they were in good health. However the same report identifies significant inequalities within London in relation to health. Life expectancy for males for example varies from 80.8 years in Kensington and Chelsea to 73.9 years in Islington. In general the levels of life expectancy are lower in central London and higher in outer London. Ethnic groups also show considerable health inequalities, with people from Bangladeshi and Pakistani ethnic groups much more likely to assess their own health as "not good" than those from other groups, with those from white British, mixed white, Asian, black African and Chinese groups the least likely to report their health as "not good"[35].

3.31 Water relates to and can impact on health in a number of ways. For example water rationing during periods of drought could have "*major impact on Londoner's health and safety*" particularly on vulnerable people[36]. Equally flooding can have significant physical and mental health effects from the immediate (e.g. drowning, illness) to the after effects (e.g. exposure to flood waters causing respiratory symptoms, stress, anxiety). These effects are discussed in more detail below.

3.32 Changes in the pressure of water in London's supply network is one possible means of reducing leakage. The London Assembly Health and Public Services Committee however has raised concern over the impacts this could have on the public, particularly the economically and physically vulnerable due to (among others) the need for pumping in buildings over three stories and the possibility of "backflow" contamination[37].

3.33 Replacing mains and fixing leaks causes noise and disruption to road transport which may lead to an increase in traffic congestion and consequently air pollution which can affect people with respiratory illnesses. Noise exposure can cause annoyance and sleep disturbance and epidemiological associations have been observed with hypertension and ischemic heart disease and decreased school performance[38]. However, the disruption caused by these works is likely to be transient i.e. last days or weeks and would only marginally increase background levels. At the same time the disruption caused by maintenance and mains replacement can be mitigated by careful planning of works to coincide with other utilities who need access under same roads or sites. Transport for London (TfL) has worked to promote such joint working on its road network[39]. The potential increase in air pollution caused by these works is also not likely to be significant compared to current levels and thus a significant effect on sufferers of respiratory illnesses is unlikely.

3.34 In addition, works carried out to replace Victorian pipes have the potential to avoid future leaks and consequent disruption. Another potential positive effect, which was mentioned in

[33] *Delivering Healthier Communities in London*, NHS London Healthy Urban Development Unit, 2007
[34] London Health Commission, 2007, *Health in London Looking back looking forward report: 2006/07 review of trends, progress and opportunities*: http://www.londonshealth.gov.uk/hinl2006.htm
[35] Ibid.
[36] London Assembly Health and Public Services Committee, 2006 – *Drought in London*: http://www.london.gov.uk/assembly/reports/health/londons-drought.pdf
[37] London Assembly Health and Public Services Committee, 2005 - *Under pressure - water pressure management in London*: http://www.london.gov.uk/assembly/reports/pubserv/water_pressure.pdf
[38] PASSCHIER-VERMEER, W. & PASSCHIER, W. F. (2000) Noise exposure and public health. Environmental Health Perspectives, 108 (suppl. 1), 123-131.
[39] Personal communication from Helen Woolston, TfL, commenting on draft of this report.

the Health Stakeholder Workshop held in March 2007 (see Methodology in Section 2) is that a major programme to fix leaks/ replace mains in London may contribute to creating jobs which would have a positive health effect, as being in employment is an important determinant of good health.

3.35 The level of water metering is expected to rise over the coming years (see Water Management context topic, below). An increase in metering could have implications for health if certain high water users e.g. disabled people, large families, etc. reduce their water consumption beyond 'healthy levels' in order to reduce their water bills. The draft Water Strategy includes provision for protecting vulnerable low income housing from negative effects associated with metering[40]. The WHO does not provide guidance on the quantity of domestic water that is required to promote good health, however Howard and Bartram (2003) reviewed the requirements for water for health-related purposes to derive a figure of an acceptable minimum to meet the needs for consumption (hydration and food preparation) and basic hygiene. The minimum 'healthy' water use was found to be 7.5 litres per person per day[41].

3.36 Flooding can cause injury and death by drowning, and an increased incidence of mental health disorders[42]. Some flood victims suffer long-term mental health effects as a result of their experience of flooding[43].

> '*The long term effects of flooding on psychological health may perhaps be even more* important *than illness or injury. For most people the emotional trauma continues long after the water has receded. Making repairs, cleaning up, and dealing with insurance claims can be stressful. If there is a lack of support during the recovery process, stress levels may increase further*'[44].

3.37 A recent review of literature on disasters and hazards reviewed suggests that certain groups within populations are more exposed to disasters, suffer a higher impact from those disasters and have a reduced capacity to recover. These groups include women, the elderly, ethnic groups, lower socio-economic groups and those new to an area[45].

3.38 Deprived communities may be particularly hard hit by a flood. A report commissioned by the Environment Agency in 2006 emphasises that while *'not all vulnerable individuals and households are deprived, it is nonetheless true that deprived neighbourhoods contain concentrations of vulnerable individuals'.* Certain characteristics that make individuals and household suffer the impacts of flooding more are more prevalent in deprived areas, including: poor health, which increases the health effects, lower levels of flood risk awareness, lower incomes and higher unemployment which reduces the likelihood of having insurance and savings that may act as a buffer against some of the impacts[46].

3.39 The positive effects on health of physical exercise are well documented. Providing space and using water bodies for sport and recreation can contribute in this way to London's health. A downside to this is that increased provision of open water bodies may cause an increase in the number of deaths by drowning. The primary potential risk to health here is gastrointestinal infection via the feacal oral route and presupposes exposure to humans which

[40] Draft Water Strategy, August 2009, Proposal 3
[41] Howard G, Bartram J. Domestic water quantity service level and health. World Health Organization, 2003 http://www.who.int/water_sanitation_health/diseases/wsh0302/en/
[42] Hajat S, Ebi KL, Kovats S, Menne B, Edwards S, Haines A (2003) The human health consequences of flooding in Europe and the implications for public health: a review of the evidence. Applied Environmental Science and Public Health 1(1): 13-21.
[43] Tunstall S, Tapsell S, Green C, Floyd P, George C (2006) 'The health effects of flooding: social research results from England and Wales' Journal of Water and Health 4(3): 365-380
[44] Ohl C, Tapsell S (2000) Flooding and human health. British Medical Journal 321: 1167-1168.
[45] Tapsell, S, Burton, R, Oakes, S and Parker, D (2005) The Social Performance of Flood Warning Communications Technologies. Technical Report. The Environment Agency, Bristol, UK.

would most likely be from recreational activities. There is evidence that recreational water exposures may cause such health effects[47]. The Government Foresight Obesity Report[48] has led to several initiatives related to people and health, encouraging people to move more and consume less. As part of these initiatives, the benefits of making healthier food and drink choices are emphasised, including the promotion of water over the consumption of soft drinks[49].

Some key 'headlines' in relation to equality in London include:

- Women from all ethnic groups and men from BME groups are under-represented among elected representatives, and among opinion leaders in business.
- London's BME population has a younger age profile than the white population.
- More than 300 languages are spoken in schools in London.
- Unemployment rates are higher for most BME groups than for the white population.
- More than a million disabled people live in London; 26.3% of London households with dependent children are headed by a lone parent.
- Recent polls suggest that Londoners welcome diversity – in January 2004, 30% of people cited the mix of people as one of their top six reasons for living in London.

3.40 There is also evidence that flooding not involving sewer outflows causes such effects. A study conducted in the northeast of England found that many people who had been flooded reported suffering from diarrhoea and upset stomachs following the flooding[50]. Following tropical storm 'Allison' in Houston, Texas in June 2001 gastrointestinal illness in people from flooded homes was elevated compared to non-flooded homes[51] . It is to be expected that the risks from exposure to sewage contaminated water will be higher than less significantly contaminated water.

3.41 The health stakeholder workshop (see separate report available from the GLA) highlighted potential risks of gastrointestinal illness from cross-connections between drinking water and grey water pipes.

Equality and Diversity

3.42 Over 40% of Londoners are from black and minority ethnic (BME) communities and significant growth in black and minority ethnic communities is projected over the next 20 years[52].

3.43 The Mayor's target minorities groups[53] are:

- Children
- Ethnic minorities
- Lesbian, gay, bisexual and transgender (LGBT) Londoners
- Older People
- Disabled and deaf Londoners
- People with mental health needs

[46] Walker, G, Burningham, K, Fielding, J, Smith, G, Thrush, D, and Fay, H (2006) Addressing environmental inequalities: flood risk. Science Report. The Environment Agency, Bristol, UK.
[47] Kay D. Fleisher JM, Salmon RL, Jones F, Wyer MD, Godfree AF, Zelenavehjacquotte Z, Shore R (1994). predicting the likelihood of gastroenteritis from sea bathing - results from randomised exposure. Lancet 344;905-909
[48] Foresight (2007) Tackling Obseity: Future Choices http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp
[49] Department of Health (2008) Healthy Weight Healthy Lives – A cross Government strategy for England http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_082378
[50] Tapsell S, Penning-Rowsell EC, Tunstall SM, Wilson TL (2002). Vulnerability to flooding: health and social dimensions. Philosophical Transactions of the Royal Society of London, Series A 360: 1511-1525.
[51] CDC (2002). Tropical storm Allison rapid needs assessment - Houston, Texas, June 2001. Morbidity and Mortality Weekly Report 51(17):365-369.
[52] GLA (2008) The Mayor's London Plan: Spatial Development Strategy for Greater London: Consolidated with alterations since 2004: http://www.london.gov.uk/thelondonplan/thelondonplan.jsp
[53] Who's vulnerable? Mayor of London's website: http://www.london.gov.uk/london-life/community-and-people/vulnerable/index.jsp

- Refugees, asylum seekers and immigrant workers
- Women

3.44 41% of all children in London, and 51% in inner London are living in poverty, with child poverty strongly related with non-employment in households with dependent children[54]. Households with the highest proportions of children in workless households were the mixed White/ Black Caribbean group, the Bangladeshi group (both at 40%) and the Black African group (39%)[55].

3.45 The London Assembly Health and Public Services Committee reports on drought in London and possible reductions in water pressure (see *Health and Wellbeing* section above) emphasise the potential for the effects of such factors to impact disproportionately on certain groups.

3.46 The Vulnerable Groups Regulations aim to protect certain metered households from paying large bills. The Regulations were introduced to help people who might otherwise worry about using water and possibly compromising their health and that of others because of concerns about affording their bill. Eligible customers pay no more than the average household bill for their region even if they use more than the average amount of water[56].

3.47 In order to qualify for assistance, the household has to be metered and someone in the home must be in receipt of benefits and in addition they will have to be responsible for three or more children under the age of 19 and in full-time education or have (or someone living in the property must have) a medical condition which requires significant additional use of water[57].

Table 8: Number of households applying for help under the Vulnerable Groups Regulations – 2006-07 and 2007-08[58]

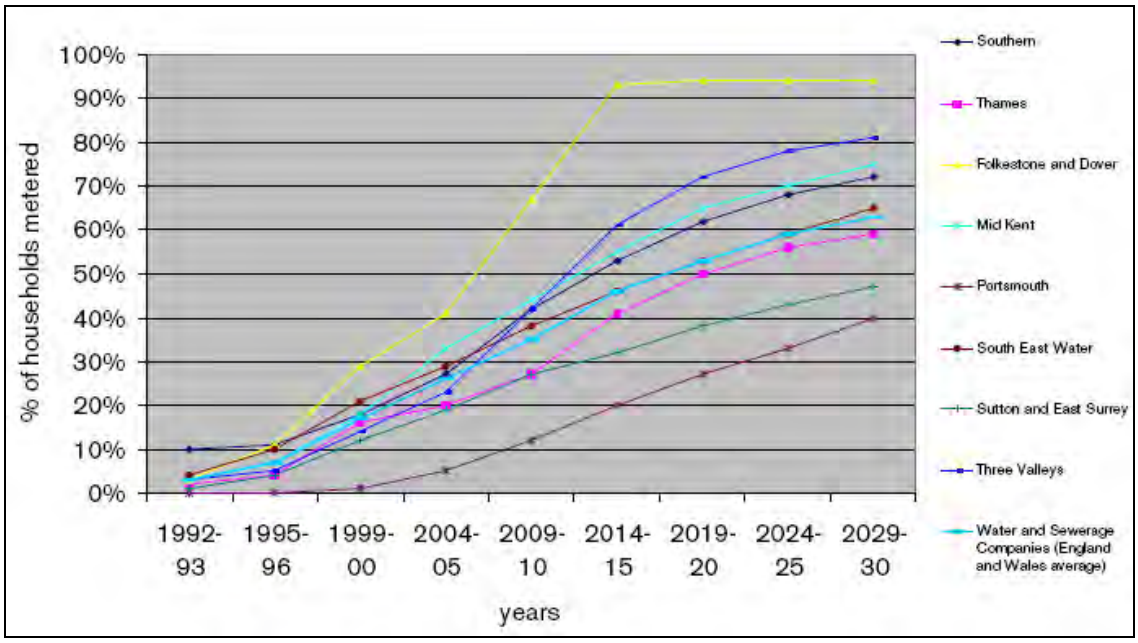
Water Company	Total number of applications		Total number of successful applications	
	2006-07	2007-08	2006-07	2007-08
Northumbrian (inc. Essex & Suffolk)	1,023	1,232	898	1,077
Thames	2,522	2,741	2,053	2,333
Sutton & East Surrey	94	113	91	110
Three Valleys	332	537	316	504

3.48 However, only a minority of homes have meters in London (for example only 17% of Thames Water served homes[59]), so the majority of vulnerable households are not protected by the Regulations. In addition, there are other 'vulnerable' people not covered by the regulations, e.g. lower income working households, pensioner households, etc.

3.49 Although the current penetration of metering is low it is predicted to increase in the next decades, see Figure 3.

[54] (2008) Focus on London 2008 Chapter 6 Poverty http://www.london.gov.uk/gla/publications/factsandfigures/fol2008/
[55] London Health Commission: Health in London. Review of the London Health Strategy high level indicators, October, 2005 - http://www.londonshealth.gov.uk/PDF/hinl2005/HiL2005Chap4.pdfGLA
[56] Ofwat 'Customers applying for help under the Vulnerable Groups' Regulations – 2006-07 and 2007-08', http://www.ofwat.gov.uk/consumerissues/problemspayingbill/gud_pro_watersure2008.pdf
[57] Ibid
[58] This is company wide data for the Water Companies that serve London; no data for London has been identified
[59] London Assembly Health and Public Services Committee Report 'Drought in London', 2006

Figure 3: Current and predicted levels of metering[60]



3.50 Water bills are also set to increase by 2009-10. The following two tables illustrate this both for England and Wales and in the Thames Region. The percentage of income spent on water and sewerage bills is set to increase for the two lowest income quintiles. Non-working households without children currently pay and will continue to pay the highest proportion of their income (Table 9).

3.51 Currently there is no indicator of 'water affordability', but there is a Government sustainability indicator that households should not spend more than 3% of their income on water and sewerage bills[61]. Table 10 illustrates the percentage of households that spend more than 3% of their disposable income on water and sewerage bills. The highest increase will be for the lowest income quintiles. In its draft price determinations[62], Ofwat has set price limits for water and sewerage companies for the 2010 – 2015 period which are intended to keep household bills broadly stable. Lower income households spend a higher percentage of their disposable income on water bills, however keeping bills broadly stable over the period 2010 – 2015 should help protect some households from the risk of falling into water poverty (spending more than 3% of household income on water and sewerage bills).

[60] Source: 1992-93 to 2004-5, Actual June Return metering numbers from Ofwat; 2009-10, PR04 final determination metering assumption; 2014-15 to 2029-30, Water Resource Plan 2004 Projections, in Institute for Public Policy Research (IPPR) 'Every drop counts, Achieving Greater Water Efficiency', 2006, p. 28
[61] Institute for Public Policy Research (IPPR) 'Every drop counts, Achieving Greater Water Efficiency', 2006
[62] Ofwat (2009) Future water and sewerage charges 2010 – 15: Draft determinations

Table 9: Percentage of income spent on water and sewerage bills – nationally and in Thames Region (by income quintile and household type)[63]

Nationally (England and Wales)	**2004/05**	**2005/06**	**2009/10**			
Lowest income quintile	2.2	2.4	2.6			
2nd income quintile	1.5	1.7	1.8			
3rd income quintile	1.2	1.3	1.3			
4th income quintile	0.9	0.9	1.0			
Highest income quintile	0.5	0.6	0.6			
Average	1.0	1.1	1.1			
Regionally (Thames)	average income households			lowest income quintile		
	2004/05	**2005/06**	**2009/10**	**2004/05**	**2005/06**	**2009/10**
Thames	0.7	0.8	0.8	1.8	2.1	2.2
Household type	average income households			lowest income quintile households		
	2004/05	**2005/06**	**2009/10**	**2004/05**	**2005/06**	**2009/10**
Working household with children	0.8	0.9	0.9	1.5	1.6	1.8
Working household without children	0.8	0.9	0.9	2.2	2.4	2.6
Non-working hh with children	1.8	2.0	2.2	2.0	2.1	2.3
Non-working hh without children	2.0	2.2	2.4	3.1	3.3	3.6
Pensioner household	1.5	1.6	1.8	2.4	2.6	2.8
All households	1.0	1.1	1.1	2.2	2.4	2.6

Table 10: Percentage of households spending more than 3% of disposable income on water and sewerage bills: nationally and in Thames Region (by income quintile and household type)[64]

Nationally (England and Wales)	**2004/05**	**2005/06**	**2009/10**			
Lowest income quintile	29.4	33.8	40.0			
2nd income quintile	7.7	10.2	14.2			
3rd income quintile	2.2	3.1	4.3			
4th income quintile	0.4	0.6	0.7			
Highest income quintile	0.0	0.1	0.1			
Average	7.9	9.6	11.8			
Regionally (Thames)	average income households					
	2004/05	**2005/06**	**2009/10**			
Thames	3.8	5.7	6.5			
Household type	average income households			lowest income quintile households		
	2004/05	**2005/06**	**2009/10**	**2004/05**	**2005/06**	**2009/10**
Working household with children	1.2	1.5	2.3	6.3	7.7	10.8
Working household without children	3.2	4.0	4.6	29.5	34.1	39.4
Non-working hh with children	16.5	19.8	25.7	20.6	24.1	30.6
Non-working hh without children	29.9	34.2	38.9	47.1	52.5	57.9
Pensioner household	11.6	14.3	19.1	28.0	33.7	41.9
All households	7.9	9.6	11.8	29.4	33.8	40.0

Safety and Security

3.52 Community safety is a key social issue for London. Safety in London and crime rates were rated as being among the worst things about living in London by 45% of Londoner's in the Annual London Survey[65], 2007. This rated higher than transport, health services and schools, with the only issues considered worse being the cost of living, traffic congestion and the cost of housing. 33% of respondents said that they felt a bit, or very unsafe walking in their neighbourhood in the evening.

[63] Defra 'Cross-Government Review of Water Affordability Report', 2004
[64] Ibid.
[65] MORI, 2007. *Annual London Survey* 2007: http://www.london.gov.uk/mayor/annual_survey/2007/als-2007-toplines.pdf

3.53 London has a significantly higher crime rate than the average for England and Wales. The Home Office crime statistics[66] for the period 2007/08 show that for "total recorded crime" the London region saw 116 offences per 1000 people, compared to 91 offences per 1000 people average in England and Wales. For the same period for "burglary" there were 13 offences per 1000 people in London compared to 11 offences per 1000 people in England and Wales, and for "other theft offences" in London there were 28 offences per 1000 people compared to 20 offences per 1000 people in England and Wales.

3.54 The Mayor's Supplementary Planning Guidance (SPG) *Providing for children and young people's play and informal recreation*[67] notes that safety fears, largely a result of traffic growth and road danger, but also a consequence of fear of crime and abduction, have left many children and young people with fewer opportunities to walk or cycle independently around their neighbourhoods.

Key problems and opportunities

3.55 Drawing on the review of other policies, plans and programmes and the baseline data, the key sustainability problems and opportunities issues for the SA and the Water Strategy to consider relating to the people and health topic are summarised in Box 3.

Box 3: Key problems and opportunities – people and health

Problems

- The complex governance structure and legislation controlling the supply and management of water and potential overlaps and relationships of the Water Strategy with other plans and strategies.
- Potential negative effects of water related issues such as flooding, water scarcity and water quality. These can impact particularly on certain deprived and other vulnerable groups.
- Growing percentage of economically vulnerable households who spend more than 3% of disposable income on water and sewerage bills.
- Lack of public awareness regarding the appropriate response to extreme water related events (floods, droughts), as well as day to day water use and efficiency.

Opportunities

- Partnership working between the Mayor and water companies, regulators and public bodies in preparation and delivery of long term strategic goals, such as replacement of Victorian sewage infrastructure.
- Promoting and protecting the transport, educational, recreation and amenity value of London's waterways and supporting the Blue Ribbon Network plan.
- Provision of new or improved water features through e.g. flood risk management and sustainable urban drainage.
- Increasing public awareness of water issues including their impact on the water environment and the risk of flooding.
- Promoting health benefits of drinking more tap water.

People and Health – evolution of the sustainability baseline in the absence of the Water Strategy

3.56 In the absence of the Water Strategy, over the intended 10 year time frame of the Strategy, the baseline under the People and Health theme is likely to evolve in the following ways:

- The health of Londoners is likely to continue improving, but existing health inequalities related to income and education levels are likely to persist and could increase;
- The amenity value of London's waterways and their use for recreation and transport is likely to increase, which may have beneficial health and wellbeing effects. There is a

[66] Home Office crime statistics for England and Wales http://www.crimestatistics.org.uk/output/page1.asp : Accessed 11/06/09
[67] GLA, 2008, Final SPG, *Providing for children and young people's play and informal recreation*: http://www.london.gov.uk/mayor/strategies/sds/spg-children-recreation.jsp

possibility that increased exposure to river water may result in an increased number of people exposed to harmful bacteria / contaminants;

- The penetration of water metering is likely to increase. This will have beneficial effects on managing water use and balancing supply and demand, however it may also impact upon low-income households, as average bills increase. There may also be upward pressure on water bills as water and sewage charges could rise as water companies seek to raise revenue to pay for upgrading water and sewerage infrastructure; and
- There is projected to be an increase in the frequency and severity of floods. As flood events have a disproportionate effect on vulnerable groups, this may result in increased negative effects on these groups.

Place and quality of surroundings

3.57 This topic focuses on the physical environment in which we live. It encompasses the natural, built and historic environment, the landscape and townscapes of the city, and its "liveability" as a place communities thrive and individuals can access and enjoy the amenities they need. The Sustainability Appraisal Objectives relevant to this topic are: **Liveability and Place**; **Accessibility and Availability**; **Landscape, Historic and Cultural Environment**; **Biodiversity**; and **Air Quality**.

Policy context, relevant baseline and key trends

3.58 The key messages for this topic context from the review of relevant policies, plans and programmes have been listed in Box 4:

Box 4: Key messages from the review of policies, plans and programmes – place and quality of surroundings

Relevance to the Strategy:

- Requirements of national water regulations relevant to Place. Particularly relevant are the WFD regulations and related river basin management and planning guidance. The WFD Regulations require the Environment Agency to gather and monitor a large amount of water related information at the river basin scale.
- The Thames River Basin Management Plan will be adopted by the Environment Agency by December 2009 which will be an important document in the management of water in the London region.
- The Making Space for Water process seeks to reduce the threat to people and their property from flooding and deliver the greatest environmental, social and economic benefit consistent with the Government's sustainable development principles. Responding to these priorities may influence the Water Strategies' approach to aspects of Place, especially biodiversity, landscape and townscape.
- The Environment Agency's Water Resources Strategy for England and Wales outlines how the Environment Agency will manage water resources in the future to avoid significant negative effects on the environment and the economy, coping with the impacts of climate change and an increase in the population. The Water Strategy should ensure that it is compatible with the policies contained in the Water Resources Strategy.
- National guidance, such as the Code for Sustainable Homes, Development and Flood Risk,

PPG13: Transportation and PPS1 Planning and Climate Change. Specific standards may be too detailed for the Water Strategy to consider including in policy; however as a strategic plan for London, the Water Strategy can highlight the need to build homes to the standards set out in the Code and other national guidance.

- The London Plan (consolidated with alterations since 2004), as well as priorities and targets set out in London Plan SPGs and other Mayoral Strategies which relate to "Place", such as the Mayor's Transport Strategy and the London Biodiversity Action Plan.
- Other London strategic plans as set out in Appendix 6, including The Blue Ribbon Network, and the draft London Housing Strategy. The latter contains housing development projections, which will affect water resources and use.

Relevance to the SA:

- Specific targets relating to Place were not identified during the review, however conformity with the goals of Government and Regional strategy has been reflected in the SA Objectives and Criteria.
- The policies, plans and programmes contain relevant baseline and key issues which have been drawn on in this context chapter. These are referred to as appropriate in the context text below.
- The Water Supply (Water Quality) Regulations 2000 and 2007 (Amendment) are important as they provide detailed information on the requirements for water quality in supply and monitoring arrangements.

Liveability and Place

3.59 Liveability and place encompasses the provision of streets, spaces and urban environments which create and enhance social cohesion, encourage active lifestyles and actively contribute to the wellbeing of residents. The Living Streets[68] organisation defines a number of variables which contribute to the "liveability" of a street. These include: walkability; balance of uses; well designed, well maintained spaces; safe, both day and night; attractive and interesting; well connected; space to relax; legible and providing information (signs etc.) where needed. Water can play an important role in creating attractive urban spaces, adding amenity value and enhancing local areas and parks. An example of how water ways can contribute to the quality of life and liveability of an area is the Hidden Corners project in Hackney. The Groundwork Trust in East London has sourced funding from the London Waterway Partnership and British Waterways to carry out improvements to a stretch of the Regents Canal. Relatively simple improvements have lead to noticeable results with achievements listed as:

- The Regents Canal in Hackney feels safer and now provides information, art and improved natural landscaping.
- Decorative railings were constructed to reduce the threat of attack to canal path users and to improve the aesthetic value of the Canal.
- Two low level benches were re-sited to make the area more user-friendly.

3.60 Noise is another aspect of the liveability of a place which the Water Strategy may influence. The 2002 GLA London Household Survey asked people which noises caused a 'serious problem'. 4% said roadworks, compared to 13% citing road traffic and 6% aircraft. Water infrastructure improvements might increase the number of roadworks in London.

Accessibility and Availability

3.61 Enhancing access to jobs, services and social networks, including for the most disadvantaged is one of the Department for Transport's four strategic objectives[69]. Improving access to public transport and services may be particularly important for certain groups – with the disadvantaged socially and economically often being most isolated and unable to access the services and amenities they need.

[68] http://www.livingstreets.org.uk/what_you_can_do/assess_livability.php
[69] Department of Transport aim and objectives: http://www.dft.gov.uk/about/aimandobjectives

3.62 Accessibility is about creating facilities for walking, cycling and public transport, but it is also about making the services and amenities which people need available locally and conveniently. Obviating the need to travel (through provision of what people need close to where they live or work) is a more sustainable way of improving accessibility than by facilitating mobility and access to services further away. The more routine activities people can do without travelling, the more London's finite infrastructure can be freed up to enable people to enjoy the special recreational, cultural and economic activities that a world city can offer.

3.63 While the public transport network is also vulnerable to extreme events, a transport system and economy which does not rely so heavily on private transport might also have greater resilience to flooding or extreme weather events, as restrictions on vehicle movements would be easier to enforce, and potentially less disruptive.

3.64 The Department for Transport policies actively encourage the transferral of freight from road to water[70], and water transport can be an important contributing factor in improving access. Transport for London's Freight Unit is also supportive of transfer of freight to water. For example the London Freight Plan sees greater water based transportation of freight as a significant opportunity to relieve congested roads and reduce emissions[71]. About three million people a year travel on the Thames by boat, and considerably more use the Thames-side paths and other waterways are used extensively for leisure purposes and as walking and cycling routes[72].

3.65 The Mayor's Transport Strategy identifies a number of options for increasing the use of the Thames, including: developing further piers; extending services and improving regularity and frequency. A lack of integration between water transport and other modes is also noted as a barrier to increased use of the Thames and other waterways for transport. The Transport Strategy was published in July 2001. Since this time work has been ongoing to improve the integration of river transport services with the wider transport network, such as through better signage and more visible maps[73]. *Transport Way to Go!* which outlines the Mayor's vision for transport in London and will inform the next transport strategy, refers to *"creating a vision for the increased use of the Thames"*[74].

Landscape, Historic and Cultural Environment

3.66 London is a city with a very rich history, and culture. With over 40,000 listed buildings and structures, and four of England's 16 World Heritage Sites it is one of the most important historic cities in the World.

3.67 English Heritage notes that:

> *"London has flourished by striking a successful balance between the old and the new. It is not a question of choosing one or the other. We must have both. The challenge is to reuse the legacy of historic buildings and areas we have inherited from past generations to regenerate failing parts of the city – to get the right buildings in the right places. Looking after the historic environment is intrinsically linked to making London a truly sustainable city"*[75].

[70] DfT Future of Transport White Paper, 2004: http://www.dft.gov.uk/about/strategy/whitepapers/previous/fot/
[71] TfL, 2007, *The London Freight Plan*: http://www.tfl.gov.uk/assets/downloads/businessandpartners/London-Freight-Plan.pdf
[72] GLA, 2001, *Mayor's Transport Strategy, Chapter 4M River Thames and Other Waterways*: http://www.london.gov.uk/mayor/strategies/transport/pdf/final_ch04m.pdf
[73] Personal communication from Helen Woolston, TfL, commenting on draft of this report.
[74] GLA (2008) *Transport Way to Go! http://www.london.gov.uk/mayor/publications/2008/11/way-to-go.jsp*
[75] Heritage Counts – The State of London's Historic Environment 2005, English Heritage (2005): http://www.english-heritage.org.uk/

3.68 As well as the River Thames and other historic waterways, London also has approximately 80km of canal network running through contrasting city landscapes. Green corridors and the Blue Ribbon Network run through built up areas and provide important habitat and open space, and also contribute to landscape. The London Plan (consolidated with alterations since 2004) recognises their importance for landscape quality, as well as biodiversity. The Blue Ribbon Network should also be *"respected as the location of a rich variety of heritage that contributes to the vitality and distinctiveness of many parts of London"*[76].

3.69 London Lakes, an initiative hosted by Wandsworth Borough Council to raise the profile and improve management of urban lakes notes that *"London's parks are a major asset to the capital and are famous throughout the world. They make an enormously important contribution to our quality of life. … Within a park we are drawn to a lake or pond. We have an image in our minds of reed fringed margins, floating water lilies, dragonflies darting over the water, ducks feeding and fish swimming below the water surface. The reality for many urban lakes is that what we actually see is eroded banks, murky water, rubbish and a total absence of plants"*[77]. Problems with urban lakes tend to stem from litter but also from declining water quality, excess algal blooms and resulting low-oxygen conditions.

3.70 While there is no single register of landscapes at risk, the national Heritage Counts in 2005 reported that nearly half of all parkland recorded in 1918 in England had been lost by 1995. Borough data is available for London, and shows that between 1918 and 1995, some boroughs have lost as much as 95% (Ealing) of parkland and the overall loss to be 30% across all London boroughs, although this very long time period covers significant social and economic transition so such losses are perhaps to be expected[78]. During the period from April 2002 to April 2008 there were 8 additional registered parks in London, from 140 to 148 respectively. Of these 148 registered parks in the capital, 5% are at high risk, 17% are at medium risk and 78% are at low risk[79].

3.71 The 2007 GLA's London State of the Environment Report[80] notes that historically, London's growth has put pressure on the river environment, modifying rivers by straightening, encasement in concrete straitjackets or being buried underground. *"River restoration seeks to recreate a more natural structure in rivers and so creating a more attractive landscape providing the opportunity to experience the sights and sounds of a living river"*. River restoration can thus play an important role in urban regeneration and the creation of sustainable urban communities through delivery of a range of social and environmental benefits[81].

3.72 A headline indicator for the London State of the Environment reporting is length of non-tidal river restored per year. For 2003 – 2007 *"full river restoration or significant improvement"* has been achieved in over 6km of watercourse:

- Restored: 1.97km;
- Partially restored: 0.15km;
- Significantly improved e.g. toe boarding[82] removal: 4.3 km;
- Total 6.42km.[83]

[76] GLA 2008, The London Plan (consolidated with alterations since 2004) London Plan, September 2006: http://www.london.gov.uk/thelondonplan/thelondonplan.jsp
[77] London Lakes: http://www.wandsworth.gov.uk/londonlakes/intro.htm
[78] Heritage Counts – The State of London's Historic Environment 2006 Indicators and data report, English Heritage: http://www.english-heritage.org.uk/hc2006/upload/pdf/HC_2006_LondonDATA.pdf
[79] Heritage Counts – The State of London's Historic Environment 2008, English Heritage : http://www.english-heritage.org.uk/hc/upload/pdf/HC08_London_Acc.pdf?1238419383
[80] GLA (2007)_ Greener London – The Mayor's State of the Environment Report for London http://www.london.gov.uk/mayor/environment/soereport.jsp
[81] London State of the Environment Report 2007, Chapter 6: Land Use. http://www.london.gov.uk/mayor/environment/soereport.jsp
[82] Toe boarding is a low wall built in the river channel to prevent erosion of the riverbank, usually made of timber.

3.73 In the mid-nineteenth century, a vast new sewer system was constructed in London to divert wastewater away from the River Thames in central London to outfalls downstream. This system was designed and built under the direction of Sir Joseph Bazalgette, the Chief Engineer to the Metropolitan Board of Works. It involved the construction of the Victoria, Albert and Chelsea Embankments as well as several pumping stations. As London's water supply and sewerage systems are modernised, it is essential that this rich heritage is conserved for future generations[84].

Biodiversity

3.74 London State of the Environment Report defines biodiversity as the variety of life on earth – all the species of plants and animals and their habitats[85]. The necessity of preserving biodiversity is recognised from an international level, for example through the Natura 2000 network[86] and the EC Habitats Directive[87] to a local level with borough level Biodiversity Action Plans. Biodiversity has intrinsic importance and is increasingly valued for its positive effects on standards of living together with associated economic benefits[88]. Two thirds of London's 1,600 square kilometres is occupied by green spaces or water. Around one third of this is private gardens, another third is parks or sports-use, and the remaining third is wildlife habitat[89].

3.75 In 2002 the Mayor published the first statutory Biodiversity Strategy for London[90]. The strategy sets two targets to measure the success of strategic objectives for biodiversity in London:

- No net loss of important wildlife habitat
- Areas of Deficiency in accessible wildlife sites are reduced.

3.76 The Mayor's Biodiversity Strategy notes that the Thames supports 118 species of fish and over 450 invertebrate species (in tidal Thames) and is an important nursery for North Sea species. Many birds also feed in the Thames' rich feeding grounds and *"the greater Thames Estuary is probably the most important in the United Kingdom for birds"*[91].

3.77 Before the expansion of suburban London, there were a wealth of farm ponds in London, however over 80% of these have been lost over the last 150 years due to built development and neglect. This in turn is threatening the survival of species such as newts[92]. Larger lakes in

Headlines relating to biodiversity in London include:

- Wildlife sites covered 17.1% (28,874 hectares) of total land in London 2003. This exceeds the 10% targets set out in the 1980 World Conservation Strategy.
- There are two Special Protection Areas (SPAs) which lie partially within Greater London. There are three Special Areas of Conservation (SAC) (Richmond Park, Wimbledon Common and Epping Forest) with a combined total of 2800 hectares. There are two Ramsar sites (the Lea Valley and South West London Waterbodies) with a combined area of 1276 hectares.
- There are 38 Sites of Special Scientific Interest (SSSIs) in Greater London, including Epping Forest and Hainault Forest, with a combined area of over 3800 hectares.

[83] London State of the Environment Report 2007, Chapter 6: Land Use. http://www.london.gov.uk/mayor/environment/soereport.jsp
[84] Water Strategy SA Scoping Report, ENTEC July 2006.
[85] London State of the Environment Report 2007, Chapter 7: Biodiversity. http://www.london.gov.uk/mayor/environment/soereport.jsp
[86] http://www.natura.org/ : Accessed 11/06/09
[87] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31992L0043:EN:HTML
[88] Water Strategy SA Scoping Report, ENTEC July 2006.
[89] London State of the Environment Report 2007, Chapter 7: Biodiversity. http://www.london.gov.uk/mayor/environment/soereport.jsp
[90] Connecting with Nature, the Mayor's Biodiversity Strategy, GLA 2002, http://www.london.gov.uk/mayor/strategies/biodiversity/biodiversity_strategy.jsp
[91] Ibid.
[92] Ibid.

London cover an area of more than 1500 hectares and are all artificial in nature, but still an important source of habitat for wildlife and plants.

3.78 The London State of the Environment Report 2007[93] notes that having access to nature has beneficial effects on well being, both in terms of physical exercise and mental health. Maintaining biodiversity is about maintaining the health of the local environment and this in turn will make it a pleasant place for people to relax and spend time in.

3.79 Both the biodiversity and quality of life value of London's river and water habitats is thus of great importance. The London State of the Environment Report states that London's rivers are valuable wildlife habitats, and river restoration and water quality have significant impacts on wildlife. River restoration is discussed briefly under Landscape, Historic and Cultural Environment above, and water quality is assessed in detail in the Water Management context topic below.

3.80 Flood management works and the inclusion of sustainable drainage systems (SUDS) in developments can also provide an opportunity to create and enhance habitats, with works at Sutcliffe Park in Greenwich recognised as a "wildlife gain" in the London State of the Environment Report for 2007. The draft Flood and Water Management Bill[94] removes the right for new development to connect to the sewerage network, and should result in more extensive use of SUDS for new developments. The Mayor's Biodiversity Strategy also recognises that allowing rivers to flood in places where this will do the least harm is both a more sustainable means of controlling flood risk, but also has secondary benefits for biodiversity in providing opportunities for the re-creation of riverside habitats.

Air Quality

3.81 London's air quality is among the worst in the UK, frequently exceeding national and European Union air quality objectives for monitored air quality pollutants. The London Air Quality Network monitors the quality of London's air at a large number of sites around the city, based on objectives related to the number of days agreed average acceptable mean levels of particular pollutants are exceeded or not. In 2005 and the months to June 2006 the annual mean NO_2 Objective was exceeded at all kerbside and roadside monitoring sites in London, a deterioration on the 2004 position. PM10 annual mean objectives were also exceeded over the same period at sites in Brent, Greenwich, Marylebone Road and Bexley[95].

3.82 The importance of air quality in London as an issue is further highlighted by the announcement in January 2009 by the European Commission that it is to commence legal proceedings against the UK for breaches in PM10 targets in London[96].

3.83 All of London's 33 Boroughs have declared themselves an Air Quality Management Area (AQMA). Most AQMAs are related to emissions of NO_x (nitrogen oxides) and particulates, largely associated with the volume of traffic on London's roads. Climate change is predicted to increase summer and reduce winter air pollution levels[97]. The higher temperatures and decreased cloud cover will increase the formation of ground level ozone, while more frequent and longer duration anti-cyclonic weather systems will increase air stagnation and reduce

[93] London State of the Environment Report 2007, Chapter 7: Biodiversity.
http://www.london.gov.uk/mayor/environment/soereport.jsp
[94] Defra (2009) Draft Flood and Water Management Bill (consultation draft)
http://www.defra.gov.uk/environment/water/flooding/flow/index.htm
[95] London Air, 2006, *Air Quality in London 2005 and mid 2006 Briefing*:
http://www.londonair.org.uk/london/reports/AirQualityInLondon2005andmid2006.pdf
[96] http://europa.eu/rapid/pressReleasesAction.do?reference=IP/09/174&type=H and
http://ec.europa.eu/environment/air/quality/legislation/pdf/pm10_exceedances_2005_07.pdf
[97] GLA (2008) The London Climate Change Adaptation Strategy, Draft report
http://www.london.gov.uk/mayor/publications/2008/docs/climate-change-adapt-strat.pdf

pollutant dispersal. The wetter winters predicted as a consequence of climate change will remove pollutants from the atmosphere and prevent their re-suspension.

3.84 Clean air is an important contributing factor to good quality of life. Air pollution has negative health impacts, and these particularly affect the most vulnerable[98] – the young and old and those suffering from respiratory diseases, and the impacts of poor air quality tend to be disproportionately felt in deprived areas[99]. It was estimated in 2005 that PM10 pollution in London alone caused 1031 premature deaths and another 1088 hospital admissions[100]. In addition poor air quality may also have an indirect affect on the health, as the perception of poor air quality may mean people are less likely to spend time outdoors – although poor outdoor air quality is likely to affect air quality indoors. This can have a negative impact on levels of physical activity and social cohesion[101].

3.85 The contribution of the water supply and sewerage systems to air pollution has not been separately quantified, but is likely to be very small. The main individual contributions are likely to come from the two sewage sludge incinerators at Crossness and Becton. Even so they are likely to account for only a tiny proportion of total nitrogen oxide (NO_X) and fine particulate (PM10) emissions in London[102].

Key problems and opportunities

3.86 Drawing on the review of other policies, plans and programmes and the baseline data, the key sustainability problems and opportunities issues for the SA and the Water Strategy to consider relating to the place and surroundings topic are summarised in Box 5.

Box 5: Key problems and opportunities – place and quality of surroundings

Problems

- Water related infrastructure developments might cause disruption, both to movement (roadworks), and in terms of noise.
- Poor integration between water transport and other modes.
- Loss of water bodies to development and through pollution and lack of maintenance and neglect e.g. of canals.

Opportunities

- Maximising the transport, amenity and recreation value of watercourses and water bodies in London. Encouraging walking and cycling along watercourses and canals.
- Restoring and protecting London's historic waterways, lakes and ponds and the heritage, biodiversity and landscape value they provide.
- Maximising the biodiversity and habitat creation, landscape and access to nature / open space opportunities that flood risk management and SUDS may offer.

Place and quality of surroundings – evolution of the sustainability baseline in the absence of the Water Strategy

3.87 In the absence of the Water Strategy, over the intended 10 year time frame of the strategy, the baseline under the Place and Quality of Surroundings theme is likely to evolve in the following way:

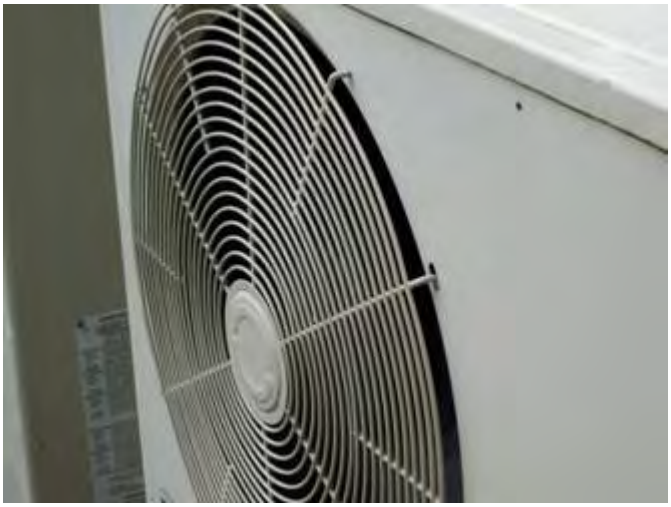
- Noise disturbance is likely to increase in the capital particularly due to increases in overall population and population density;

[98] GLA, 2002, *Cleaning London's Air, the Mayor's Air Quality Strategy*: http://www.london.gov.uk/mayor/strategies/air_quality/air_quality_strategy.jsp
[99] *The London State of the Environment Report 2007*, Chapter 4: Pollution, GLA 2007 http://www.london.gov.uk/mayor/environment/soereport.jsp
[100] Ibid.
[101] Ibid.
[102] ENTEC, 2006, Water Strategy SA Scoping Report.

- The amenity value of the blue ribbon network, and the use of the Thames for moving freight and passengers are likely to increase;
- Biodiversity in the capital is likely to come under increasing pressure as development and infrastructure is delivered to meet the needs of an increasing population. Climate change is also is likely put pressure on biodiversity and habitats; and
- Air quality may continue to decrease as the population increases could lead to a rise the need to travel and in particular the number of car journeys. However European and national legislation requires air pollution to be reduced, and at the London level action is and is likely to continue to be taken to tackle poor air quality, such as through low-emission zones. Air quality problems are also likely to be exacerbated by a changing climate, with higher average temperatures and lower cloud cover increasing the impact of air pollution.

Climate Change

3.88 This topic covers the critically important issue of climate change. Climate change is predicted to lead to significant challenges for London, both in terms of direct impacts on infrastructure and services, and in terms of the indirect effect it will have on factors such as the availability of water and extreme weather events and flooding. London's response will be to seek to mitigate the causes of climate change (reducing CO_2 emissions etc.) and to adapt to climate change which is already inevitable.



Policy context, relevant baseline and key trends

3.89 The key messages for this topic context from the review of relevant plans and programmes have been listed in Box 6:

Box 6*:* Key messages from the review of plans and programmes - climate change

Relevance to the strategy:

- National guidance and policy related to climate change as it impacts on water issues. For example Making Space for Water and the Planning and Climate Change supplement to PPS1 provides clear direction for climate change related policy. The Water Resources Strategy for England outlines the direction Environment Agency plans to take in managing water resources in a changing climate.
- The Climate Change Act (2008), and consultations on Water Metering and the Restriction of Non-essential water uses provide detailed context and emerging priorities for the national policy approach to climate change and water issues.
- The London Plan and the Mayor's Climate Change Action Plan, which sets targets for the reduction of CO_2 emissions (60% below 1990 levels by 2025). Emerging strategies are also relevant, notably the Climate Change Adaptation Strategy which is currently being developed.
- There is considerable climate change related research and guidance produced by regulators and public bodies, including the GLA (Evidence Base: Climate Change in the Further Alterations to the London Plan, GLA 2007). The Environment Agency reports, as reviewed in Appendix 6 in particular provide key direction in climate change related issues, such as catchment flood management, drought and river basin management planning (RBMPs).

Relevance to the SA:

- Key targets and information on key issues are presented in the baseline context information, below. For example, targets from the Mayor's Climate Change Action Plan are included in paragraph 3.99.
- These targets and conformity with policy and strategy relating to climate change has also been reflected in the SA objectives and criteria.

3.90 "*Climate change is the most pressing environmental, social and economic problem facing the planet today*"[103]. The United Kingdom taken as a whole is the world's eighth largest emitter of CO_2. London is responsible for 8% of all of UK emissions, producing 44 million tonnes of CO_2 each year. Figure 4 below shows a breakdown of London's CO_2 emissions by sector in 2006.

3.91 Looking into this data, energy use in existing homes is the largest single source of CO_2 in London, with 38% of the total. Hot water heating accounts for 18% of this figure for the domestic sector[104]. The commercial and industrial sectors combined contributed 40% of London's CO_2 emissions in 2006. 7% of this was for water heating. Ground based transport is responsible for 22% of London CO_2 emissions. This is relatively low for a city the size of London, and is attributed to the investment in and use of public transport in London, and policies to combat congestion and manage road traffic, such as the congestion charge[105].

3.92 Between 1965 and 1999, energy consumption in Greater London increased overall by around 16%, in spite of a net fall in population of 7%. Thus, the per capita rate of energy consumption has risen significantly[106]. However the Mayor's Climate Change Action Plan shows that since 1990, London's overall CO_2 emissions have gone down, from just over 45 million tonnes per year to approximately 44 million tonnes in 2006. The Action Plan identifies that this change is largely due to a halving of industrial emissions, due to the relocation of industrial activity to other parts of the UK or abroad, along with a significant shift in the UK's electricity generating mix, with a reduced contribution from coal and more from natural gas[107].

3.93 However, London's population is growing – with the London Plan projecting an increased from 7.57 million in 2006 to 7.94 – 8.19 in 2016, an increase of between 370,000 – 620,000 people – which is the equivalent of a city bigger than Leeds. This will impact on energy use, green house gas emissions and could lead to more people and property being at risk from the effects of climate change. Without concerted action to curb emissions, the Mayor's Climate Change Action Plan predicts that London's emissions of CO_2 are predicted to increase by 15% to 51 million tonnes by 2025[108]. The Mayor's action plan seeks to reduce these emissions by 7.7 million tonnes by 2025, and the plan asserts that *"half of this reduction can be delivered if just two thirds of Londoners make simple behavioural changes and put some basic energy efficiency measures in place*", such as using energy efficient light bulbs and appliances.

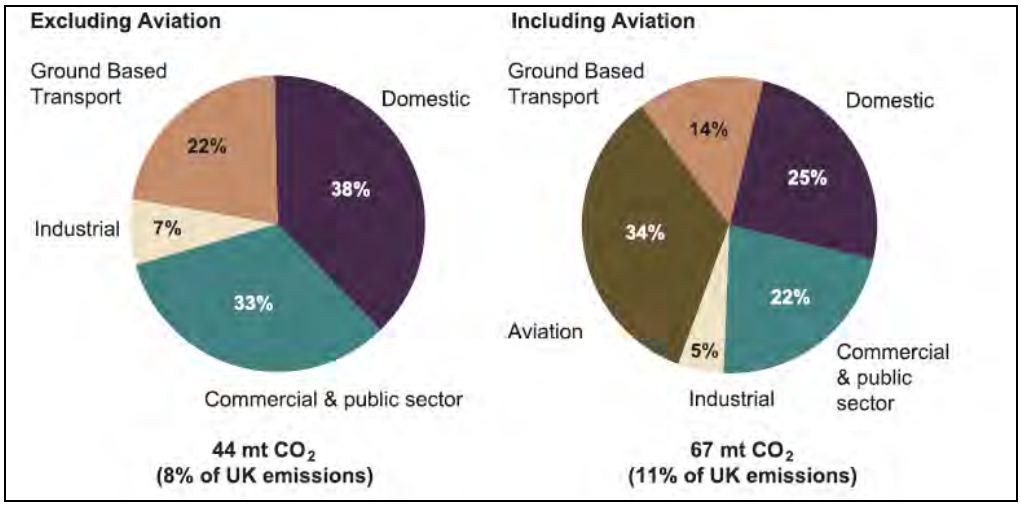
3.94 The draft Water Strategy (July 2009) identifies a number of issues raised by the fact that London is a dynamic, growing city, which taken with the effects of a changing climate is predicted to bring about:

- A greater demand for water from the mains network, and therefore from the environment
- An increased flow to, and discharges from, the sewage treatment works
- A greater risk of surface flooding as rainwater runs off new houses, driveways and roads

[103] London State of the Environment Report 2007, Chapter 1: Climate Change: http://www.london.gov.uk/mayor/environment/soereport.jsp
[104] GLA, 2007, Action Today to Protect Tomorrow, the Mayor's Climate Change Action Plan.
[105] Ibid.
[106] GLA, 2004, A Green Light to Clean Power – the Mayor's Energy Strategy.
[107] London State of the Environment Report 2007, Chapter 1: Climate Change: http://www.london.gov.uk/mayor/environment/soereport.jsp

- An increase in storm and tidal surges.

Figure 4: 2006 CO_2 emissions from London[109]



3.95 Even if all CO_2 emissions ceased immediately the projected temperature increases worldwide would continue until the middle of the century. Latest projections from the UK Climate Impacts Programme (UKCP09) indicate that, under a medium emissions scenario, climate change will lead to[110]:

- Winters that are 1-2ºC warmer by the 2020s and 3 – 4 ºC warmer by the 2080s.
- Summers that will be 1-2ºC hotter in the 2020s, and as much as 4-6ºC hotter by the 2080s.
- More frequent high summer temperatures, which will be exacerbated in central London due to the urban heat island effect.
- Winters that are 6% wetter by the 2020s and up to 20% wetter by the 2080s.
- Summers that are drier by 6% by the 2020s and by 22% by the 2080s.
- Potentially more / stronger wind storms[111].
- Less cloud cover.
- Relative sea level rise of 96cm and 2 metres by the end of the century[112].

3.96 While London currently has a very high standard of protection from tidal flooding, climate change will increase the probability of all forms of flood risk, and the city is already exposed to far greater potential damage from flooding than any other urban area in the UK[113]. A number of parts of London are within the tidal flood plain with over 150 square kilometres of London below high tide level[114]. The Mayor's Climate Change Action Plan estimates that 1.25 million people and property valued at over £80 billion is located in floodplain[115]. The Environment Agency identifies fluvial flooding from the rivers, surface water and sewer flooding from the drainage system, ground water flooding and combined tidal and fluvial as sources of flood risk

[108] GLA, 2007, Action Today to Protect Tomorrow, the Mayor's Climate Change Action Plan.
[109] Action Today to Protect Tomorrow, the Mayor's Climate Change Action Plan, 2007
[110] UKCIP (2009) Key Findings for London http://ukclimateprojections.defra.gov.uk/content/view/2148/528/
[111] GLA (2009) Climate Change Adaptation Strategy
[112] Ibid
[113] London's Warming – the impacts of climate change on London, summary report, UKCIP and GLA 2002
[114] Action Today to Protect Tomorrow, the Mayor's climate change action plan, GLA 2007
[115] Ibid.

in London, and that climate change will have a major effect on the extent and frequency of future flooding[116].

3.97 London's exposure to potential damage from flooding is so high due to the fact that it is home to such a large and dense population, and relatively vulnerable infrastructure, such as the underground network. The flood risk situation in London is further exacerbated by the fact that flooding potential comes from both upstream (fluvial flooding) and downstream from the tidal Thames (tidal flooding / sea surge).

3.98 A lack of surface permeability in public spaces is also exacerbating flood risks, as it minimises natural drainage opportunities. For example the loss of front gardens to parking and other hard surfacing is cited as a key component in London losing its ability to absorb rainfall naturally, thus leading to an increase in run-off, and pressure on the city's underground drainage system[117]. Furthermore over 70% of Thames tributaries are contained in a culvert or concrete channel; and the replacement of green space by roads and buildings has reduced the city's ability to absorb rainfall[118].

3.99 The Mayor's Climate Change Action Plan seeks for London to become an exemplar in the reduction of CO_2 from buildings, industries and transport. It includes an ambitious target of stabilising London's CO_2 emissions by 2025 at 60% below 1990 levels, with steady progress towards this over the next 20 years. This compares to the UK government's current aspiration, for a 60% reduction from 2000 levels by 2050.

3.100 The London Plan (consolidated with alterations since 2004) requires that developments should reduce the amount of CO_2 generated by 20% through the use of on site renewable energy generation, wherever feasible. The Mayor's Energy Strategy[119] encourages wind-power schemes, and recognises industrial areas, and particularly riverside locations in industrial and commercial use as being potential sites. The Strategy also advocates small scale hydro schemes in London, such as St Josephs RC School in Wandsworth, which receives power from a micro-hydro scheme on the River Wandle.

Key problems and opportunities

3.101 Drawing on the review of other policies, plans and programmes and the baseline data, the key sustainability problems and opportunities issues for the SA and the Water Strategy to consider relating to the climate change topic are summarised in Box 7.

Box 7: Key problems and opportunities – climate change

Problems

- The implications of increased population, economic growth and development in London will cause an increase in energy use and emissions.
- More frequent droughts, floods and extreme weather events.
- Energy use and CO_2 emission implications of water supply options, such as desalination, or pumping.

Opportunities

- Promoting riverside wind-power schemes and micro-hydro where appropriate.
- "Mode shift to lower carbon forms of transport" is expected to contribute 20% of the planned reduction in CO_2 emissions by 2025 from ground-based transport – river transport could play an important role in this.
- Reducing water use/ improving efficiency should reduce CO_2 emissions.

[116] Thames Region Catchment Flood Management Plan, Environment Agency 2009
[117] London Assembly, 2005, *Crazy Paving – the Environmental Importance of London's Front Gardens*: http://www.london.gov.uk/assembly/reports/environment/frontgardens.pdf
[118] *"Warmer, Wetter, Hotter Drier"* essay by Alex Nickson (GLA) and Dave Wardle (Environment Agency) for the East London Green Grid Primer, GLA 2006
[119] GLA, 2004, A Green Light to Clean Power – the Mayor's Energy Strategy.

- Improving contingency planning and increasing preventative measures to reduce the risks of dangerous climate change.

Climate change - evolution of the sustainability baseline in the absence of the Water Strategy

3.102 In the absence of the Water Strategy, over the intended 10 year time frame of the strategy, the baseline under the Climate Change theme is likely to evolve in the following ways:

- Climate change is likely to reduce the amount of water resources available to London, increase the average temperature (and frequency of heat waves), and increase the risk from all types of flooding. The urban heat island effect may be exacerbated by increased development densities in some areas;
- National and London policy is seeking to reduce CO_2 emissions dramatically over the period to 2050. Energy efficiency in new development, new technologies and raised awareness of climate change as an issue may lead to a decline in per-capita energy use and CO_2 emissions over the next 10 years. Although there has been a modest fall in emissions between 2002 and 2009 due in part to a decline in manufacturing[120], based on existing trends of increasing energy consumption per capita, overall energy consumption and emissions could in fact rise in the capital due to projected increases in population and economic development[121];
- If the predicted increase in population outweighs demand reduction efforts, together with the effects of climate change, this could undermine River Basin Management Plan and other strategic goals to improve water quality in London'. For example climate change and increased abstractions may reduce river flows, thus negatively affect water quality by increasing the concentration of effluent; and
- Climate change is likely to increase the risk of tidal, fluvial, and surface water flooding in the capital through a combination of rising sea levels and increasing frequency storm and extreme rainfall events.

Water Management

3.103 This context topic is important for the SA of the Water Strategy as it seeks to cover all aspects of the management of water in London. It provides information on the water management situation in London, and seeks to identify key issues and opportunities arising from these. The Sustainability Appraisal Objectives relevant to this topic are: **Water Quality**; **Water Resources**; **Drainage**; and **Flood Risk**. The information on water resources, drainage and flood risk is structured under: water quality, water supply and waste-water disposal.

[120] LSDC (2009) London's quality of life indicators 2008 – 09 report. http://www.londonsdc.org/documents/qol_reports/QoL_indicators.pdf

[121] The London Climate Change Action Plan (GLA 2007) indicates that electricity and gas consumption in London causes accounts for 75% of London's emissions and is set to increase by 15% by 2025, if nothing is done to reduce emissions.

Policy context, relevant baseline and key trends

3.104 The key messages for this topic context from the review of relevant policies, plans and programmes have been listed in Box 8:

Box 8: Key messages from the review of policies, plans and programmes - water management

Relevance to the Strategy:

- The Water Strategy (Defra 2008) and the Water Resources Strategy for England and Wales (Environment Agency 2009) set the national policy framework for water resources and quality.
- The draft Flood and Water Management bill should improve the effectiveness of managing the risk of flood and coastal erosion, improve the sustainability of water resources and protect against potential droughts.
- There are a large number of policy and regulatory documents relevant to the Water Strategy, as presented in Appendix 6. The Water Supply regulations for example set standards for water companies, in terms of water quality. Although the responsibility for meeting these requirements is for the water companies, the Water Strategy should refer to and support such standards.
- The Water Framework Directive Regulations and related River Basin Planning guidance set out the regulatory requirements expected of the Environment Agency in relation to the WFD. For example emerging River Basin Management Plans, which the Environment Agency is due to complete by the end of 2009. A large amount of information and data is being collated by the Environment Agency in relation to its' River Basin Planning responsibilities, and this information could provide a very useful input to monitoring implementation of the Water Strategy.
- Emerging and currently draft policy and legislation, such as that relating to restricting non-essential water uses, and water metering.
- National and London policy, for example the Code for Sustainable Homes includes standards for potable water usage per-capita in the home – the Water Strategy could encourage such standards to be met, or exceeded.
- Other Mayoral strategies, in particular the London Plan which includes nine policies directly related to water management (see Appendix 6) as well as many others indirectly related. London Plan policies considered to be directly relevant to the Water Strategy are:
  4A.3 – Sustainable design and construction
  4A.9 – Adaptation to climate change
  4A.12 – Flooding
  4A.13 – Flood risk management
  4A.14 – Sustainable drainage
  4A.15 – Rising groundwater
  4A.16 – Water supplies and resources
  4A.17 – Water quality
  4A.18 – Water and sewerage infrastructure
- Water management related reports and policy developed by the Environment Agency, in particular catchment flood management planning, drought plans, catchment abstraction management plans, Thames Estuary 2100, and in future, the River Basin Management Plan for the Thames Region.

Relevance to the SA:

- Specific targets relating to water and people and health were not been identified during the review. However, conformity with the goals of Government and Regional strategy has been reflected in the SA objectives and criteria.
- The policies, plans and programmes contain relevant baseline and key issues which have been drawn on in this context chapter. These are referred to as appropriate in the context text below.
- The Water Supply (Water Quality) Regulations 2000 and 2007 (Amendment are important as they provide detailed information on the requirements for water quality in supply and monitoring arrangements.

Water Quality

3.105 Defra reported that, in 2006[122]:

[122] Defra (n.d.) e-Digest Statistics about: Inland Water Quality
http://www.defra.gov.uk/environment/statistics/inlwater/kf/index.htm Accessed: 21/08/09

- 21% of the total river lengths in London were of good biological quality (England average 71%) and 37% were of good chemical quality (England average 66%).
- London was ranked ninth (last) of the English regions in terms of both biological and chemical water quality.
- However, the total river lengths classed as having good biological quality in London increased by 16 percentage points between 1990 and 2004, and lengths with good chemical water quality increased by 18 percentage points.

3.106 However water quality in the Thames is a lot better today than it has been for many years. After decades of poor water quality, the 1960s saw the combined effects of inadequately treated sewage, industrial discharges, thermal pollution from power stations and use of non-biological detergents meaning that parts of the estuary were considered 'biologically dead'. However in the late 1960s and 1970s improvements were made at the two main sewage treatment plants at Crossness in southeast London and Beckton in east London, resulting in a dramatic improvement in water quality. As a result, many different animals, birds and fish have returned to live and breed in the estuary. Today there are 121 different species of fish and over 170,000 birds in the estuary[123].

3.107 Drinking water quality in London is exceptionally high. In relation to drinking water in the Thames Region, the Drinking Water Inspectorates 2008 report on drinking water quality (in 2007)[124] concluded that:

> *"Drinking water quality across the region was maintained at the same level of compliance achieved in 2006, with compliance at 99.98% (based on 40 parameters).* Despite remaining the same overall, underlying this figure were a number of changes with fewer failures for 10 parameters (colour, taste and odour, sodium, nitrate, iron, nickel, lead, E coli and enterococci) which were offset by more failures for 3 parameters (antimony, pesticides and bromates) and first time failures for two further parameters (benzo(a)pyrene, and tetrachloromethanes)."

3.108 Although bottled water has to meet the 2003 EU Regulations[125] related to water quality, there are no labelling requirements to help people to determine if a product is suitable for their nutritional needs, nor compare it to similar products and to tap water. Thus bottled water is not required to reflect its chemical and bacteriological content[126].

Water Supply

3.109 Four companies supply London with water: Thames Water, which supplies 76% of London's population, Three Valleys Water, 14%, Essex & Suffolk Water, 6.6% and Sutton & East Surrey, 3.7%[127].

3.110 Each company has a duty to ensure the security of its water supplies. The security of supply index allows Ofwat to monitor compliance of the water companies with this duty. Thames Water currently ranks 20 out of 23 water companies in terms of their security of supply index and their security of supply index is C which indicates a 'significant deficit'[128].

[123] Thamesweb, the Thames Estuary Partnership Website: http://www.thamesweb.com/topic.php?topic_name=Water%20Quality
[124] Drinking Water Inspectorate (2008) Drinking Water 2007 Thames Region, http://www.dwi.gov.uk/pubs/annrep07/CIR07%20Thames%20Region.pdf
[125] Council Directive 80/777/EEC of 15 July 1980 on the approximation of the laws of the Member States relating to the exploitation and marketing of natural mineral waters
[126] http://www.ciwem.org/policy/policies/bottled_water.asp Accessed: 18 June 2009
[127] London Assembly Health and Public Services Committee Report (2006) 'Drought in London',
[128] Ofwat (2008) Service and Delivery – Performance of the water companies in England and Wales 2007 – 08, http://www.ofwat.gov.uk/regulating/reporting/rpt_los_2007-08.pdf

3.111 In a dry year, London has a deficit of 200 million litres a day, equivalent to the daily demand of 1.2 million Londoners[129]. London is among the driest capital cities in the world, with available water resources per head similar to that of Israel[130], and climate change is likely to make droughts like that of 2005/06 increasingly common. 80% of the capitals' water is abstracted from the Thames and the River Lee and stored in reservoirs; the remaining 20% come from local groundwater in the chalk aquifer under London[131].

3.112 Population growth is also increasing pressure on water supply. In 2004, there were 600,000 more people living in London than in 1991. The population is predicted to rise by up to 620,000 additional people by 2021. Based on current water use, water companies will have to provide approximately 105 million additional litres of water a day to meet the needs of the increasing population[132]. The Integrated Impact Assessment for the Mayor's Housing Strategy[133] identifies the additional housing planned for London over the next ten years will increase the amount of water resources consumed, and have a concomitant effect on amount of sewage produced.

3.113 The Environment Agency has estimated that, without any further action to manage water demand, under some models new strategic water resources may be required for London by 2020.

Leakage management

3.114 Leakage is defined by Ofwat[134] as '*the loss of water from the supply network, which escapes other than through a controlled action*'.

3.115 Ofwat distinguishes between distribution losses which include all losses of potable water between the treatment works and the highway boundary and supply pipe losses or leakage from customers' pipes between the highway boundary and the customer's stop tap. The sum of these components does not include internal plumbing or losses of untreated water[135].

3.116 Ofwat sets targets for water companies to reduce leakage to the sustainable economic level (SELL), i.e. the level at which it costs more (including environmental and social costs) to reduce leakage than to obtain water from another source[136].

3.117 Supplying water requires energy and consequently produces carbon emissions. The national average of energy use and CO_2 emissions in 1998/99 for the supply of water were 468 kWh per million litres of water supplied, producing 209 kg of CO_2[137]. The total greenhouse gas emissions (from energy use only as per Carbon Reduction Commitment guidelines) for the water and sewerage sectors is 3.5 million tonnes CO_2e, and if transport and process GHGs emissions are included (as per Defra guidelines) the total is 4.5 million tonnes CO_2e[138].

3.118 Thames Water failed their leakage reduction targets in 2005-06 but managed to exceed its target for 2006-07. Ofwat warned in 2007 that '*although the company is now well on track to meeting Ofwat's regulatory targets, there is a still a lot of work to be done. Thames Water*

[129] Environment Agency (2006) 'Planning for a better London'
[130] UKCIP and GLA (2002) London's Warming – the impacts of climate change on London, summary report,
[131] GLA (2006) "*Warmer, Wetter, Hotter Drier"* essay by Alex Nickson (GLA) and Dave Wardle (Environment Agency) for the East London Green Grid Primer
[132] Ibid.
[133] GLA (2009) The London Housing Strategy – Draft for Public Consultation: Integrated Impact Assessment
[134] Ofwat (2008) Service and Delivery – Performance of the water companies in England and Wales report 2007 -08 http://www.ofwat.gov.uk/regulating/reporting/rpt_los_2007-08.pdf
[135] Ibid.
[136] Ibid.
[137] BRE (2004) 'Energy use and CO_2 emissions in the Water Industry' Newsletter, Issue 4
[138] Ofwat (2008) Service and Delivery – Performance of the water companies in England and Wales report 2007 -08 http://www.ofwat.gov.uk/regulating/reporting/rpt_los_2007-08.pdf

cannot afford to be complacent and Ofwat will continue to monitor closely the company's future performance'[139]. The company did better than its leakage target for 2007-08.

3.119 Leakage by Thames Water in 2007-08 was 715 ml/d (million litres per day) compared to a target of 755 ml/d[140]. The leakage targets set by Ofwat for Thames Water for the remainder of the 2005-10 price review period (to 2009-10) is 685 Ml/d[141].

3.120 However, fixing leaks and replacing mains is not only expensive but can cause considerable disruption especially to road transport, air-pollution (dust) and noise if it is not adequately managed. Thames Water currently applies for nearly one million permits for street works every year. Work is being carried out in 23 areas of London and in one of those areas 60 bus routes have been disrupted. Thames Water claims that there is a limit to the amount of leakage repair work that can be done in London at any one time and that it needs to be carried out by highly skilled workers[142].

3.121 In addition leakage itself can cause disruption, for example a mains water leakage in Brentford (London Borough of Hounslow) in May 2006 caused severe 'traffic disruption and the closure of a mental health care day centre' as well as damage to the fabric of the road[143]. However, a recent initiative to encourage utility companies to reduce their disruptive impacts on road traffic may help reduce the negative impact of leakage repair works[144].

3.122 Supply pipe losses are also significant. It has been estimated that around 30% of leakage in the UK comes from customer-owned supply pipes[145]. During 2007-08, as in previous years, the bulk of leakage savings reported were the result of company's activity in repairing and replacing consumers' supply pipes. In 2007-08 this delivered savings of 46 million litres/day, an increase of 4 million litres/day on the previous year, representing 69% of the total water efficiency savings. Water suppliers have policies to assist customers with repairs. Thames Water has a policy for fixing only the first leak and only external leaks and for owner-occupiers only[146]. Supply pipe losses can often go undetected unless a property is metered.

Pressure Management

3.123 Thames Water is currently carrying out a 'Network Improvement Project'[147]. One of the two areas of work is 'pressure management' which aims to reduce fluctuations in pressure in the water mains in order to reduce leakage and burst pipes.

3.124 However, a long-term reduction in water pressure in London could have serious implications for, among others, those living above the third storey in a block of flats, those with combi-boilers (which are increasingly being installed as they are more energy efficient) and the

[139] Ofwat (29 June 2007) 'Ofwat statement on Thames Water's leakage performance'. Available: http://www.ofwat.gov.uk/legacy/aptrix/ofwat/publish.nsf/content/pn2007.html
[140] Ofwat (2008) Service and Delivery – Performance of the water companies in England and Wales report 2007 -08 http://www.ofwat.gov.uk/regulating/reporting/rpt_los_2007-08.pdf
[141] Ibid.
[142] Richard Aylard, External Affairs and Environment Director, Thames Water in the 16 May 2006 meeting of the Health and Public Services Committee on 'Drought in London'
[143] Disruption in Brentford due to flooding, London Borough of Hounslow news archive, May 2006: http://www.hounslow.gov.uk/text/25_may_brentford_flood
[144] http://www.tfl.gov.uk/corporate/media/newscentre/archive/11511.aspx
[145] Water UK, 'Towards Sustainability, 2005-2006, Highlights'
[146] There are two options in the policy– a (1) free repair or (2) subsidised relay. (1) Free repair option available to domestic customers who are owner-occupiers experiencing their first leak on their external supply pipe. Repairs are covered by a one-year warranty (subsequent repairs charged at £350). (2) The subsidised relay option is broken down into two choices: (a) replacement of the supply pipe from the boundary to the point of entry of the building covered by five-year warranty or (b) a full relay, replacement of supply pipe from the boundary to the inside stop valve covered by a ten year warranty. Service and Delivery – Performance of the water companies in England and Wales supporting information report 2007-08, , Ofwat 2008 p. 55
[147] Thames Water 'Improvements to our water supply network', http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/5327.htm

emergency use of fire sprinklers and fire hydrants[148]. The health and equality implications of this are discussed in the People and Health context topic above.

3.125 London's water is delivered by a pumped distribution system, as opposed to a gravity fed one. Thames Water sets the water pressure at which the water flows through the pipes, however a set pressure cannot be delivered across the whole of London. Water pressure is a function of the pressure set by Thames Water, the topography of the area, the demand, whether an individual lives above the third floor and the extent to which there are leaks and bursts in local pipes[149].

3.126 Thames Water's supply in London is divided into more than 800 different 'district metering areas' (DMA), each of which has different pressure at different times of the day depending on changes in levels of demand[150]. Therefore, pressure can be reduced in some areas and not in others.

3.127 The Water Industry Act 1991 requires the water undertakers to provide a supply of water sufficient for domestic use, but they are not required to provide water at a height greater than that to which it would flow by gravitation from the reservoir or tank from which the supply is taken. A minimum pressure of 0.7 bar[151] has to be maintained in pipes under the Water Supply and Sewerage Service (Customer Service Standards) Regulations 1989. Nevertheless, Ofwat's service standards establish 1 bar as the minimum, and much of London exceeds this rate and has approximately 3 bars pressure[152].

3.128 Key issues that emerged from the London Assembly Health and Public Services inquiry into Thames Water's Network Improvement Project included[153]:

i) Buildings with more than three storeys would have to install additional pumping equipment and backflow prevention devices, to prevent contaminated water in the mains flowing back into the water supply and to ensure adequate pressure for showers and washing machines. The cost of fitting new pumps could be in the region of £6,000 to £25,000 per property. For council housing alone, it is estimated that the cost of installing pumps in 300,000 houses could be between £90 million and £340 million, and the cost to the whole of London could be £1 billion. Thames Water disputes this figure.

ii) Additionally, the lower the pressure the higher the risk of bacteria and other contaminants entering the system, for instance, through leakage or broken pipes. Furthermore, the installation of pumps could increase the risk of backflow of contaminated water into the drinking water supply. The installation equipment to prevent backflows in every dwelling where there is additional pumping equipment would be costly. Haringey Council estimate that the installation of anti-backflow equipment across 15 sites they identified could cost £1.4 million; five times that of the pumping equipment itself.

iii) The impacts on the physically and economically vulnerable, including those living in care homes, hospitals, dialysis patients, low income, elderly and those who are being cared for at home.

iv) Impacts on combi-boilers and fittings. Combi-boilers will cease to work if water pressure drops to a certain level and the hot water will cut out. Also some showers and taps need a certain pressure to work effectively. However, Thames Water maintains that pressure would not be reduced to less than 1 bar and combi-boilers are designed to work with pressure under 1 bar. But pressure is variable and depends on other things such as demand, etc, so this could remain a problem.

[148] London Assembly Health and Public Services Committee Report (2005) 'Under Pressure'
[149] Ibid.
[150] London Assembly Health and Public Services Committee Report (2005) 'Under Pressure',
[151] 1 bar is the pressure needed to raise water to a height of 10 meters, approx. 2 storeys high
[152] London Assembly Health and Public Services Committee Report (2005) 'Under Pressure'
[153] Ibid.

v) Impact on the fire service as lower water pressure could make ineffective water sprinklers and also fire hydrants.

3.129 As well as affecting those vulnerable groups cited in (iii) above, lowering pressure would also particularly affect those living in high rise buildings. In the recent Health Workshop, it was pointed out that as lower income groups are more likely to live in high rise buildings this would be a differential effect on certain groups.

Water abstractions

3.130 Catchment Abstraction Management Strategies (CAMS) are strategies prepared by the Environment Agency for managing water resources, abstractions and licenses at a local level. There are two CAMS that affect London:

i) The London CAMS which includes a number of tributaries that join the Thames between Kingston and Erith, but not the Thames. The main rivers are the Brent, Crane and Lower Lee (downstream from Feildes Weir) in the North and Hogsmill, Beverley Brook, Wandle and Ravensbourne in the South[154].

ii) The Thames Corridor CAMS which covers water resources and licensing in the River Thames[155].

3.131 A classification system has been developed in order to provide information on the availability of water resources within a catchment. The 'resource availability status' indicates the relative balance between committed and available resources, showing whether licenses are likely to be available and highlighting areas where abstraction needs to be reduced[156]. There are four categories of resource availability status (see Table 11).

3.132 There are five Water Resources Management Units (WRMUs) in the London CAMS that include both surface and groundwater. Of these, one WRMU is over-abstracted, one is over-licensed, two have a 'no water available' status and only one has a 'water available' status[157].

Table 11: Resource availability status categories[158]

Indicative resource availability status	Definition
Water available	Water likely to be available at all flows including low flows. Restrictions may apply.
No water available	No water available for further licensing at low flows although water may be available at higher flows with appropriate restrictions.
Over-licensed	Current actual abstraction is resulting in no water available at low flows. If existing licences were used to their full allocation, they would have the potential to cause unacceptable environmental impact at low flows. Water may be available at high flows with appropriate restrictions.
Over-abstracted	Existing abstraction is causing unacceptable environmental impact at low flows. Water may still be available at high flows with appropriate restrictions.

3.133 Additionally, there are three WRMUs in the Thames Corridor CAMS. Two of those are over-abstracted and the third has a 'no water available' status[159].

[154] Environment Agency (2006) 'The London CAMS, Final Strategy Document'
[155] Environment Agency (2004) 'Thames Corridor CAMS'
[156] Ibid.
[157] Environment Agency (2006) 'The London CAMS, Final Strategy Document'
[158] Ibid.

3.134 Current abstraction levels in the Thames region are 10% higher than ideal from an environmental perspective[160].

New resource development

3.135 There are a number of possible new water resource options ranging from desalination to effluent re-use. None of these options is without environmental, and / or public health impacts and economic costs.

Desalination

3.136 Ofwat believes that Thames Water cannot achieve 'security of supply' by 2009-10 without developing new resources, particularly the planned desalination plant in Newham (East London)[161]. The Government approved the construction of the plant on 15 June 2007[162]. The project is currently underway[163] and will deliver 148 million litres/day when complete (during 2009 – 10)[164].

3.137 Desalination is however a very energy intensive process; for every day that the desalination plant is in full use, the emissions would excess of 150 tonnes of carbon dioxide. Thames Water's predicted use pattern for the plant would lead to the emission of 22,600 tonnes of carbon dioxide per year[165]. However, Thames Water has stated that the desalination plant will run on biodiesel, and that they are investigating other sources of renewable fuels[166]. There are other concerns associated with desalination, e.g. the need to dispose of the highly saline effluent which could affect river / estuary water quality, the impact of intake pipes on aquatic organisms, and the visual impact of the plant[167].

3.138 Desalination could be justified in some circumstances for instance as a way of dealing with peaks in demand where there is a high seasonal tourist population[168].

Reservoirs

3.139 Reservoirs which store water when it is more plentiful (i.e. in the winter), for use when there is higher demand (i.e. the summer), are another potential new water resource option. There are several new reservoirs being considered in south east England. Thames Water, for example, has proposed a major new reservoir near Abingdon in Oxfordshire to help cope with the projected future increase in demand for water from London, Swindon and Oxfordshire. The reservoir is expected to cost around £1 billion and would cover an area of approximately 10 square kilometres and hold up to 150 million cubic metres of water. Thames Water had intended to apply for planning permission for this development in May 2008, however it was been decided to include consideration for the reservoir in Thames Water's updated Water Resources Management Plan[169]. The Environment Agency, in its response to the draft Plan, has said that it is yet to be satisfied that the proposed reservoir is the best solution for the

[159] Environment Agency (2005) 'Thames Corridor CAMS, Annual Update'
[160] Environment Agency officer cited in London Assembly Environment Committee 'Down the Drain, London's Water Usage and Supply', 2005
[161] Ofwat (2006) 'Security of Supply, Leakage and Water Efficiency Report 2005-6'
[162] Thames Water, 15 June 2007, 'Thames desalination plant to be powered by green energy'
[163] Thames Water http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/2802.htm
[164] Thames Water (2008) Draft Water Resources Management Plan. Thames Water indicate that the intention is that the final Water Resources Management Plan will be published in July 2009, though it was not available at time of drafting this report (16/07/09)
[165] Appeal by Thames Water Utilities Limited Site at Beckton Sewage Treatment Works Opening Submission on Behalf of the Mayor of London
[166] Thames Water http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/2807.htm
[167] CIWEM Information Resources: Desalination, www.ciwem.org
[168] Environment Agency (2006) Do we need large-scale water transfers for south east England?',
[169] Thames Water (2008) Draft Water Resources Management Plan

company's customers, the environment and the wider South East[170]. Thames Water responded that the scheme would be delayed by five years and reduced in size by a third (from 150 million cubic metres to 100 million cubic metres)[171].

3.140 Reservoir developments tend to be unpopular in the area where the development is proposed. As a consequence of the development, people may have to be relocated and there can be a loss of agricultural land and associated employment. Reservoir construction can use significant amounts of natural resources and can be disruptive and cause increase in traffic and noise over several years, during construction. Another serious issue is planning blight; people may not be able to sell their homes until the impact of the development becomes clear. Once built, reservoirs often become tourist attractions[172], with the associated potential for recreational and economic benefits but also some negative impacts such as traffic generation and loss of tranquillity.

Water transfers/water grid

3.141 Another option to increase supply would be to build a 'water grid' which would consist of large pipelines to move water to south east England. The Environment Agency considerers that although this is a feasible option it would only be justifiable if:

- The demand for water in south east England exceeds the available supply; and
- There are no better, cheaper options locally[173].

3.142 The cost of developing and transferring water from Wales to London, for example, has been estimated at least four times the cost of developing new reservoirs in the South East and pipeline to bring the water to London. Additionally, using the River Severn as part of a transfer network would have significant environmental impacts[174].

Effluent re-use

3.143 Sewage treatment plant effluents are normally discharged to a river or the sea. This option takes treated effluent from a sewage treatment plant and uses it to further the public water supply. The main advantage effluent re-use is that it can provide a reliable source of water. Public health is obviously the main concern[175].

3.144 This is a particularly good option when the effluent is discharged to sea as the removal of discharges inland would affect river flows, particularly in summer[176].

New boreholes

3.145 There is little scope in south east England for new groundwater abstraction[177], so this is not likely to be a very feasible option in most cases.

Water use data

3.146 Averaged over the past five years, the household water use in London is 161litres per person per day[178]. This is slightly higher than the average for England and Wales, which was

[170] The Environment Agency's representation on Thames Water Draft Water Resources Management Plan, Environment Agency 2008 http://publications.environment-agency.gov.uk/pdf/GEHO0808BOOB-e-e.pdf?lang=_w
[171] Thames Water (2009) Statement of Response – Draft Water Resources Management Plan http://www.thameswater.co.uk/cps/rde/xbcr/corp/statement-of-response.pdf
[172] Do we need large-scale water transfers for south east England?', Environment Agency, 2006
[173] Ibid.
[174] Ibid.
[175] Ibid.
[176] Ibid.
[177] Ibid.
[178] Draft Water Strategy, May 2009

estimated as 150 litres per person per day[179]. Water use in London has risen steadily during the twentieth century[180] and there is a dry year deficit of 170 mega litres/day, equivalent to 1.1 million Londoners' daily demand[181]. The Environment Agency predicts that per capita consumption is expected to rise in London in the long term, but that overall average should show a fall until 2020 as more people have water meters installed[182].

3.147 Water companies currently forecast an increase in the per capita use of water, mostly based on predictions for a reduction in the average household occupancy[183]. The average per capita consumption of a one person household is 78 litres per person per day more than a household with four people[184].

Water efficiency

3.148 Water companies have a duty to promote water efficiency but do not have targets to improve household water efficiency, which could contribute significantly to achieving security of supply[185].

3.149 A recent Institute for Public Policy Research (IPPR) report[186] identifies several challenges for encouraging water efficiency:

- A minority of households in the UK pay for water on a metered basis so most people have no direct financial incentive to use less water.
- People's relationship with water is complex and few relate their water use to its environmental impact. Water is usually perceived as plentiful in the UK. Additionally, people's practices are often part of a well established routine and embedded within a set of social norms, which complicates efforts to influence behaviour.
- There is public mistrust of the motives of water companies in encouraging customers to use less water, especially when companies fail their leakage targets or report an increase in benefits.
- The evidence base on the cost-effectiveness of demand management measures is not as robust as for supply-side measures partly due to the influence of behaviour on demand. In their price reviews, companies usually struggle to secure funding to undertake large-scale water efficiency trials. This is in contrast to the funding of investigative work on supply-side measures.
- Water efficiency technologies have a low market uptake. There are several possible reasons for this including an assumption that water-efficient products are of lesser quality, the lack of public information on water efficient products and fittings for homes, no labelling scheme in place, and no incentives for domestic consumers to buy them.

3.150 Metering can reduce water use by 10-15%[187]. Water companies must install meters in all new homes and there are plans for a phased approach to installing new meters on change of occupancy. Customers can ask to have a meter installed[188]. Thames Water plans to bring

[179] Draft Water Strategy, GLA August 2009
[180] Ibid
[181] Environment Agency State of the Environment (London) http://www.environment-agency.gov.uk/research/library/publications/34083.aspx
[182] Ibid
[183] Institute for Public Policy Research (IPPR) (2006) 'Every drop counts, Achieving Greater Water Efficiency'
[184] Environment Agency State of the Environment (London) http://www.environment-agency.gov.uk/research/library/publications/34083.aspx
[185] Institute for Public Policy Research (IPPR) (2006) 'Every drop counts, Achieving Greater Water Efficiency'
[186] Ibid. p.9
[187] Environment Agency (no date), Household water metering: Position statement: http://www.environment-agency.gov.uk/research/library/position/41229.aspx
[188] London Assembly Health and Public Services Committee Report (2006) 'Drought in London'

the level of metering in London to 77% within 15 years[189], and has proposed beginning a 10-year programme of compulsory metering of households in 2010[190].

3.151 It is important to have appropriate tariffs so that lower income and other vulnerable groups are not disadvantaged by the increase in metering (see People and Health context topic above)

3.152 Reducing water use would result in energy savings and a reduction in CO_2 emissions: IPPR's calculations suggest that 10% reduction in total household water demand could result in carbon savings of 126 tonnes per day or 45,990 tonnes per year. This does not include energy savings from a reduction in hot water use within the home. As noted under the climate change context topic above, water heating contributes 18% of CO_2 emissions from homes in London. This level of saving could contribute to the UK's domestic target to cut carbon emissions by 26% by 2020[191].

3.153 However, energy usage in the water industry is expected to increase in the future as a result of more strict water quality treatments and rising demand leading to increased pumping of water between resource zones and the development of energy intensive desalination plants[192].

Domestic water efficiency

3.154 Recent studies show that potential water savings in the existing housing stock are estimated to range from 12% to 30%. The variation reflects the influence of individual behaviour[193].

3.155 The recent IPPR report[194] reviews the following studies:

- The Sustainable Development Commission (2006) estimates that a 30% reduction in water demand is achievable in an average home through retrofitting of more efficient appliances and minimisation of demand.
- The Environment Agency (2006) estimates a reduction of 14% through retrofitting only. The Agency estimated that a packet of five retrofit measures could save 103 million litres per day, based on a moderate take up in metered households. Higher take up could save up to 382.7 million litres per day. Based on an average water bill, the Agency calculated a payback period of between 22 and 26 months for the retrofit measures.
- The Market Transformation Programme (2006) identified technical savings potential of 12%, with further savings achievable through metering. It also produced scenarios that suggest that by 2020, policies to encourage take up of more efficient products could reduce household demand significantly.

3.156 Water companies have a duty to promote water efficiency in the household, but expenditure in this area has declined since 1997. The current regulatory system rewards supply expansion and profits are made by selling more water and treating more wastewater. There are no such incentives for investing in demand management and other efficiency measures[195].

3.157 Due to the current low penetration of metering, there is no financial incentive for most individual households to retrofit their homes. A study in 2005[196] highlighted that *"for householders to take the lead in improving their homes they must be able to do it at a low cost, with minimal disruption and maximal financial and environmental benefits"*.

[189] Thames Water (2009) Draft Water Resources Management Plan – Statement of Response
[190] Thames Water (2008) Draft Water Resources Management Plan
[191] Ibid.
[192] Yorkshire Water (2005) cited in Institute for Public Policy Research (IPPR) (2006) 'Every drop counts, Achieving Greater Water Efficiency'
[193] Institute for Public Policy Research (IPPR) (2006) 'Every drop counts, Achieving Greater Water Efficiency'
[194] Institute for Public Policy Research (IPPR) (2006) 'Every drop counts, Achieving Greater Water Efficiency'
[195] Ibid.
[196] AEA Technology (2005) cited in Environment Agency (2006) 'Marketing Strategies to Promote Retrofitting Behaviour'

Use of reclaimed water (greywater and rainwater) for non-potable needs

3.158 The third item in the water use hierarchy (draft Water Strategy, July 2009) refers to the use of rainwater and greywater for non-potable uses. The use of reclaimed water would require a separate or dual supply system as opposed to the current single supply of drinking-quality water.

3.159 Table 3.4 in the draft Water Strategy summarises the potential sources and end uses of rainwater and greywater respectively:

- The source of rainwater is roof guttering and the potential end uses are: toilet flushing, car washing and plant watering.
- The sources of greywater may be wash basins, baths and showers and potential end uses are toilet flushing and car washing.

3.160 Reclaimed water systems require adequate maintenance including suitable water treatment, i.e. depending on the source of the water and the levels of bacteria, the duration of storage and the potential level of contact with humans which can be very low, e.g. toilet flushing or higher, e.g. car washing[197]. Currently, there are no required standards for reclaimed water, but the draft Water Strategy indicates that Defra intends to produce appropriate standards for non-potable water.

3.161 Health risks associated with rainwater harvesting are very low and considerably less than the level considered tolerable for drinking water supplies[198]. Greywater contains lower levels of organic matter and nutrients than wastewater; however heavy metals are in the same concentration range[199] so it would have to be adequately treated prior to use.

3.162 A potential additional risk of greywater/dual systems are misconnections with the drinking water system. The Water Supply Regulations (1999) impose legal requirements to avoid cross-connections and backflow of greywater into the drinking water system by placing an obligation on installers not to allow such cross-connections and to clearly mark the different pipes and fittings to distinguish between recycled and mains water[200].

3.163 Rainwater harvesting systems can be installed in both new and existing buildings. Rainwater can be used for all non-potable uses, i.e. all purposes except drinking. These systems can be expensive: a basic system has an approximate cost of £1,500 and plumbing and fitting costs can exceed £1,000[201] per dwelling.

3.164 The Environment Agency estimates that using greywater for toilet flushing can save up to 18,000 litres of water a year for each person. Toilet flushing accounts approximately for one third of domestic water usage[202]. However, *"in practice most domestic roof areas are too small to satisfy all this potential demand regardless of storage cistern size, so it important to evaluate the potential savings before investing in an expensive installation"*[203].

3.165 When running costs are included, rainwater harvesting systems have been found to be less cost effective than efficiency measures such as reduced flush toilets by Grant (2002). He also found that the environmental impact of rainwater harvesting, including energy use for

[197] Reclaimed Water Systems, Information about Installing, Modifying or Maintaining Reclaimed Water Systems, Water Regulations Advisory Scheme 1999 http://www.wras.co.uk/pdf_files/IGN%209-02-04%20Reclaimed.pdf
[198] Fewtrell L and Kay D. (2007) A desk-top health impact assessment of rainwater harvesting in the UK. Centre for Research into Environment and Health. Submitted to Water Research
[199] Eriksson E, Auffarth K, Henze M, Ledin A. (2002) 'Characteristics of grey wastewater' Urban Water 4, 85-104
[200] Environment Agency, Conserving water in buildings: A Practical Guide, available: http://www.environment-agency.gov.uk/static/documents/Leisure/geho1107bnjree_1934318.pdf
[201] Environment Agency 'Rainwater Harvesting', www.environment-agency.gov.uk
[202] Environment Agency, Conserving water in buildings: A Practical Guide, available: http://www.environment-agency.gov.uk/static/documents/Leisure/geho1107bnjree_1934318.pdf
[203] Environment Agency, Conserving water in buildings: A Practical Guide, available: http://www.environment-agency.gov.uk/static/documents/Leisure/geho1107bnjree_1934318.pdf

pumping is higher than for efficiency measures even when taking into account the potential reduction in combined sewer overflows[204].

3.166 The Environment Agency notes that *"in existing housing, it is generally more economic to employ water-saving measures than to reuse rainwater or greywater. However, with new developments, rainwater reuse becomes a more attractive option"*[205] due to economies of scale and ease of fitting.

3.167 Another potential issue is that rainwater storage could induce perceptions that water is plentiful and therefore cause some people to increase their use.

3.168 However, rainwater harvesting has the additional benefit that it can contribute to reducing the risk from surface and sewer flooding and also reducing volumes to combined sewers and consequently sewage pollution in water courses. In residential areas, sewer flooding presents considerable risk as both local residents and emergency services may be exposed to the many chemical and microbiological agents present in sewage[206].

3.169 Water butts are a lower cost option to provide storage for rainwater which can be used for watering gardens. Water butts offer storage capacity between 100 and 700 litres and their price ranges from approximately £30 to £350[207].

Drainage

Traditional rainwater drainage

3.170 Traditional rainwater drainage aims to remove run-off from built up areas as quickly as possible usually by collecting it in pipes and thus minimise the risk of flooding in the immediate area[208].

3.171 Traditional drainage systems fall into two categories[209]:

- Combined sewer systems, where a single pipe is used to convey foul sewage and surface run-off. Sewage is carried to a treatment works of limited capacity requiring stormwater overflows that may allow sewage to spill into watercourses during heavy rains.
- Separate sewer systems, where foul sewage and run-off are conveyed in separate pipes that carry the sewage to a treatment works and the run-off to a watercourse. Although better than the combined system, this system also causes water pollution: run-off is contaminated as it flows through an urban area with pollutants such as heavy metals, oils and petrol, organic debris, silt, dust, pesticides and detergents which are discharged into a water course.

3.172 The issues relating to wastewater disposal in London are dealt with in more detail in the following section on the wastewater disposal hierarchy. A map showing the sewer systems in London is included in the draft Water Strategy (see Figure 5.1).

Rainwater drainage in London

3.173 Most of central London's drainage system was constructed by the Victorians in the 1850s. London's sewers are designed to carry a combination of sewage and rainfall. Increased

[204] Nick Grant (2002) 'Water Conservation Products. A Preliminary Review', Elemental Solutions
[205] Environment Agency, Conserving water in buildings: A Practical Guide, available: http://www.environment-agency.gov.uk/static/documents/Leisure/geho1107bnjree_1934318.pdf
[206] Bridges O. (2003) 'Double trouble: health risks of accidental sewage release' Chemosphere 52 1373-1379
[207] See, for example, Water Butts Direct: http://www.waterbuttsdirect.co.uk/viewall.htm?gclid=CITx1a_3zJkCFQEpGgodCxvTuQ
[208] CIRIA Report 523 (2000) 'Sustainable Urban Drainage Systems, Best Practice Manual'
[209] Ibid.

development in London means that more ground is covered by impermeable surfaces and less rainfall is absorbed into the ground and consequently more is going into the drains[210].

3.174 During heavy rains, drainage pipes overflow and the contents of the sewers are discharged into receiving watercourses. This has not only an impact on the water environment but can also result in localised flooding when rivers burst their banks. West London suffered flash flooding in August 2004, with significant damage to streets and homes, loss of water supply and overflow of raw sewage in the Thames[211].

3.175 Surface water flooding also occurs when London's drainage system cannot cope with rainfall and flooding spreads from water collecting on roads and pavements. This type of flooding is becoming more common, due to a number of factors which include an increase in the frequency of intense storms which is expected to worsen due to climate change and an increase in development[212].

3.176 As noted, the increase in impermeable surfaces due to development and paving of front gardens in London is another factor. These surfaces do not allow water to be absorbed by the ground and reduce the time it takes for the water to reach the drains[213].

3.177 More than a third of London's green spaces and one fifth of the total land area is made up of private gardens. London's private gardens cover an area slightly smaller than the combined size of London's inner boroughs, 319 square kilometres. As well as a key component of London's ecosystem, they are crucial in the city's ability to absorb rainfall[214].

3.178 Front gardens are considerably smaller than back gardens, a conservative estimate would be that they cover 3% of the total area of London or around 48 square km. Two thirds of London's front gardens are already at least partially covered by surfaces other that vegetation, with paving, bricks, concrete, or gravel being the most usual. The gradual loss of London's front gardens and their capacity to absorb rainfall is increasing the city's vulnerability to flash flooding and increasing the burden of run-off on the drainage system[215]. The London Assembly Environmental Committee estimates that the total areas of parking bays in London's former front gardens now adds up to an area of around 32 square km[216].

3.179 The lack of capacity of the drain system to deal with the increase in run-off and sometimes the inadequate maintenance of those drains add to the problem[217]. London's urban drainage system could take a rainstorm event with a probability of once every three years but a rainstorm of the kind which took place once every fifty years would be a major flooding problem and due to the number of basement flats in London probably cause loss of life[218].

3.180 One of the issues in managing drainage is that different aspects of street drainage are the responsibility of different authorities including the boroughs, Transport for London, Thames Water and private landowners in some cases[219]. The confusion over responsibilities around drainage maintenance led the Mayor to create the Drain London Forum. This is a partnership involving all the organisations with responsibility for and information on surface water management in London. The Forum has undertaken scoping study to assess how much was known about the location and ownership of London's drainage network, and to propose a

[210] London Assembly Environment Committee (2005) 'Crazy paving. The environmental importance of London's front gardens'
[211] Ibid.
[212] 'London under threat? Flooding risk in the Thames Gateway' London Assembly Environment Committee, 2005
[213] 'London under threat? Flooding risk in the Thames Gateway' London Assembly Environment Committee, 2005
[214] London Assembly Environment Committee (2005) 'Crazy paving. The environmental importance of London's front gardens'
[215] 'London Assembly Environment Committee (2005) 'Crazy paving. The environmental importance of London's front gardens'
[216] Ibid.
[217] London Assembly Environment Committee (2005) London under threat? Flooding risk in the Thames Gateway'
[218] Edmund Penning-Rowsell cited in 'Flooding in London' A London Assembly Scrutiny Report, 2002
[219] London Assembly Environment Committee (2005) London under threat? Flooding risk in the Thames Gateway'

process by which information can be shared and maintained to develop a regional Surface Water Management Plan for London[220].

Urban run-off

3.181 Rainwater run-off from developments increases the risk of flooding, is an important source of diffuse pollution and reduces the amount of water soaking into the ground. Rain falling on urban areas is normally drained through surface water drains and discharged into watercourses via surface water outfalls[221].

3.182 Traditional urban drainage can have several effects on[222]:

- Water quality: rainwater falling on impermeable surfaces picks up dust, oil, litter, organic matter, etc, which ends up in watercourses. These pollutants have serious impacts on receiving water bodies and as a consequence of repeated discharges, life can be severely restricted and fish can suffocate in the event of a storm. The quality of groundwater can also be affected where discharges soak into the ground. Also many people are unaware that surface drains discharge directly into watercourses so liquid waste such as oil, garden chemicals or car washing waste are often poured into the drains adding to the pollution.
- Flooding: traditional drainage systems are designed to remove rainwater as quickly as possible from developed areas. This causes higher flow rates and can result in flooding downstream. Storage measures such as balancing ponds or underground storage tanks are often required to compensate these higher flows.
- Water resources: impermeable surfaces reduce the amount of water that infiltrates into the ground, reducing groundwater levels and low flows in streams.
- Biodiversity: altered flow patterns with higher peak flows and reduced low flows can alter river habitats dramatically. Increased flow rates cause river bank erosion and because of this many streams have been confined to concrete channels, with the consequent loss of river side habitats. Another effect of traditional drainage systems is the trapping of amphibians in road gullies.

Sustainable Drainage Systems

3.183 Sustainable Drainage Systems (SUDS), sometimes referred to as Sustainable urban Drainage Systems, are a series of techniques that have been developed in order to reduce the adverse effects of drainage[223].

3.184 SUDS include both measures to prevent pollution and run-off at source and a range of physical structures to receive the surface run-off. Source control measures include permeable surfaces and rainwater harvesting systems, including water butts. Physical structures include swales, ponds and wetlands. These types of structures can provide natural 'treatment' of water prior to discharge to a water course. As noted in the Place context topic above, as well as reducing the risk of flooding, pollution and helping maintain natural flows, these physical structures can also be designed to improve amenity and biodiversity in built up areas[224].

3.185 The 'surface water management train' addresses run-off quantity and quality at all the stages of the drainage system[225]:

[220] Draft Water Strategy, GLA August 2009
[221] Environment Agency, SEPA & Environmental and Heritage Service of Northern Ireland (2003) 'Sustainable Drainage Systems (SUDS), an introduction
[222] Ibid.
[223] Ibid.
[224] Ibid.
[225] Ibid.

- Minimising the quantity of run-off should be considered first as this determines the size of the downstream systems and provides scope for the greatest savings. The use of rainwater for watering gardens and flushing toilets may be possible. Another desirable option at this stage is infiltration if the soil and groundwater conditions permit it.
- Collected run-off should be removed from the site in a way that minimises pollution and allows further volume reduction and infiltration.
- Finally, if necessary further flow attenuation and passive treatment can be installed to reduce flood risk and improve water quality before discharge to a watercourse.

3.186 The cost of SUDS does not only include the cost of installation but also maintenance and operation costs. Certain features such as wetlands and ponds can be expensive to install and maintain. However, it is increasingly being accepted that the cost of maintaining well-designed systems is no higher than the cost of a conventional drainage system or open landscaped area[226].

3.187 The benefits of SUDS also include environmental and amenity benefits and indirect benefits such as a reduction in flooding, costs of wastewater treatment in combined systems and cost of pollution remediation in watercourses[227].

3.188 HR Wallingford have carried out research and reporting for the Department of Trade and Industry to determine good practice in whole-life cost assessment for SUDS development and management[228].

Waste-water disposal

The sewerage network

3.189 The function of a sewerage network is to convey domestic and industrial wastewater and run-off from impermeable surfaces to a treatment works for treatment and disposal. Combined sewers carry a wastewater together with surface run-off whilst separate systems provide separate pipes, with surface run-off being discharged to the nearest receiving water course and wastewater being taken to the treatment works[229].

3.190 Up to the mid 20th century most sewers were combined systems. Since then separate systems have become the norm for new development. The majority of central London is served by a core of combined systems with more recently developed areas served by separate systems. The local topography and distance from a suitable receiving water course often determines that new separate systems discharge into the older, downstream combined system[230].

3.191 The draft Water Strategy includes a map of the London sewer system, showing the areas that are served by a combined and areas served by a separate system (see Figure 5.1).

Combined sewer overflows (CSOs)

3.192 It is not cost effective or feasible to transport or treat the total combined volume of wastewater and run-off at a sewage treatment works. For this reason and to prevent sewer flooding, CSOs serve as 'safety valves' for the sewer system by limiting the flows carried forward for treatment to the level that the downstream sewage treatment system can accommodate. The

[226] CIRIA Report 523 (2000) cited in Berry, C.W. ' Sustainable Urban Drainage- UK Experience and practical application in New Zealand' 2002
[227] Berry, C.W.(2002) ' Sustainable Urban Drainage- UK Experience and practical application in New Zealand'
[228] See http://www.ciria.com/suds/index.html for further information
[229] CIWEM 'Environmental Impact of Combined Sewer Overflows' http://www.ciwem.org/policy/policies/overflows.asp
[230] Ibid.

quantity of flows passed forward at CSOs is calculated by a multiple of the 'dry weather flow' carried in the sewer[231].

3.193 The main assumption behind this approach is that the heavily polluted flow in the sewer would be diluted by the surface run-off and thus it would be environmentally acceptable to discharge into a water course which would also have increased in flow in the same event[232].

3.194 However, despite considerable dilution, storm sewage discharges from CSOs may contain significant loads of several pollutants including bacteria and viruses, heavy metals and hydrocarbons. The presence of raw sewage in water courses also causes aesthetic pollution[233].

3.195 These discharges can in extreme cases result in fish deaths, public health hazards and visual and odour problems[234].

Sewers in London

3.196 London's sewage system is around 140 years old and it is often unable to cope with the combined wastewater and run-off flow from the city[235] as they were not designed for the current population numbers. The sewers along the tidal Thames are largely combined systems[236].

3.197 There are 57 CSOs in London, of which 36 are considered 'unsatisfactory' in terms of frequency of discharge and/or environmental impact. Even during periods of moderate rainfall, the overflows discharge storm water and sewage into the River Thames on average once a week[237].

3.198 The Environment Agency estimates that more than 50 million cubic metres of untreated sewage discharged into the Thames every year. Additionally, 5,000 properties are at risk of flooding by sewage in London[238].

3.199 A Thames Tideway Strategy Group (TTSG) was set up in 2000 to assess the environmental impact of CSOs and to prepare potential solutions having regard to cost. Some of the solutions considered include[239]:

- The use of Sustainable Drainage Systems (SUDS) techniques to reduce rainfall inputs into CSOs. However, it was concluded that the use of these techniques alone could not deal with the amount of water that enters the system.
- The separation of all existing combined sewerage systems, providing one system for run-off and other for sewage. However, it was determined that such a scheme would be far too expensive.
- A 35km long storage-and-transfer tunnel. The tunnel would run beneath the Thames from Hammersmith in West London and convey the discharge from 36 CSOs for collection and treatment at a sewage treatment works in east London where a plant to handle the storm flows could be built. This was the studies preferred solution, at an estimated cost of £2bn.

3.200 The estimated time to deliver this solution is up to 15 years (too late for the 2012 Olympics) and Defra asked the TTSG to look into smaller-scale options which could provide earlier

[231] Ibid.
[232] Ibid.
[233] Ibid.
[234] Ibid.
[235] Thames Web 'Combined Sewer Overflows' http://www.thamesweb.com/page.php?page_id=76&topic_id=2
[236] Defra 'Water Quality- Sewage Treatment' http://www.defra.gov.uk/environment/water/quality/sewage/
[237] Thames Web 'Combined Sewer Overflows' http://www.thamesweb.com/page.php?page_id=76&topic_id=2
[238] Environment Agency (2006) 'Planning for a better London'
[239] Thames Web 'Combined Sewer Overflows' http://www.thamesweb.com/page.php?page_id=76&topic_id=2

solutions. In July 2006 Defra asked Thames Water to develop and assess two of the options in detail and report back by the end of 2006[240].

3.201 In March 2007 the Government gave the green light for a single tunnel, 32.2km long and more than seven metres wide, to be constructed from Hammersmith in West London, to Beckton, in East London, with an additional spur tunnel (5.5km long) from Abbey Mills in Stratford to Beckton[241].

Sewer misconnections

3.202 CSOs are not the only way raw sewage is spilled in watercourses in London. Household appliances can be accidentally connected to the surface water drain, instead of the foul water drain in separate systems. These 'misconnections' mean that discharges from sinks and toilets go straight into watercourses without prior treatment and are created by people doing their own plumbing but also by professional plumbers[242].

3.203 Damage to watercourses can be severe when several houses or businesses are misconnected in the same area. For instance, it is considered likely that as many as one in ten properties in the London Borough of Barnet are misconnected[243].

Sewer flooding

3.204 The operational area of Thames Water, London and the Thames Valley, has the greatest number of houses at risk of internal sewer flooding in England and Wales, mainly due to the increasing demand placed on the Victorian network. Increasing housing density and more intense summer storms are adding to the problem[244]. Five thousand properties are at risk of flooding by sewage in London[245].

3.205 Sewer flooding can occur as a result of the existing sewer system being unable to cope with excessive flows, which is known as hydraulic flooding. This type of sewer flooding can happen because of overloading of the combined sewer system, exacerbated by the increase in impermeable surfaces, including paving of front gardens or extensions and inflow of groundwater if there is deterioration of pipe joints[246].

3.206 Sewer flooding can also occur if there is a blockage in a pipe. These are one off incidents usually caused by unsuitable items being flushed down toilets or a build up of fat and grease from restaurants[247].

3.207 Sewer flooding can occur outside the building when the sewer is full and overflows occur at manholes or drains in gardens. This is known as external flooding. Internal flooding occurs when sewage overflows inside of the building from toilets and drains. Basement flats are particularly prone to sewer flooding, due to lying low relative to the depth of the public sewer[248].

[240] Defra 'Water Quality- Sewage Treatment' http://www.defra.gov.uk/environment/water/quality/sewage/
[241] Ibid.
[242] Environment Agency 'How can drainage lead to pollution?' http://www.environment-agency.gov.uk/homeandleisure/pollution/water/31424.aspx
[243] Ibid.
[244] Thames Water 'Sewer flooding' http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6163.htm
[245] Environment Agency (2006) 'Planning for a better London
[246] Thames Water 'Sewer flooding' webpage: http://www.thameswater.co.uk/cps/rde/xchg/SID-F82982C8-26FD2D94/corp/hs.xsl/6880.htm
[247] Thames Water 'Sewer flooding' webpage: http://www.thameswater.co.uk/cps/rde/xchg/corp/hs.xsl/6163.htm
[248] Ibid.

Flood Risk

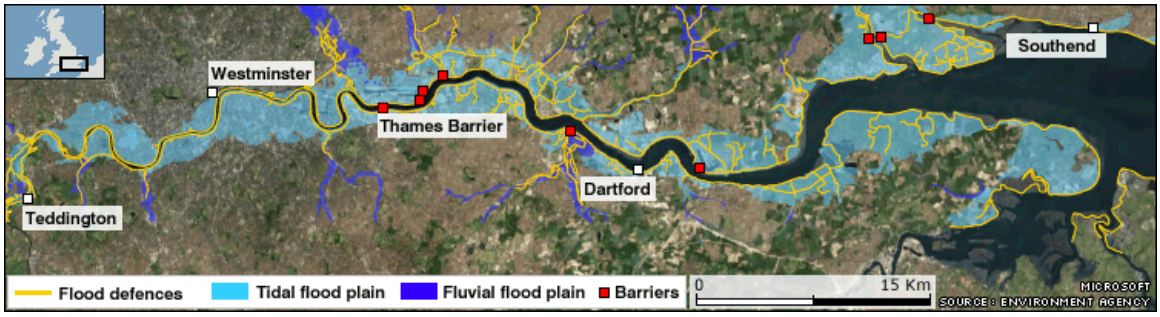
Flooding in London

3.208 Flooding can occur from one of several sources or a combination of sources: coastal flooding, river flooding, localised or fluvial flooding, groundwater and sewer flooding[249].

3.209 The draft Regional Flood Risk Appraisal of London stresses that *'flood risk is a serious consideration for London'* and that 15% of Greater London has some extent of known flood risk. Tidal and river flooding are a major risk for London. Around 45 square miles of London is at risk of tidal flooding, an area containing 400,000 properties and home to 1.25 million people[250], 16 hospitals, 30 overland railway stations, 68 underground stations and eight power stations[251].

3.210 Figure 5 below shows the extent of the flood plain in London, extending as far as the Thames Estuary in Essex.

Figure 5: Flood plain extent in London.



Source: Environment Agency[252]

3.211 The London Flood Response Strategic Flood Plan highlights that as well as those who live in the floodplain in London there are

> *'many more people work in, visit or travel through potentially vulnerable areas and could be unfamiliar with the risk. The cultural mix in London and the high mobility of the population serve to make incident and emergency response more complex. Because it is a densely developed urban area, there is a rapid response to rainfall in both the natural and constructed drainage systems with the result that there may be no forewarning of fluvial and surface water flooding'*[253].

3.212 Climate change will cause an increase in the risk of flooding:

> *'sea level rise, more frequent and higher storm surges and increased winter rainfall and more intense summer rainfall will add to existing risk and it may not prove possible to improve fixed defences sufficiently to maintain or raise protection standards'*[254].

[249] See Draft Regional Flood Risk Appraisal (June 2007) Chapter 2 'Overview of flood risk to London' Available: http://www.london.gov.uk/mayor/strategies/sds/docs/regional-flood-risk.rtf
[250] City of London (2007) Rising to the challenge – The City of London Corporation's Climate Change Adaptation Strategy http://217.154.230.218/NR/rdonlyres/7347D392-3CF3-4344-8B2D-9AF9315E8801/0/SUS_climateadapt.pdf
[251] Environment Agency (2006) 'Planning for a better London'
[252] Image downloaded from BBC: http://news.bbc.co.uk/nol/shared/spl/hi/pop_ups/07/sci_nat_enl_1187112433/img/1.jpg (29/08/07)
[253] London Resilience (2007) 'London flood resilience strategic plan'
[254] Ibid.

Impacts of flooding

3.213 Flooding in London can cause widespread disruption, for instance to public transport. In the period from 1992 to 2003, flooding caused over 1200 incidents and 200 station closures in the underground network. Approximately half of these were associated with flash flooding. The cost in passenger delays alone of flooding in London Underground between September 1999 and March 2004 reached approximately £14.6 million[255]. However, TfL note[256] that it should also be noted that closures and disruption for other reasons, for example the number of closures for security alerts and due to staffing issues, "far" exceeds those due to flooding incidents.

3.214 Floods do not only cause damages to infrastructure and transport. As well as having the potential to cause fatalities, research[257] has shown that flooding causes short-term physical effects and, more significantly, short- and long-term psychological effects. These are discussed in the People and Health context topic, above.

Flood Risk Management

3.215 As the risk of flooding cannot be completely eliminated the term 'flood risk management' is preferred to 'flood defence'. Broadly, the main options to reduce flood risk to people, property and the environment are flood defences, flood forecasting and warning systems, increasing flood resilience of properties, changes in land management and discouraging inappropriate development in areas at risk of flooding[258]. These options for management have to be combined, e.g. using flood warnings to reduce the consequences of a flood defence breaching or being overtopped.

3.216 Defra is responsible for flood and coastal erosion risk management in England. The Environment Agency and local authorities are responsible for delivery on the ground. The Environment Agency is the main operating authority and has 'permissive powers' i.e. is empowered but not has a legal obligation to manage flood risk from main rivers and the sea. The Environment Agency is also responsible for forecasting and flood warning and for raising awareness of flood risk. Local authorities have similar powers for 'ordinary watercourses' i.e. those who have not been designated as main rivers[259].

Flood defences in London

3.217 London is protected by a combination of tidal and fluvial flood defences.

3.218 As a result of the 1953 flood, a system of tidal flood defences was constructed in London. The Thames Barrier, which has been operational since 1982, is a key part of this system. There are also around 400 smaller barriers and movable flood gates downstream of the Thames Barrier and over 300 km of river walls and embankments stretching into Essex and Kent that have been raised by two metres to give additional protection from storm surges. Upstream of the Thames Barrier river walls prevent the normal range of high tides from flooding parts of inner and central London[260].

3.219 Since its completion in 1982, the Thames Barrier has been closed 101 times (up to March 2007) to prevent flooding. The general trend shows an increase in the number of closures per year. Closure of the Thames Barrier is also accompanied of closure of other barriers and

[255] London Climate Change Partnership (2005) 'Climate Change and London's transport system. Summary Report'
[256] Personal communication from Helen Woolston, TfL, commenting on draft of this report.
[257] RPA, FHRC, *et al*, 'The appraisal of the human-related intangible impacts of flooding', 2004, Defra/EA Joint Flood and Coastal Erosion Risk Management Programme
[258] Defra (n.d.) http://www.defra.gov.uk/environ/fcd/default.htm
[259] Defra (2007) Flood and coastal erosion risk management, Available: http://www.defra.gov.uk/environ/fcd/defrafm.pdf
[260] See Draft Regional Flood Risk Appraisal (June 2007) Chapter 2 'Overview of flood risk to London' Available: http://www.london.gov.uk/mayor/strategies/sds/docs/regional-flood-risk.rtf

flood gates, which causes disruption to navigation and mooring. The Environment Agency has indicated that closing the Thames Barrier more than 70 times in a year is not likely to be sustainable[261].

3.220 Most of the Thames tributaries have flood defences to reduce the risk of fluvial flooding. Most of these consist of river walls and widened channels. Although these structures protect people and property from flooding, they also cause reduction of biodiversity and amenity value of rivers and have increased maintenance requirements[262].

Reducing the risk of flooding through planning

3.221 PPS25 requires local planning authorities to undertake strategic flood risk assessments (SFRAs) in consultation with the Environment Agency. The SFRA will be used to refine information on areas at risk of flooding taking into account other sources of flooding and the impacts of climate change, in addition to the information contained on the Environment Agency flood maps which cover tidal and main river flooding only. SFRAs should be used by local authorities to inform Sustainability Appraisals of Local Development Documents, and will provide the basis from which to apply the Sequential Test and Exception Test in the development allocation and development control process[263].

3.222 The aim of the *sequential test* is to steer development from areas at medium or high risk of flooding, i.e. Flood Zones 2 and 3 as shown on Environment Agency flood maps. The aim should be to steer development to Zone 1 (low risk). Where there are no reasonable sites available in Flood Zone 1, decision makers can consider reasonably available sites in Flood Zone 2 and only where there are no reasonably available sites in Flood Zone 2, decision makers should consider developments in Flood Zone 3. Within each flood zone new development should be located in sites at the lowest risk of flooding and higher vulnerability uses, e.g. hospitals, schools, housing, should be located on parts of the site at lowest probability of flooding. Figure 6 shows the vulnerability to flood risk classification[264].

3.223 The *exception test* should be applied after the sequential test and when more vulnerable development and essential infrastructure cannot be located in Zone 1. For the exception test to be passed it should be demonstrated that the development provides sustainability benefits to the community which outweigh flood risk, that the land is suitable for development or previously developed or there is no alternative land and finally a site specific flood risk assessment should demonstrate that the development will be safe and will not increase the risk of flooding elsewhere[265].

3.224 The Thames Gateway is a key regeneration area where up to 160,000 new dwellings and other land uses will be built. The development will take place on previously developed land in London, Kent and Essex much of which is located in the 1 in 1000 year tidal floodplain. The area within London is defended by the Thames Barrier and other associated structures: other barriers, gates, walls and embankments. The area also includes several tributary rivers which also entails risk of fluvial flooding[266].

3.225 The draft London Regional Flood Risk Appraisal states that

> *'development in the Thames Gateway is being carried out in the knowledge of the existing flood risk and how the flood risk is likely to change in the future. Each development proposal will have to be accompanied by a Flood Risk Assessment, and*

[261] Ibid.
[262] Ibid.
[263] DCLG (2006) Planning Policy Statement 25: Development and Flood Risk
[264] DCLG (2006) Planning Policy Statement 25: Development and Flood Risk
[265] DCLG (2006) Planning Policy Statement 25: Development and Flood Risk
[266] See Draft Regional Flood Risk Appraisal (June 2007) Chapter 2 'Overview of flood risk to London' Available: http://www.london.gov.uk/mayor/strategies/sds/docs/regional-flood-risk.rtf

these should make reference to the East London Strategic Flood Risk Assessment completed by Thames Gateway London Partnership. It is not sufficient to rely on the presence of flood defences; the FRA must consider the implications of a breach or overtopping of the defences and how that may be managed. It is expected that new developments will, where necessary, be sited and designed to manage flood risk. This may be done through flood resilient construction, buildings that can quickly recover from flooding, flood warning and evacuation procedures. In addition the new development will integrate the principles of "Making Space for Water" and the East London Green Grid to give an overall aim of improving the sustainability of flood management in the Thames Gateway'.

Other options and issues in relation to flood risk management

3.226 Using open and green spaces to temporarily accommodate flood waters is another option to manage flood risk cited in the draft London Regional Flood Risk Appraisal: the Green Grid concept in East London is mentioned as a good example. Upstream storage may be more appropriate in some cases and this will need to be considered in conjunction with neighbouring local authorities and indeed regions[267].

3.227 Surface water should be managed at source and large development locations provide good opportunities to integrated surface water management options[268]. This is discussed in more detail in the SUDS sub-section above.

3.228 Designing developments to be flood compatible or flood resistant is another option to manage 'residual' flood risk[269], in that defences or other options can never eliminate the risk completely and there is always the possibility of overtopping or breaching.

3.229 The Association of British Insurers in collaboration with the National Flood Forum has published a fact sheet on flood resilience and flood protection for the home[270]. This is aimed at people who are at risk of flooding or have been flooded. Some suggested measures may be expensive to retrofit so are particularly appropriate for those who are undertaking repairs after a flood. Flood resilience measures include: moving electrics well above flood level; replacing plaster with more water resistant materials; installing flood resilient doors and window frames; installing one-way valves into drainage pipes to prevent sewage backing up etc. Other measures are aimed at stopping the water from entering the home and include door guards and airbrick covers. As noted, the cost of retrofitting such measures is likely to be high, and as a result it is important to consider their incorporation into new development in flood risk areas.

[267] See Draft Regional Flood Risk Appraisal (June 2007) Chapter 2 'Overview of flood risk to London' Available: http://www.london.gov.uk/mayor/strategies/sds/docs/regional-flood-risk.rtf
[268] Ibid.
[269] Ibid.
[270] Association of British Insurers and National Flood Forum (2006) ' Repairing your home or businesses after a flood- how to limit damage and disruption in the future' Available: http://www.abi.org.uk/BookShop/ResearchReports/Flood%20Repair%20Doc%201.pdf Accessed: 10/06/09

Figure 6: Vulnerability to flooding classification

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
Highly Vulnerable	• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.[19]
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste.[20] • Sites used for holiday or short-let caravans and camping, **subject to a specific warning and evacuation plan**.
Less Vulnerable	• Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non–residential institutions not included in 'more vulnerable'; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment plants. • Sewage treatment plants (if adequate pollution control measures are in place).

Source: PPS25 (DCLG, 2006)

3.230 The Environment Agency is responsible for flood forecasting, warning and undertaking flood awareness campaigns. The Environment Agency does not only provide warnings for the public but also for their professional partners in flood emergencies: emergency services and local authorities mainly. However, warnings cannot be issued for all flood events. Although the Environment Agency aims to provide at least 2 hour warnings where possible, in many areas little or no warning can be provided for fluvial flooding. For tidal flooding, the Environment Agency can normally provide a warning of up to 12 hours although this does not take into account breaches in existing defences in which case no warning could be provided. Additionally, no warning is generally possible for surface water flooding[271].

3.231 A further issue is that many of those living in flood risk areas in London may particularly vulnerable from the point of view of receiving a flood warning: including elderly people, those with disabilities, those whose first language is not English etc.

3.232 Emergency planning and response is another key component of flood risk management in London, given the large numbers of people living and working on the floodplain[272].

[271] London Resilience (2007) 'London flood resilience strategic plan'
[272] Ibid.

Key problems and opportunities

3.233 Drawing on the review of other policies, plans and programmes and the baseline data, the key sustainability problems and opportunities issues for the SA and the Water Strategy to consider relating to the water management topic are summarised in Box 9.

Box 9: Key problems and opportunities – water management

Problems

- London's water deficit in dry years and over abstraction of existing water resources which has knock on effects on the water environment. Potential social and environmental effects of developing new resources.
- London's increasing population and decaying water infrastructure including leaky pipes and drainage and sewerage systems unable to cope.
- Higher levels of leakage, challenges and barriers of fixing leaks (e.g. disruption caused) and issues associated with potential reduction in water pressure to reduce leakage.
- Rising per capita water use, exacerbated by increase in single person households and lack of incentives and understanding to change behaviours.
- Poor (but improving) biological and chemical quality of London's water bodies. Diffuse and aesthetic pollution caused by sewer misconnections and combined sewer overflows and effects on biodiversity and amenity value of watercourses.
- Risk of flooding from all sources and potential impacts on health, well being, infrastructure.
- The effects of climate change and increasing population in all the above.

Opportunities

- Increasing financial incentive to save water by installing water meters.
- Opportunities for reducing water consumption in new developments and promoting retrofitting and more responsible use of water resources.
- Improving infrastructure and water environment as a result of new development and regeneration, e.g. the Olympics.
- Increasing water available by using reclaimed water.
- Inclusion of SUDS in new developments and reducing the risk of flooding by opening up rivers and providing space for water. Consequent increase in the provision amenity, recreation and biodiversity benefits.

Water management - evolution of the sustainability baseline in the absence of the Water Strategy

3.234 In the absence of the Water Strategy, over the intended 10 year time frame of the strategy, the baseline under the Water Management theme is likely to evolve in the following ways:

- The chemical and biological quality of London's rivers are improving;
- National and EU regulations, especially the implementation of the Water Framework Directive are likely to lead to further improvements in the water quality of London's waterways. However, as noted under the evolution of the baseline in relation to the Climate Change topic, there is the possibility that the effects of climate change may reduce water quality by reducing river flows and increasing the incidence of combined sewer overflows;
- London's water deficit is likely to increase, due to projected increases in population and changing weather patterns, especially warmer, drier summers. However, the management of demand and increasing water efficiency measures may help to reduce the deficit. Some new water resources may be developed, but major new developments are likely not to be online within 10 years;
- Loss of water through leakage is likely to reduce as water companies repair / replace damaged pipes, although overall leakage levels in London are likely to remain high in comparison to other areas given the age of much of the infrastructure;

- Changing weather patterns are likely to increase the amount of surface water run-off, flooding and overflow of sewage into water courses;
- The risk and severity of flooding in London is likely to increase, resulting in greater damage and disruption to transport networks and other infrastructure. There are also potential negative health consequences associated with flooding, which are covered in the People and Health section above; and
- If the current schedule for the construction of the Lee Tunnel and the Thames Tunnel are met, they could be completed in approximately 2014 and 2020 respectively. Therefore, within 10 years the level of untreated sewage overflowing from London's sewers into the River Thames and its tributary the River Lee should be substantially reduced. The tunnels should assist compliance with the Urban Waste Water Treatment Directive.

Waste and Resources

3.235 This topic provides information relevant to the production and management of waste and the consumption of resources (other than water). Particular focus is given to the consumption of non-renewable materials.

Policy context, relevant baseline and key trends

3.236 The key messages for this topic context from the review of relevant policies, plans and programmes have been listed in Box 10:

Box 10: Key messages from the review of policies, plans and programmes - waste and resources

Relevance to the Strategy:

- The objectives and targets included in the National Waste Management Strategy. A key issue raised in the Waste Strategy is the relationship between waste management and water quality, particularly due to run off, and pollution of ground-water.
- Sustainable design and construction techniques such as those set out in the Code for Sustainable Homes. The Water Strategy can support broader efficiency of resource use, recognising that there are significant interactions between resource use and water issues.
- Mayoral Strategies and SPGs, particularly the London Plan, and the Mayor's Municipal Waste Management Strategy, which highlights the transportation of waste by water, and leachate to water from landfill as two critical issues in London.

Relevance to the SA:

- Targets and priorities relating to waste set out in the *National Waste Management Strategy*, the Mayor's *Municipal Waste Management Strategy*, and resource related objectives in (for example) the *Code for sustainable homes*, and the Government *Strategy for Sustainable Development* have been reflected in the SA Objectives and Criteria.
- The policies, plans and programmes contain relevant baseline and key issues which have been drawn on in this context chapter.

3.237 The waste management hierarchy as set out in the National Waste Strategy[273] aims to first avoid the production of waste altogether, then re-use materials; then recycle and compost

[273] Defra (2007) Waste Strategy for England and Wales 2007: http://www.defra.gov.uk/environment/waste/strategy/strategy07/pdf/waste07-strategy.pdf

them; then recover energy from them; and finally, as a last resort, dispose of them. This hierarchy is echoed in the Mayor's Waste Strategy[274].

3.238 Total annual municipal waste production for London (in 2007/2008) is estimated at 4.14 million tonnes[275], of which households produce 3.34 million tonnes and non-household sources produced 0.8 million tonnes[276].

3.239 53% of this total figure for London was sent to landfill in 2007-08, a down from 72% in 2000-01. 22% was incinerated (with energy from waste), up from 20% in 2000-01, and 22% was recycled or composted in 2005-06, and increase from 8% in 2000-01. While this increase in recycling is encouraging, London still lags considerably behind other English regions. The East of England achieved 40% recycling/composting over the same period, for example, and all regions exceeded 25%. The England average in 2007-08 was 34% recycled or composted.

3.240 London's high rates of waste production and a lack of facilities to deal with waste mean that the capital has severe difficulties in meeting European and UK targets for reducing and recycling waste.

3.241 The National Waste Strategy sets ambitious targets:

- A 29% reduction in waste produced (waste prevention) by 2010, and by 45% by 2020.
- Recycling and composting of household waste: at least 40% by 2010, 45% by 2015 and 50% by 2020.
- Recovery of municipal waste: 53% by 2010, 67% by 2015 and 75% by 2020.

3.242 Resource consumption in relation to the Water Strategy is in relation to developing new resources, e.g. consumption of aggregates and other materials. Replacing water mains and repairing leaks also involves the use of new resources.

3.243 Treating waste water and sewage results in the production of sewage sludge. The predicted increase in the population of London is likely to increase the production of sewage sludge. The Mayor's Waste Strategy seeks to encourage the development of anaerobic digestion plants which could turn sewage sludge into a digestate suitable for agricultural and horticultural use[277].

3.244 London currently sends the majority of its municipal waste to landfill[278]. Landfill can lead to the contamination of water resources as heavy metals, solvents and other contaminants may leach from the soil. The UK is subject to binding targets under the EU Landfill Directive[279]. These targets are;

- By 2010 to reduce biodegradable municipal waste landfilled to 75% of that produced in 1995;
- By 2013 to reduce biodegradable municipal waste landfilled to 50% of that produced in 1995; and
- By 2020 to reduce biodegradable municipal waste landfilled to 35% of that produced in 1995.

[274] GLA (2003) Rethinking Rubbish in London – the Mayor's Municipal Waste Management Strategy. http://www.london.gov.uk/mayor/strategies/waste/docs/wastestrat_all.pdf
[275] Defra National Waste Statistics, November 2008 release http://www.defra.gov.uk/environment/statistics/wastats/bulletin08.htm
[276] Ibid
[277] GLA (2003) Rethinking Rubbish in London – The Mayor's Municipal Waste Management Strategy
[278] Ibid
[279] Council Directive 1999/31/EC on the landfill of waste http://ec.europa.eu/environment/waste/landfill_index.htm Accessed: 21/08/09

3.245 Although the Mayor's Municipal Waste Strategy seeks to reduce the amount of waste created in the Capital, it is likely that due to the projected increase in London's population the volume of waste arisings in London will increase. The amount of this waste that ends up in landfill, and the possible risk posed to water resources by leachate, depends on the success of the Waste Strategy.

3.246 The Mayor's Municipal Waste Strategy includes proposals to increase the amount of waste incinerated in London. During incineration water is used to cool fly-ash, and during this process the water can be contaminated[280]. Thus increasing the amount of waste sent for incineration may adversely affect water resources in the capital.

3.247 London currently transports 27% of its municipal waste on the Thames[281]. The projected increase in waste levels may result in an increase in the amount of traffic on the Thames.

Key problems and opportunities

3.248 Drawing on the review of other policies, plans and programmes and the baseline data, the key sustainability problems and opportunities issues for the SA and the Water Strategy to consider relating to the waste and resources topic are summarised in Box 11.

Box 11: Key problems and opportunities – waste and resources

Problems

- London's high rates of waste production and a lack of facilities to deal with waste mean that the capital has severe difficulties in meeting European and UK targets for reducing and recycling waste.

Opportunities

- Minimising the contribution of the water industry to the amount of waste generated in London.

Waste and resources – evolution of the sustainability baseline in the absence of the Water Strategy

3.249 In the absence of the Water Strategy, over the intended 10 year time frame of the Strategy, the baseline under the Waste and Resources theme is likely to evolve in the following ways:

- While per-capita waste arisings may fall, for example as a result of campaigns to reduce packaging waste and meet statutory recycling targets, if population increases in line with projections, overall waste levels are likely to increase, including sewage sludge. Dealing with this waste may pose a threat to the quality of water resources, for example, by increasing the amount of leachate from landfill or other forms of disposal, or the water required in the process of waste incineration;
- Reducing leakage from water mains in London is likely to produce a large amount of construction waste, however this amount may not be significant in comparison to overall construction waste arising from new development across the city over the next 10 years.

[280] GLA (2003) Rethinking Rubbish in London – The Mayor's Municipal Waste Management Strategy
[281] Ibid

Economy

3.250 This topic presents information relevant to the economy. While initially it may seem that the water strategy has limited relevance to London's economy, in fact water – be it as a resource (for drinking, or for business use), a means of transport, a source of leisure and amenity value or a threat in the form of flooding and heavy rain – is a fundamental element in London's economic success.

Policy context, relevant baseline and key trends

3.251 The key messages for this topic context from the review of relevant policies, plans and programmes have been listed in Box 12:

Box 12: Key messages from the review of policies, plans and programmes - economy

Relevance to the Water Strategy:

- The *Water Environment (Water Framework Directive) Regulations* and *River basin planning guidance* reflect the economic importance of water, and the regulations require economic analyses to be carried out by the Environment Agency.
- Current consultations by Defra relating to proposed changes to powers to restrict non-essential uses of water (2007), water charging (2005) and water metering in areas of serious water stress (2007), and a call for evidence on household charging for sewerage services (2008).
- Mayoral strategies, in particular the London Plan, and the Mayor's Economic Development Strategy, which recognises the value of water as a means of transport and as a source of amenity, leisure and recreation value.

Relevance to the SA:

- Specific targets relating to Economy were not been identified during the review of policies, plans and programmes. However, conformity with the goals of Government and Regional strategy has been reflected in the SA objectives and criteria.
- The policies, plans and programmes contain relevant baseline and key issues which have been drawn on in this context chapter.

Background

3.252 London is a successful world city with a global outlook. London's economy is highly competitive, its workforce highly skilled. Since 2000 it has consolidated its position as the key driver of national economic success. London's economy contributes around 17% of the UK's total Gross Domestic Product, and its annual rate of employment growth is above that of the rest of the UK. The London Plan (consolidated with alterations since 2004) projected net growth in jobs in London between 2006 and 2026 is 912,000[282], although the current recession may reduce this level of growth, and has certainly led to a downturn in economic conditions in the period 2007 – 2009, and this situation is likely to continue, with the Organisation for Economic Co-Operation and Development (OECD) concluding that the economy of the UK is in a "severe recession" and predicting only a "mild" recovery in 2010[283].

3.253 However even before the events of 2007 onwards, benefits of the remarkable economic success of the 1990s and early 2000s were not being felt by all. The Mayor's Economic

[282] GLA (2008) The London Plan, (consolidated with alternations since 2004),
[283] OECD (2009) OECD Economic Outlook no.85, June 2009, UK outlook: http://www.oecd.org/dataoecd/7/4/20209191.pdf

Development Strategy notes that London has the highest rates of child poverty in Great Britain and only 71% of its working age population is in employment. Specific features of the London economy include a concentration of relatively high skill jobs, meaning those with low qualifications face higher risks of exclusion than elsewhere, and the high levels of earnings mean that housing costs are very high, especially for those on low incomes[284]. In 1980, the top 10% of full-time male earners in London had weekly earnings just over twice as high as those in the bottom 10%. In 2000 the ratio had grown to nearly four times[285]. At the same time there is social and economic deprivation in many parts of the capital, over half of London boroughs (19 out of 33) are in the top 30% most deprived in England[286].

3.254 Equality is discussed fully in the People and Health context topic, above.

Water related to economic factors

3.255 London' rivers, waterways and water bodies can make a contribution to the city's success, with the London Economic Development Strategy expressing that the Thames, in particular, is an important and underused asset due to the opportunities it provides for tourism, leisure and recreation. The economic contribution of water based transport (for people and freight) is also recognised. The Thames could go further in providing convenient, congestion free passenger access to central London. The Thames can also act as an asset to help support regeneration and economic development initiatives, while other Rivers, such as the Lea or river Brent can play an important role in local development[287].

3.256 Research from the Netherlands has estimated that having a view of water or a lake nearby can increase the price of a residential property by up to 10%, and having a view or being close to a park can raise the value by up to 8%[288].

3.257 Water shortages, transport disruption and flooding are recognised by the London Economic Development Strategy as climate change related risks to the London Economy[289].

3.258 The economic cost, measured in terms of insurance claims, of the recent severe flooding in the UK was estimated at £2 billion (Association of British Insurers[290]). Another estimate put the total cost figure in excess of £3 billion[291]. The disruption to businesses and individuals was enormous.

3.259 As discussed in the Water Management context topic, much of London is exposed to high risk of flooding. Flood risks are likely to increase as development further encroaches on flood-plains, and due to climate change impacts. Whether the choice is to built greater resilience into developments, invest more heavily in defences, or restrict development altogether in the highest risk areas is a decision beyond the Water Strategy to influence, however they will all have economic implications.

[284] GLA (2005) Sustaining Success, the London Economic Development Strategy, http://www.london.gov.uk/mayor/strategies/economic_development/docs/sustaining_success_full.pdf Accessed 10/06/09
[285] GLA (2008) The London Plan, (consolidated with alternations since 2004),
[286] Data Management and Analysis Group (2007) Deprivation in London http://www.londoncouncils.gov.uk/economicdevelopment/briefings/IndexofMultipleDeprivationIMD2007.htm Accessed: 10/06/09
[287] GLA (2005) Sustaining Success, the London Economic Development Strategy, http://www.london.gov.uk/mayor/strategies/economic_development/docs/sustaining_success_full.pdf Accessed: 10/06/09
[288] Luttik, J. (2000), The value of trees, water and open space as reflected by house prices in the Netherlands. Landscape and Urban Planning, Vol. 48, pp 161-167
[289] Ibid.
[290] Reported in BBC: http://news.bbc.co.uk/1/hi/business/6912827.stm Accessed 10/06/09
[291] Association of British Insurers (2007) Summer Floods 2007: Learning the Lessons http://www.abi.org.uk/BookShop/ResearchReports/Flooding%20in%20the%20UK%20Full.pdf

Key problems and opportunities

3.260 Drawing on the review of other policies, plans and programmes and the baseline data, the key sustainability problems and opportunities issues for the SA and the Water Strategy to consider relating to the economy topic are summarised in Box 13.

Box 13: Key problems and opportunities – economy

Problems

- Deprivation, unemployment and economic inequality are all important issues in London. These are likely to be exacerbated, especially over the first few years of the strategy timeframe, by the effects of the ongoing economic downturn in the UK and globally.
- Flooding and water shortages can have significant economic consequences by disrupting businesses, transport, supply routes etc.

Opportunities

- Reducing deprivation and inequality and facilitating economic development through improved water management and reduction of flood risk.
- Maximising the regeneration potential of London's rivers and waterways – as highlighted in the London Economic Development Strategy.
- Developing the recreation, leisure and tourism potential of the Thames and other London water bodies.
- Encouraging the development of the Thames as a key transport route – both for passengers and freight.

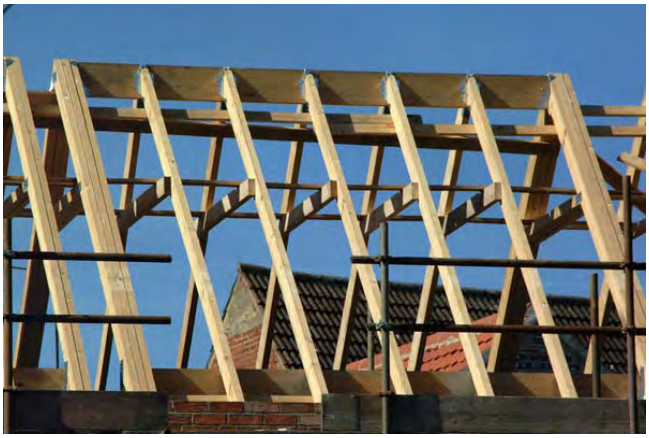
Economy - evolution of the sustainability baseline in the absence of the Water Strategy

3.261 In the absence of the Water Strategy, over the intended 10 year time frame of the Strategy, the baseline under the Economy theme is likely to evolve in the following ways:

- London has a strong and dynamic economy, but there are extensive economic inequalities which could increase over time;
- Particularly during the early years of the 10 year time frame, the effects of the ongoing economic downturn are likely to exacerbate economic inequalities, and restrict investment in new development and projects (including those related to water); and
- Flood risk is likely to increase as pressure on land for housing and other development leads to developments encroaching further into areas at risk of flooding, and due to the effects of climate change. Flooding can have significant negative economic and social effects, disrupting transport networks and other infrastructure, inundating homes and businesses, and impacting on physical and mental wellbeing of those affected, which in turn imposes and economic cost on society. Increased risk and incidence of flooding will increase the potential scale and risk of these costs.

Cross-cutting Issues and Policies

3.262 This context section highlights key overarching issues and trends which the Water Strategy will need to be aware of and respond to. Factors such as the projected expansion in London's population over the coming few decades will have significant effects on the supply, use and



management of all aspects of water in the Capital. While specific issues are discussed in more detail in the previous sections, this section seeks to bring together the key overall policy, trends and issues.

Policy context, overarching baseline and key trends

3.263 Box 14 presents the key messages for this topic from the review of policies, plans and programmes included in Appendix 6.

Box 14: Key messages from the review of policies, plans and programmes - cross-cutting issues and policies

Relevance to the Strategy:

- High level strategies and plans, for example, the UK Sustainable Development Strategy does not provide direct water related policy or direction for the Water Strategy, but does set out the framework for Sustainable Development which the Government advocates, and which all GLA strategies should seek to reflect and support.
- The London Plan, and Further Alterations is the Mayor's highest level spatial strategy and policy for London. The Water Strategy will go further than the London Plan in terms of detail, but must be in conformity with policies in the London Plan. The London Plan describes itself as "the integrating framework for all" other Mayoral strategy.

Relevance to the SA:

- These documents provide the high level basis for the appraisal: The SA seeks throughout to ensure that the Water Strategy is as supportive of sustainable development as is possible, and the SA objectives and criteria draw upon and reflect Government and Regional strategy.
- These high-level policies, plans and programmes also contain relevant baseline and key issues which were drawn on in this context chapter.

3.264 The population of London in 2006 was estimated at 7.57 million[292]. The London Plan (consolidated with alterations since 2004) provides a "best current estimate" of population in 2016 of between 7.94 and 8.19 million rising to between 8.26 and 8.71 million in 2026. This equates to an increase of up to 1.14 million people between 2006 and 2026. The London Plan (consolidated with alterations since 2004) also predicts an increase in the number of households from around 3.2 million (mid-2006) to as high as 3.9 million in 2026, an increase of approximately 540,000 to 728,000 households in 20 years, equivalent to more than 27,000 – 36,000 additional households a year. GLA projections for the period 2006 to 2026, suggest that by 2025, London will have an additional 912,000 jobs[293] although the current recession may reduce this level of growth, and has certainly led to a downturn in economic conditions in the period 2007 – 2009.

3.265 To meet this projected growth the London Plan (consolidated with alterations since 2004) has set a minimum target for housing provision of 30,500 additional homes per year. This target will be the basis for monitoring up to 2016, and the figure will be reviewed in 2011, and from time to time thereafter.

3.266 This dramatic increase in population and homes will require the provision of associated public and social infrastructure – transport, education, health-care, green spaces, and will place increasing demand on London's resources, including water. This is discussed further in the Water Management context section.

3.267 The London Plan (consolidated with alterations since 2004) identifies specific development and regeneration areas in the Thames Gateway and the London-Stansted-Cambridge-Peterborough growth area, which includes Opportunity Areas in North East London. These will present locally-specific resource issues due to the focus of large scale development.

[292] GLA (2008) The London Plan (consolidated with alterations since 2004)
[293] GLA (2008) London Plan (consolidated with alterations since 2004)

Relating to water such developments will increase water demands, run off and waste water. In addition meeting the housing development projections for London over the next years will require increased development in flood risk areas. This is discussed further in the Water Management and Climate Change context sections.

3.268 Climate change is another cross-cutting issue as it will affect all aspects of life in London, and may impact particularly on water related issues such as flooding and the reliability of supply. The effects and implications for the Water Strategy of climate change are discussed fully in the Climate Change context section.

3.269 The London Plan (consolidated with alterations since 2004) identifies a number of driving forces for change in the city. These include:

- Globalisation of the economy together with "dramatic" advances in technology.
- Increased inter-relationship between major economies, shrinking distance between people, markets and business decision makers.
- Fundamental and accelerating environmental imperative to use energy and resources more efficiently, mitigate and adapt to climate change, and reduce emissions and environmental stress.
- Movement of people – particularly to London from elsewhere in the UK and from abroad.
- Growth of wealth and incomes, and a strong rising demand for leisure and tourism activities.
- Increasing social and economic polarisation.
- Increase in positive view of diversity, and decrease in tolerance of discrimination, misuse of resources and pollution.
- The 2012 Olympic and Paralympic games.

Key problems and opportunities

3.270 Drawing on the review of other policies, plans and programmes and the baseline data, the key sustainability problems and opportunities issues for the SA and the Water Strategy to consider relating to the cross-cutting topic are summarised in Box 15.

Box 15: Key problems and opportunities – cross-cutting

Problems

- The rise in population will increase the pressure on water resources and drainage and sewage infrastructure. There will also be an increase in the numbers of people living in flood risk areas. These will also be exacerbated by Climate Change.

Opportunities

- Increasing potential for regeneration and decontamination through development could provide opportunities to enhance the water environment.

Cross-cutting issues and policies – evolution of the sustainability baseline in the absence of the Water Strategy

3.271 In the absence of the Water Strategy, over the intended 10 year time frame of the Strategy, the baseline under the Cross-cutting Issues and Policies theme is likely to evolve in the following ways:

- The projected increase London's population is likely to have significant effects on all aspects of water use, management and disposal in the capital, potentially increasing demand for water (even where per-capita use falls), increasing effluent requiring

treatment and disposal, and putting ever greater pressure on existing sewage infrastructure;

- As noted under the Economy theme, the scale of development planned in some areas of London, such as Thames Gateway, may leading to more homes and businesses being located in areas at risk of flooding; and
- Climate change has the potential to affect all aspects of life in London, and may impact particularly on water related uses such as flooding and the reliability of water supply.