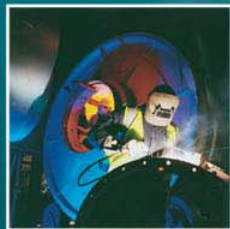
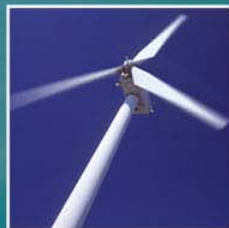
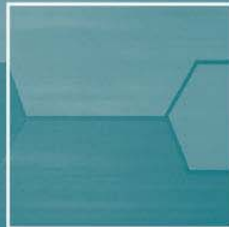
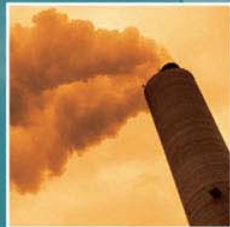


Derby City Council, Amber Valley Borough Council and South Derbyshire District Council

Derby Housing Market Area Water Cycle Study

Scoping and Outline Water Cycle Study

January 2010



Entec

Creating the environment for business

Copyright and Non-Disclosure Notice

The contents and layout of this report are subject to copyright owned by Entec (© Entec UK Limited 2009) save to the extent that copyright has been legally assigned by us to another party or is used by Entec under licence. To the extent that we own the copyright in this report, it may not be copied or used without our prior written agreement for any purpose other than the purpose indicated in this report.

The methodology (if any) contained in this report is provided to you in confidence and must not be disclosed or copied to third parties without the prior written agreement of Entec. Disclosure of that information may constitute an actionable breach of confidence or may otherwise prejudice our commercial interests. Any third party who obtains access to this report by any means will, in any event, be subject to the Third Party Disclaimer set out below.

Third-Party Disclaimer

Any disclosure of this report to a third-party is subject to this disclaimer. The report was prepared by Entec at the instruction of, and for use by, our client named on the front of the report. It does not in any way constitute advice to any third-party who is able to access it by any means. Entec excludes to the fullest extent lawfully permitted all liability whatsoever for any loss or damage howsoever arising from reliance on the contents of this report. We do not however exclude our liability (if any) for personal injury or death resulting from our negligence, for fraud or any other matter in relation to which we cannot legally exclude liability.



Report for

Sarah Banks, Derby HMA Growth Point Coordinator
Roman House
Friar Gate
Derby
DE1 1XB

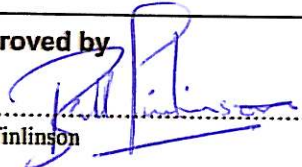
Main Contributors

Sandra Ryan
Peri Boitsidis
Katie Hill
Barry Rodgers
Laura Fielding

Issued by


.....
Laura Fielding

Approved by


.....
Bill Finlinson

Entec UK Limited

Canon Court
Abbey Lawn
Abbey Foregate
Shrewsbury SY2 5DE
England
Tel: +44 (0) 1743 342000
Fax: +44 (0) 1743 342010

Doc Reg No. 25498D058

h:\projects\hm-255\25498 derby water cycle strategy\ld040 design\final
report version 3\25498_final_report_master_copy_i3_reviewed.doc

Derby City Council , Amber Valley Borough Council and South Derbyshire District Council

Derby Housing Market Area Water Cycle Study

Scoping and Outline Water Cycle Study

January 2010

Entec UK Limited



Certificate No. FS 13881



Certificate No. EMS 69090

In accordance with an environmentally responsible approach,
this document is printed on recycled paper produced from 100%
post-consumer waste, or on ECF (elemental chlorine free) paper



Entec

Creating the environment for business



Executive Summary

Purpose of this Report

This report has been produced for the purpose of providing strategic level advice on water infrastructure and environmental capacity to the Councils, to inform their Local Development Frameworks and strategic site allocation. The study area has been defined as the three local authority boundaries of Amber Valley Borough, Derby City and South Derbyshire District to cover the growth area of the Derby Housing Market Area (HMA) (which falls within the Government's Six C's [Three Cities and Three Counties] Growth Point including Derby, Nottingham and Leicester).

The aims and objectives of the Derby Water Cycle Study can be outlined as follows:

- Take an integrated approach to management of the water environment;
- Meet EU framework targets on water quality, determining whether environmental resources can cope with providing water and receiving wastewater to/from further development;
- Ensure sustainable flood risk management over the long term are delivered through policies to protect future development from flooding;
- Aspire for water neutrality in all developments, by identifying mechanisms for achieving high standards of water efficiency, with the aim of reaching water neutrality through a stepped programme of measures and planning policy;
- Determine whether the existing water and wastewater services infrastructure has sufficient capacity to support the planned development;
- Determine whether environmental resources can cope with providing water and receiving wastewater to/from further development;
- Provide the evidence base for the Local Development Framework.

The study has been prepared in accordance with the guidance prepared by the Environment Agency on Water Cycle Studies, complying with the Scoping and Outline stages to clearly outline the impact of projected growth on the water cycle in the Derby HMA and highlight any potential problems that may need addressing in order to achieve this growth sustainably.

The study has involved working with the key stakeholders, the Water Companies, the Environment Agency and the Councils to establish the key constraints within the water cycle to identify integrated solutions in order to achieve sustainable development.



Data for this study has been collated from Severn Trent Water (STW), South Staffordshire Water (SSW), the Environment Agency (EA), English Nature, the three Councils listed above and Derbyshire County Council. While we endeavour to ensure the information provided in this report is correct, the assessments made in this report are reliant on data received by Entec from these third parties.

The study examines issues regarding water resources, wastewater treatment, water quality, sewerage and flood risk in general across the whole study area. Where constraints are identified these are explored further and recommendations made to either resolve these problems or to identify future work required.

This study comprises the Scoping and Outline stages of a water cycle study, with the purpose of providing the evidence base for the Councils' Local Development Framework. The focus of the Scoping and Outline stages is gathering and assessing available data; identifying environmental and major infrastructure constraints; and deciding whether further detailed assessment is needed. As part of this work strategic level assessments have been undertaken to provide a general overview of issues across the study area. The need for a further Detailed Study has been identified.

The report has been informed by the most up to date environmental and infrastructure data that could be made available from the Environment Agency, Severn Trent Water and South Staffordshire Water in August 2009. This information has been provided solely for use in these stages of the water cycle study and should not be used for any other purpose. Developers should prepare their own site specific assessments to determine the suitability of a site with regard to the water cycle elements. We would draw the reader's attention to the Third Party Disclaimer at the front of this report limiting the uses to which the information in this report can be put.

Water Resources

The major reservoirs in the Derbyshire Derwent catchment (in the Derwent and Dove valleys), augmented by a transfer from Rutland Reservoir (Anglian Water), and several river abstractions, provide the majority of water supplying the area occupied by the Derby HMA.

The study area is predominantly supplied by Severn Trent Water's East Midlands Water Resource Zone. A small percentage of South Derbyshire is supplied by South Staffordshire Water.

In the East Midlands the resource situation is significantly constrained. The Environment Agency's Catchment Abstraction Management Strategies (CAMS) show that the vast majority of resource management units relevant to the study area have either no water available, are over licensed, or are even over abstracted. However, there are some exceptions applicable to both water companies, where the CAMS assessment concludes that there is some water available.

Climate change is expected to reduce resource availability further. Severn Trent Water predicts that by 2034/2035, the deployable output will reduce by 38.8 megalitres per day (Ml/d). This is equivalent to a reduction of 4.4%.



Without additional measures, Severn Trent's draft Water Resource Management Plan (WRMP) forecasts a deficit in supply throughout the growth period. To rectify the deficit, their final planning scenario has allowed for certain measures that include a combination of demand management and increases in existing abstraction, where water is deemed available, so that in the final planning scenario of their draft WRMP, a surplus in supply and demand is forecast. The forecast supply surplus is based on the assumption that consumption rate in new households will decline from the current level of 132 litres per head per day (l/h/d) to 129 l/h/d.

South Staffordshire Water's draft WRMP forecast a surplus in their baseline scenario. Their plan includes a reduction of 3Ml/d groundwater sources in the vicinity of the River Mease (Habitats Directive designation) and Checkhill Bogs Site of Special Scientific Interest (SSSI) to reduce the pressure on habitats protected under the Habitats Directive.

The forecast surplus in supply suggests that the driver for water neutrality may not be so strongly justified. Nevertheless, there are serious pressures on the water resources in the area, and the final scenario in Severn Trent's management plan is based on a lower consumption rate than existing. To reduce the pressure on water resources in the region and to support the water company's management plans, it is key that the Local Authorities bring forward recommendations for all new homes to be water efficient in the Core Strategy. The recommendations from this study are for the Councils to include policies for all new homes to achieve the Code for Sustainable Homes Level 3/4 as a minimum.

Wastewater Treatment and Sewerage

Public sewerage is provided by Severn Trent Water in the study area. This study has identified, through high level assessments, that there are likely to be capacity issues at some of the wastewater treatment works within the growth period. The treatment works at Fritchley, Duffield, Coton Park, Milton and Findern have been found to be already at capacity based on the measured flow from works, provided by Severn Trent Water. The treatment works at Stanton, Kilburn and Melbourne will potentially exceed their consented flow by 2015 based on the predicted growth used in this study based on the RSS targets. It is recommended that STW concentrate their assessments of growth and investment at Stanton and Melbourne works also.

The capacity of the sewerage (foul sewer network) has been highlighted as a constraint to development, particularly within Derby City. The EA and STW are aware of this issue, and STW has included plans in their long term strategy to deal with existing hydraulic inadequacies in the sewerage system. This constraint is an important issue that will concern the strategic housing sites in Derby City.

Some options available to STW are to transfer sewerage from Derby City to treatment works in South Derbyshire to alleviate pressures in the sewerage network.

It is recommended that a Detailed Water Cycle Study is undertaken to investigate these issues regarding capacity at the treatment works and the sewerage network. The Detailed Study would provide more definitive answers on the number of houses that could be accommodated by the existing works, and work with Severn Trent Water as they



confirm their investment plans. The sustainability and costs of certain options to alleviate the sewerage capacity issue in Derby would also be assessed.

Water Quality

The water quality of the rivers within the study area has been found to be a potential issue, as a result of elevated nutrient levels. These are likely to be a result of a combination of sources, including agricultural / urban run-off as well as sewage discharge.

A number of designated sites are present in the study area, including the River Mease Special Area of Conservation in South Derbyshire. The River Mease also has an issue with elevated nutrients and is currently failing to meet its Water Framework Directive objectives. At the time of writing the Environment Agency's current position on the River Mease is to object to any new development that will discharge surface run-off or effluent into the Mease, relevant to the Netherseal and Overseal areas.

Increases in the controls on quality of discharge consents within the study area maybe required as a result of the Water Framework Directive (WFD), with particular regard to phosphorous levels. This may require further investment from STW and also potentially from developer contributions. New developments will also need to assess the impact and quality of surface run-off within the River Mease catchment.

Agricultural sources are also partly responsible for the high nutrient levels in the areas watercourses. Actions have already been identified in the Humber River Basin Management Plan (RBMP) to help improve run-off and water quality from agricultural land. It is recommended that the Core Strategy supports these actions.

Flood Risk and Drainage

The main sources of flood risk in the study area have been identified as fluvial, from the rivers Derwent and Trent and their tributaries and from surface water run-off. Development in the highest flood risk zones should only be permitted if they are at the appropriate level of vulnerability in accordance with PPS25.

Level 1 Strategic Flood Risk Assessments (SFRA) have been prepared for all three Council areas, and the findings of these are summarised in this report. It is recommended that the findings of the SFRAs are taken into account in spatial planning: developments should, where possible, be located in the lowest flood risk zone based on the SFRA mapping.

The Trent Catchment Flood Management Plan, prepared by the Environment Agency, proposes action to reduce flood risk in the study area. These are summarised in Chapter 6. The Agency has also prepared the Lower Derwent Strategy to help manage and reduce flood risk in Derby City. As part of the strategy, a Blue Corridor vision is recommended to help control the flooding through Derby, and this should be put into action as soon as possible.



Surface water flooding, as a result of heavy rainfall events, urbanisation and insufficient drainage capacity is a problem in the study area, with particular reference to Derby City and urban areas. The strategic housing sites identified in the Derby HMA Growth Point Programme of Delivery at Wilmorton College and Boulton Moor are shown to contain areas at risk of surface water flooding.

Defra has recently announced the top 77 Councils in the UK that are to receive funding to undertake Surface Water Management Plans (SWMPs). Derby City is listed and it is recommended that the SWMP is started as soon as possible, to review the areas within the City most at risk of surface water flooding, to contribute to future development planning, the Core Strategy, and Severn Trent's investment plans. Defra also has a further fund available to Councils not listed in the top 77 and it is recommended that Amber Valley Borough and South Derbyshire District review the merits of applying for additional funding to assess surface water flooding in their administrative areas.

Sustainable Drainage Measures are recommended in the study area to provide multiple benefits such as providing amenity and environmental benefits, reducing pressures on the drainage system and providing more storage of rainwater. These are considered particularly important in the study area, to alleviate the existing issues with sewerage capacity and to contribute to the improvement of river water quality.

The opening up of culverted watercourses could provide required green corridors for the urban areas where there are deficiencies for open space. The Trent Catchment Flood Management Plan also recommends that the Environment Agency and the Councils identify locations within the urban areas where Biodiversity Action Plans habitats may be created. This is already underway as part of the Green Infrastructure Strategy for the 6C's (3 Cities and 3 Counties) Growth Point.

Recommended Actions and Policies

Policy Recommendation	Discipline Area	Justification
Local Authorities should require developers of private homes to design new homes to meet the minimum water use standard in Level 3/4 of the Code for Sustainable Homes (105 l/p/d)	Water Resources	All new social housing funded through the Housing Corporation is required to be built to level 3 of the Code For Sustainable homes, 105l/p/d. Councils' should support a high level of water efficiency in remaining homes to ensure that the water companies plans for demand management and water supply can be met in the growth period



Policy Recommendation	Discipline Area	Justification
<p>The Core Strategy for each Council should include policies to support the water companies' water efficiency activities as set out in the WRMPs, particularly the drive for increased water efficiency activities in existing households.</p>	<p>Water Resources</p>	<p>Councils' should support a high level of water efficiency in existing development (residential and non-residential) to ensure that the water companies plans for demand management and water supply can be met in the growth period</p>
<p>The WCS recommends that each Council's Core Strategy includes policies that promote sustainable drainage techniques (SuDS) that mimic natural drainage, rather than using traditional piped systems in all new developments.</p>	<p>Water Quality / Flood Risk</p>	<p>To support the requirements of PPS25, the Trent CFMP, the Pitt Review and the forthcoming Floods and Water Management Bill, the Councils should encourage all new development to use SuDS to reduce flood risk from both fluvial and surface water run-off. SuDS will also provide a level of treatment, improving water quality and contributing to meeting WFD targets.</p>
<p>The Core Strategy for each Council should encourage culverted watercourses to be opened up to natural channels where feasible</p>	<p>Water Quality / Flood Risk</p>	<p>To provide green corridors within existing urban areas, contributing to sustainable flood risk management whilst also creating recreational areas, in line with national and regional policy, and the requirements of the Trent CFMP and Humber RBMP.</p> <p>These will also offer up green corridors within urban areas, in line with the Green Infrastructure requirements</p>



Recommended Action	Discipline Area	Justification
<p>It is recommended that a Detailed Water Cycle Study is undertaken,</p>	<p>All</p>	<p>To review the water companies final investment and management plans.</p> <p>To continue the stakeholder engagement and promote ongoing dialogue between the local authorities and the water companies for monitoring and assessing the impacts of growth on the water resources management in the study area.</p> <p>To provide further clarification on the location and annual rate of growth, to determine exactly the pressures on the hydraulic and treatment capacity of WwTWs, the capacity of sewerage, and the likely impacts of the WFD and discharge criteria on required investment.</p>
<p>The works at Fritchley, Duffield, Coton Park, Findern, Milton, Stanton, Kilburn and Melbourne should be assessed by STW</p>	<p>Wastewater</p>	<p>To assess their capacity to receive growth in the immediate term, so that potential capacity issues to 2015 are dealt with as early as possible.</p>
<p>It is recommended that STW continues communication with the Derby HMA</p>	<p>Wastewater</p>	<p>To determine where and when growth will occur in the Derby WwTW catchment, to identify the preferred option to alleviate pressures on the sewerage system.</p>
<p>To prepare a Level 2 SFRA for the Derby Principal Urban Area</p>	<p>Flood Risk and Drainage</p>	<p>To apply the Sequential Test to each Council's strategic allocations in support of the Core Strategy. These will cover all forms of flooding.</p>
<p>It is recommended a Surface Water Management Plan is undertaken for Derby City in line with a Detailed WCS</p>	<p>Flood Risk and Drainage</p>	<p>To identify the highest risk areas of the city and provide mitigation to surface water flooding.</p>
<p>The Core Strategy for each Council should encourage culverted watercourses to be opened up to natural channels where feasible.</p> <p>Land management techniques should be applied and encouraged where possible in rural areas to alleviate flooding. Examples include wetland creation and afforestation</p>	<p>Flood Risk and Drainage</p>	<p>These will create green corridors in urban areas, providing benefits to flood alleviation, amenity, recreation and water quality.</p>



It is recommended that the Councils continue to meet regularly with the stakeholders of this study, to monitor the growth rates and location, particularly given the uncertainty at present with the economic climate. The purpose of these meetings would be to update the water companies on the growth patterns in order for water resources and wastewater to be managed appropriately.

A Detailed Water Cycle Study is recommended to update this report following the release of the water companies Final Water Resource Management Plans (due November 2009). The study would be able to inform the Councils on the schemes that have been granted funding by Ofwat, and confirm the measures in place to manage resources over the growth period. Additional advice and strategies will also be delivered to ensure water efficiency measures are delivered in the study area. Through clarification of the growth rate and locations, the Detailed Study would be able to assess exactly the pressures on the hydraulic and treatment capacity of wastewater treatment works, the capacity of sewerage, and the likely impacts of the WFD and discharge criteria on required investment.



Contents

1.	Introduction	1
1.1	Aims and Objectives	1
1.2	How to Use this Water Cycle Study	2
2.	Development and Growth	3
2.1	Planning Policy Context	3
2.1.1	National Policy	3
2.1.2	Regional Policy	5
2.2	Derby Housing Market Area	6
2.2.1	Adopted Local Plans	6
2.2.2	Emerging Local Development Frameworks	6
2.2.3	Derby City	7
2.2.4	South Derbyshire	8
2.2.5	Amber Valley	8
2.3	Planned Growth in Housing Stock	8
2.4	Legislation and Regulations	9
3.	The Water Cycle	13
3.1	Introduction	13
3.2	Integrated Catchment Management	15
3.3	The Study Area	15
3.3.1	River Basin District	17
3.3.2	Geology and Hydrogeology	17
4.	Water Resources and Public Water Supply	19
4.1	Water Resources Supply and Management	19
4.1.1	Catchment Abstraction Management Strategies	19
4.1.2	Water Resources in the Study Area	20
4.1.3	Resource Management	20
4.2	Strategic Water Resources	21
4.2.1	Severn Trent Water Draft Water Resource Management Plan	21
4.2.2	South Staffordshire Water Draft Water Resource Management Plan	25
4.3	Constraints and Opportunities	27



4.3.1	Supply Constraints: Regional Water Resource Availability	28
4.3.2	Supply Constraints: Catchment Water Resource Availability	29
4.3.3	Local Water Supply Infrastructure	30
4.4	Capacity for New Development	31
4.4.1	Water Supply	31
4.4.2	Sustainable Development / Water Neutrality Assessment	33
4.4.3	Supply Infrastructure	35
4.4.4	Climate Change Allowance	36
4.5	Water Company Preferred Strategy	36
4.6	Summary and Recommended Policies / Development Strategy	37
5.	Wastewater Treatment, Sewerage and Water Quality	41
5.1	Wastewater Treatment and Sewerage	41
5.1.1	Existing Wastewater Treatment Works	42
5.1.2	Existing Sewerage	44
5.1.3	Sludge Management	45
5.2	Water Quality	45
5.2.1	Baseline Environment	46
5.3	Constraints and Opportunities	53
5.3.1	Environmental Constraints	53
5.3.2	Infrastructure Constraints	56
5.4	Capacity for New Development	57
5.4.1	Climate Change Allowance	62
5.5	Summary and Recommended Policies / Development Strategy	63
6.	Flood Risk and Drainage	67
6.1	Flood Risk Management	67
6.2	Sources of Flooding	68
6.2.1	Fluvial Flooding	68
6.2.2	Surface Water Flooding	70
6.2.3	Flooding from Infrastructure	72
6.2.4	Other Sources	74
6.3	Constraints to Development	74
6.3.1	Environmental Constraints and Future Capacity	74
6.3.2	Infrastructure Constraints and Future Capacity	75
6.4	Sustainable Flood Risk Management	75



6.4.1	Trent Catchment Flood Management Plan	75
6.4.2	Lower Derwent Strategy	77
6.4.3	Sustainable Drainage Systems (SuDS)	78
6.4.4	Land Management	81
6.4.5	Climate Change Allowance	81
6.5	Recommended Policies / Development Strategy	82
7.	Integrated Recommendations and Guidance	85
7.1	The Water Environment	85
7.2	Water and Sewerage Infrastructure	86
7.3	Integrated Recommendations	87
7.4	Recommendations for Future Work	93
8.	References	95
Table 2.1	Primary Water Related Legislation	10
Table 4.1	Impact of Climate Change on Deployable Output (Supply)	28
Table 4.2	Summary of Water Efficiency Scenarios Used in Sensitivity Analysis	32
Table 5.1	Current Population and Consent Conditions for WwTWs Serving the Study Area	43
Table 5.2	Assumed compliance with WFD targets, based on GQA measurements	47
Table 5.3	Housing Growth and Future DWF to 2015	57
Table 5.4	Estimated Housing Numbers to 2026 at WwTWs most Affected by Growth	60
Table 6.1	References for the Councils' Strategic Flood Risk Assessments	67
Table 6.2	Summary of Main CFMP Actions for LPAs in Burton, Derby and Nottingham (Policy Unit 5)	76
Table 6.3	Preferred Strategies from the Lower Derwent Strategy Document (Environment Agency, 2008)	78
Table 7.1	Policy Recommendations to Achieve Sustainable Development Relating to the Water Cycle	88
Table 7.2	Recommended Actions	89
Figure 2.1	The Derby Housing Market Area (HMA)	5
Figure 2.2	Planning Context of Water Cycle Studies	7
Figure 2.3	Planned Growth in Housing Stock for Derby HMA used in the Water Cycle Study (from liaison with each Council during the study)	9
Figure 3.1	Traditional View of the Water Cycle Without Artificial Influences	13
Figure 3.2	Schematic of the Urban Water Cycle Based on Current Practice	14
Figure 3.3	Hydrological Context	16
Figure 3.4	Geology	18
Figure 4.1	Water Resource Zones	22
Figure 4.2	Severn Trent Water - Dry Year Baseline supply demand balance for the East Midlands Water Resource Zone	24
Figure 4.3	Severn Trent Water – Dry Year Final Plan supply demand balance for East Midlands Water Resource Zone	25
Figure 4.4	South Staffordshire Water – Dry Year Annual Average Supply Demand Balance (Baseline)	26
Figure 4.5	South Staffordshire Water – Dry Year Annual Average Supply Demand Balance (Final)	27
Figure 4.6	Summary of Alternative Growth Rate and Demand Scenario Forecasts	33
Figure 5.1	Wastewater Treatment Works and Catchments	After Page 42
Figure 5.2	Phosphorous Compliance against Water Framework Directive Targets	48
Figure 5.3	Designated Sites	52
Figure 5.4	Wastewater Treatment Catchments in the River Mease Catchment	54
Figure 5.5	Wastewater Treatment Works DWF with additional housing to 2015	59
Figure 5.6	Potential Impact of Growth on Effluent Flow at Major WwTWs 2015 to 2026	62
Figure 6.1	Flood Zones from Strategic Flood Risk Assessments	After Page 74
Figure 6.2	Groundwater Source Protection Zones	80
Figure 7.1	Development Strategy for the Derby HMA	91



Figure 7.2 Strategy for Developers

92

Appendix A	Water Resources and Supply
Appendix B	Wastewater Treatment and Water Quality
Appendix C	Environment Agency's Current Position Statement on the River Mease (August 2009)
Appendix D	Draft Humber River Basin Management Plan Actions
Appendix E	Tables D.2 and D.3 from PPS25 Annex D
Appendix F	CFMP Actions
Appendix G	Climate Change



Glossary

AMP	Asset Management Plan
BAP	Biodiversity Action Plan
BOD	Biological Oxygen Demand
BREEAM	Building Research Establishment Environmental Assessment Method
CAMS	Catchment Abstraction Management Strategy
CLG	Communities and Local Government
CFMP	Catchment Flood Management Plan
CSH	Code for Sustainable Homes
CSO	Combined Sewer Overflow
Defra	Department for Environment, Food and Rural Affairs
DPD	Development Plan Document
DWF	Dry Weather Flow
EA	Environment Agency
EIA	Environmental Impact Assessment
EMDA	East Midlands Development Agency
GIS	Geographical Information System
GQA	General Quality Assessment
HMA	Housing Market Area
IUD	Integrated Urban Drainage
LDF	Local Development Framework
l/h/d	Litres per head per day
LPA	Local Planning Authority
MI/d	Megalitres per day
pcc	Per capita consumption
PPS25	Planning Policy Statement 25



PR	Periodic Review (for water companies' investment plans)
RBMP	River Basin Management Plan
RSS	Regional Spatial Strategy
SAC	Special Area of Conservation
SFRA	Strategic Flood Risk Assessment
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
SSW	South Staffordshire Water Ltd
STW	Severn Trent Water Ltd
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
WCS	Water Cycle Study
WFD	Water Framework Directive
WRMP	Water Resource Management Plan
WRZ	Water Resource Zone
WwTW	Wastewater Treatment Works
UKCIP	United Kingdom Climate Change Impacts Programme



1. Introduction

1.1 Aims and Objectives

The partners of the Derby Housing Market Area (HMA) wish to achieve an integrated approach to management of the water environment alongside the proposed growth levels. The Outline Water Cycle Study (WCS) provides an effective and customised planning tool allowing the local authorities to effectively develop the proposed growth strategy, whilst targeting the management of infrastructure investment and providing useful, sustainable targets for developers. The project brief indicated a vision for the water cycle to:

- Take an **integrated approach to management of the water environment**;
- **Meet EU framework targets on water quality**, determining whether environmental resources can cope with providing water and receiving wastewater to/from further development;
- **Ensure sustainable flood risk management** over the long term are delivered through policies to protect future development from flooding; and
- **Aspire for water neutrality in all developments**, by identifying mechanisms for achieving high standards of water efficiency, with the aim of reaching water neutrality through a stepped programme of measures and planning policy.

The project also aims to:

- Determine whether the existing water and wastewater services infrastructure has sufficient capacity to support the planned development (with particular emphasis on proposed strategic developments);
- Identify if additional water and wastewater infrastructure is required for new development, together with the timescale for its delivery and viability of providing that infrastructure; and
- Provide the evidence base for the Local Development Framework.

Flood risk in each local authority of the Derby Housing Market Area has been considered within the Strategic Flood Risk Assessments (SFRA) for Derby City, Amber Valley Borough and South Derbyshire District. The WCS study will therefore only be summarising flood risk, using the evidence supplied in the SFRAs to avoid repetition of work.

A WCS can be undertaken in three stages; an initial scoping study, an outline study and a detailed study leading to a Water Cycle Strategy. This study comprises a combined scoping and outline study and aims to clearly outline the impact of projected growth on the water cycle in the Derby HMA and highlight any potential problems that may need addressing in order to achieve this growth sustainably. The study has involved consultation with key stakeholders in the Water Companies, the Environment Agency and the Derby HMA partners.



1.2 How to Use this Water Cycle Study

A WCS provides an agreed plan, backed up with evidence, for providing integrated solutions to sustainable management of the water cycle, whilst meeting any additional demands associated with growth. This document brings together environmental and water infrastructure asset information that has been provided by the Environment Agency and the water companies. It sets out the current capacity of existing infrastructure (where this information is available), highlighting where the main pressure points are and identifies the environmental constraints to growth and sets out the areas for further investigation in a Detailed Water Cycle Study.

The data and analysis presented in this combined Scoping and Outline Phase provide the evidence base for making planning decisions at a strategic level. It highlights areas where further analysis is required as a result of access to relevant data from either the water companies or the local authorities. It does not provide an instant answer for determining planning applications. This evidence should be used to consider which options will best support the LDF Core Strategy for each Council area and related policies.

It is important to understand the different scales at which the elements of the water cycle (water supply, sewerage and drainage) are managed, and the impacts this has on assessing constraints to growth. The different legislative and regulatory frameworks used to manage water resources, wastewater, sewerage, water quality, floods and drainage also needs to be considered.

Water supply is managed strategically, as there is a high level of connectivity in the water supply network. Water can be moved great distances from the raw water sources (rivers, reservoirs, or groundwater) to the point of delivery. New developments can generally be connected to the main system relatively easily. In contrast, wastewater treatment works (WwTWs) have much smaller defined catchment areas and so the location of development relative to the capacity of the nearest treatment works and receiving water can be critical. Furthermore, both water resource and wastewater catchments rarely coincide with administrative boundaries. Although drainage issues are specific to individual developments, the integration of drainage across sites offers significant potential for green space / habitat creation and can also increase the amenity value of a site, in addition to reducing flood risk and potentially water demand.

This report contains three technical sections presenting the water resource, receiving water quality/wastewater infrastructure and potential drainage and flooding issues across the study area. The evidence in these sections is examined in the context of the whole water cycle and integrated conclusions drawn with recommendations for the Local Authorities and Developers to ensure sustainable delivery of the proposed development in the study area.

Detailed information on the methods used to assess the environmental constraints, and on sustainable development features, such as demand management measures and sustainable drainage techniques, are included within a series of appendices.



2. Development and Growth

2.1 Planning Policy Context

National, regional, sub regional and local planning policy sets out guidance and requirements for delivering sustainable development and therefore addresses, amongst other things: housing and employment growth and its distribution; water management and protection; infrastructure provision; and flood risk management. The following sections outline the relevant planning policy in which these issues are framed, and the current and emerging development plans for each Authority in the Derby HMA.

2.1.1 National Policy

Government guidance is provided through a series of Planning Policy Statements (PPSs), the most relevant of which are summarised below.

Planning Policy Statement 1 (PPS1) – Delivering Sustainable Development and the Supplement to PPS1: Planning and Climate Change

An important theme in government planning policy is the need to achieve sustainable development which includes dealing with Climate Change. PPS1 ‘Delivering Sustainable Development’ (2005) and the December 2006 supplements to it on: ‘Climate Change’, ‘Zero Carbon Development’ and the ‘Code for Sustainable Homes’ have now been incorporated in a Planning and Climate Change Bill. PPS1 requires regional planning bodies (RPBs) and local planning authorities (LPAs) to prepare development plans which ensure that development is pursued in line with the principles for sustainable development and promote outcomes in which environmental, economic and social objectives are achieved together over time. This should be achieved using a spatial planning approach.

Specifically, planning authorities should identify land suitable for meeting housing and other types of development taking into account the need to provide essential infrastructure and avoid flood risk. In addition they should address the issue of climate change; the management of pollution; and the minimisation of impacts from the management and use of resources based upon sound science. PPS1 advises that regional planning authorities and local authorities should promote amongst other things the sustainable use of water resources and the use of sustainable drainage systems in the management of runoff.

The PPS1 supplement advises local planning authorities that when deciding suitable locations for development, and for what type and intensity, they should take into account the capacity of existing and potential infrastructure including water supply, sewage and sewerage, to service the site or area in ways consistent with successfully adapting to likely changes in the local climate. In addition, they could consider physical and environmental constraints such as sea level rises, flood risk and stability, and take a precautionary approach to increases in risk which may arise as a result of potential changes to the climate.



PPS 3 – Housing

PPS3 underpins the delivery of the Government's strategic housing policy objectives where the goal is to ensure that everyone has the opportunity to live in a decent home, which they can afford, in a community where they want to live. Most future development within the three authorities will be for housing. PPS3 requires that new housing should be built on previously developed land (PDL) before greenfield land. PPS25 reiterates this requirement in its Exception Test.

PPS 12 – Creating Strong, Safe and Prosperous Communities through Local Spatial Planning

PPS 12 was published in June 2008. It outlines the nature of local spatial planning and the key components of local spatial plans and how they should be prepared. It should be taken into account by local planning authorities in preparing Local Development Frameworks (LDFs) which include development plan documents (DPDs) and other local development documents (LDDs).

With regard to infrastructure, PPS12 states Core Strategies *should be supported by evidence of what physical, social and green infrastructure is needed to enable the amount of development proposed for the area, taking account of its type and distribution. This evidence should cover who will provide the infrastructure and when it will be provided. The Core Strategy should draw on and in parallel influence any strategies and investment plans of the local authority and other organisations.*

The water cycle study forms part of the robust and credible evidence base which will underpin policies within the Authorities Core Strategy and other relevant LDDs.

PPS 25 – Development and Flood Risk

PPS25 sets out Government policy on development and flood risk. It aims to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas of highest risk. It also aims to ensure that new development does not increase the risk of flooding elsewhere. Where, in exceptional circumstances, new development is necessary in such areas then the aim is to make it safe without increasing flood risk elsewhere and, where possible, to reduce flood risk overall.

PPS25 stipulates that all planning applications for developments greater than 1 hectare must be accompanied by a Flood Risk Assessment detailing surface water management plans to demonstrate that runoff does not increase from the proposed development once it has been built and that runoff is not simply moved elsewhere.

This approach is supported in the Government's Pitt review of the summer 2007 flooding, in which the comments in PPS25 are reiterated. It makes it clear that developments within flood zone 2 and 3 should not be allowed to proceed unless there is clear proof that they are compatible developments for these zones, and that LPAs should become responsible for local flooding.



2.1.2 Regional Policy

Figure 2.1 The Derby Housing Market Area (HMA)



The East Midlands Regional Plan is the Regional Spatial Strategy (RSS) relevant to the Derby HMA. The RSS was adopted in March 2009 and establishes the broad development strategy for the region. It provides a regional framework within which Local Planning Authorities can prepare their Local Development Frameworks (LDFs) for the period to 2026. The Derby HMA is part of the Three Cities Three Counties Growth Point (6Cs), which has been identified by Communities and Local Government to deliver additional housing by 2016. The RSS sets out the Three Cities Sub Regional Strategy which facilitates the delivery of this significant growth requirement.

Policy 13a of the RSS sets a target for housing provision across the HMA of 36,600 dwellings between 2006-2026 with 14,400 dwellings within the Derby City area; 12,000 dwellings within the South Derbyshire District and 10,200 dwellings within the Amber Valley Borough. The policy requires 21,400 of these dwellings to be within or adjoining the Derby Principal Urban Area (PUA).

The adopted RSS sets out policies relating to the regional approach to water management and protection; green infrastructure provision; and flood risk management which indicate how LPAs can deliver this as part of their



LDFs. Policy 32: A Regional Approach to Water Resources and Water Quality requires LPAs to work with key partners to ensure there is timely provision of appropriate additional infrastructure for both supply and waste water treatment and to ensure sustainable water extraction is achieved. Furthermore, the policy requires LPAs to promote the use of sustainable drainage and water efficiency techniques especially in new development. Policy 35: A Regional Approach to Managing Flood Risk requires LDFs to incorporate policies which ensure inappropriate development is not located in flood risk areas. In addition, Policy Three Cities SRS 5 expects the Derby HMA authorities to provide green infrastructure as part of a coordinated approach to providing new and enhancing existing green infrastructure across their boundaries.

2.2 Derby Housing Market Area

2.2.1 Adopted Local Plans

The Derby HMA covers the administrative areas of Derby City, Amber Valley Borough and South Derbyshire District Councils. Each authority has an adopted local plan which are the policies used to determine development applications within their respective authority boundaries. Under the transitional arrangements outlined in PPS12, the Local Plans expired on the 27th September 2007 and only policies saved by the Secretary of State under a direction continue to be part of the Development Plan. Derby City and Amber Valley Borough have saved policies relating to flooding, however South Derbyshire has not had any previous flood or water local plan policies saved. Where policies have been saved, they are being updated and replaced by Local Development Framework policies for the relevant authorities. The Water Cycle Study therefore informs the development of this emerging local plan policy, in particular developing each authority's Core Strategy Development Plan Document (DPD).

2.2.2 Emerging Local Development Frameworks

As required by the Planning and Compulsory Purchase Act 2004, the Derby HMA local authorities are reviewing their adopted local plans and currently preparing Local Development Frameworks (LDF) containing a suite of Local Development Documents (LDD) which outline the development strategy for the Derby HMA in accordance with the RSS.

The Core Strategy is the key document of each LDF and sets out each Council's vision and spatial strategy for future development to 2026. The Councils have recently aligned their Core Strategy and are due to consult on the next stage of the emerging Core Strategy Development Plan Document – Options- in Autumn 2009.

All other LDDs of the LDF need to conform to the Core Strategy. The Water Cycle Study will inform the Core Strategy and other LDDs providing them with an evidence base to assist in delivering national, regional and local objectives relating to water, flood risk and also green infrastructure in a timely and structured manner.

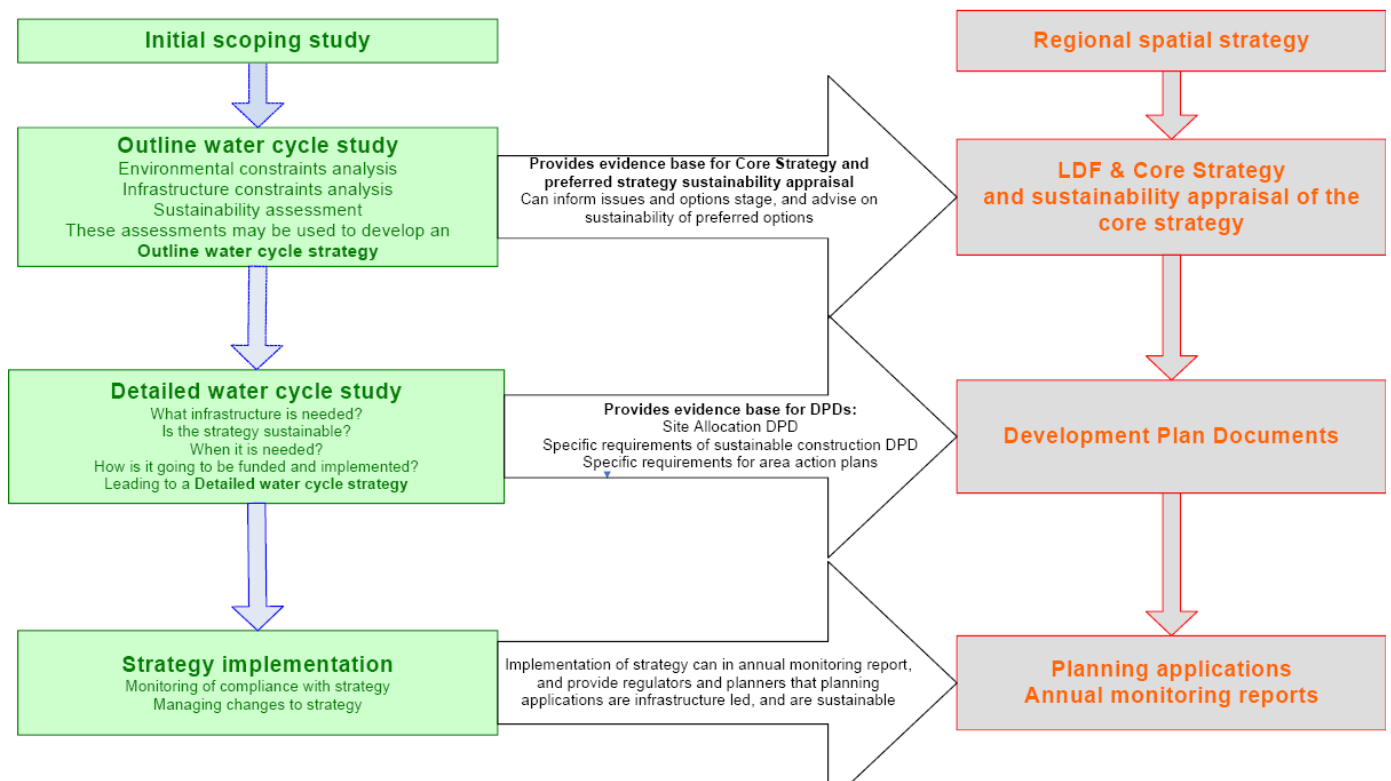


This Outline Water Cycle Study provides the evidence base for the emerging spatial policy options for delivering, as a minimum, the growth identified in the RSS for the Derby HMA. It assists the partner authorities in the development of these options and also options for water, flood risk and green infrastructure policies.

A Detailed Water Cycle Study works alongside the latter stages of the Core Strategy development process and will lead to a water cycle strategy which will: identify management measures and infrastructure required and their timing and location; who is responsible for each measure; and provide guidance to developers.

Figure 2.2 presents how the various stages of a WCS fit in with the LDF phases.

Figure 2.2 Planning Context of Water Cycle Studies



2.2.3 Derby City

For Derby City, the Core Strategy DPD is required by the RSS to plan for a minimum of 14,400 dwellings over the period 2006-2026. This equates to an average of 720 dwellings per annum all to be located within the Derby PUA. For this Outline Water Cycle Study, housing completions have been taken into account, resulting in an annual rate of 692 dwellings per annum from 2011 to 2026 to reach the RSS target of 14,440. A sensitivity of +/- 20% of this growth has been applied where necessary, to reflect that the authority may wish to test this housing trajectory, as part of the evolving DPD process.



2.2.4 South Derbyshire

For South Derbyshire, the Core Strategy DPD is required by the RSS to plan for a minimum of 12,000 dwellings over the period 2006-2026. This equates to an average of 600 dwellings per annum. The RSS requires at least 320 dwellings per annum to be located within or adjoining the Derby PUA which could be in the form of sustainable urban extensions as required. The remaining 280 dwellings per annum are to be located mainly at Swadlincote, including sustainable urban extensions as required. For this Outline Water Cycle Study, an annual housing rate of 611 has been assumed for the period from 2009 to 2026 to meet the RSS target. Where more detailed information is available on the location and timing of development, this has been used in the assessment of impacts on wastewater treatment, to 2015. A sensitivity test of +/-20% of this growth has been applied where necessary to test the impact of more or less growth in the District.

2.2.5 Amber Valley

For Amber Valley, the Core Strategy DPD is required by the RSS to plan for a minimum of 10,200 dwellings over the period 2006-2026. This equates to an average of 510 dwellings per annum. The RSS requires that at least 30 dwellings per annum are to be located within or adjoining the Derby PUA which could be in the form of sustainable urban extensions as required. The remaining dwellings will be located mainly at Alfreton, Belper, Heanor and Ripley, including sustainable urban extensions as required. For this Outline Water Cycle Study the housing trajectory provided by the council has been used up to 2015, followed by an assumed annual growth rate of 598 dwellings per annum to meet the RSS target. A sensitivity test of +/-20% of this growth has been applied where necessary to test the impact of more or less growth in the Borough.

2.3 Planned Growth in Housing Stock

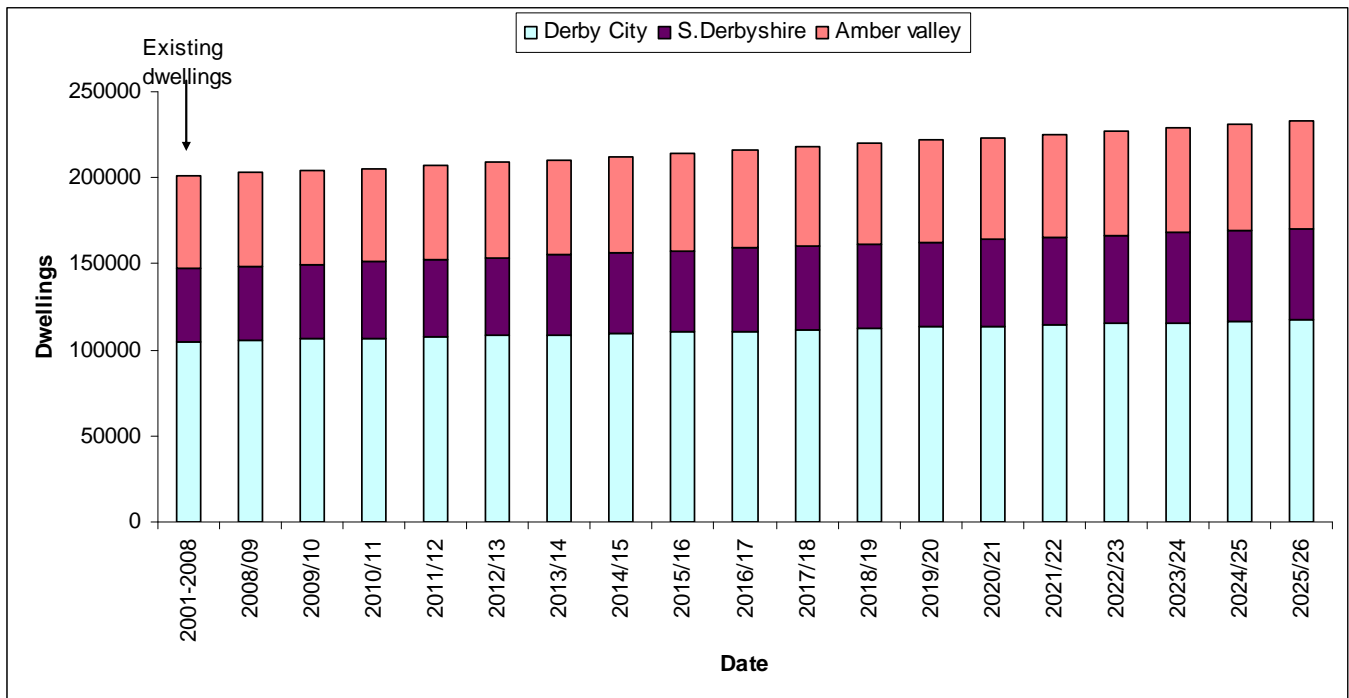
For the water cycle study to assess impacts of growth on water resources, wastewater treatment, water quality and flooding, it is necessary to understand where and when the growth will be delivered. However, it is notoriously difficult to project where and when development will occur, as the growth is dependant on private developers for a proportion of housing stock, the approval of planning permissions, the state of the economy and many other various factors.

Entec requested housing trajectories from the three Councils, based on the most up to date information on preferred strategic sites and committed development. Whilst some of the projected growth is relatively certain in terms of timing, location and scale for the immediate future, for the timescales to 2026 the timing, location and scale of development is a bigger unknown. To this end, it was agreed with the individual councils to use a steady rate of increase in housing to 2026, based on the targets set for each Council in the Regional Spatial Strategy.

This steady rate of growth is presented in Figure 2.3 and is used to assess the impact of growth over the period to 2026. It should be noted that in reality development will occur in a much less steady pattern, which will have more localised impacts, mainly on infrastructure.



Figure 2.3 Planned Growth in Housing Stock for Derby HMA used in the Water Cycle Study (from liaison with each Council during the study)



2.4 Legislation and Regulations

Legislation, guidance and supporting evidence for water related issues, such as water quality, flood risk management and urban drainage, have a significant impact on the water cycle and are often the cause of changes in water infrastructure, as much as development pressures. Any adaptations to the water cycle must be compliant with such legislation and some are undertaken within the regulatory framework.

There is currently an unprecedented level of change in the legislation and guidance for water related issues. Some of these changes are driven by European directives; others are in response to national pressures, from the 2007 summer floods for instance. These changes are either currently being implemented, soon to be applied or likely to change in next five to ten years. Given that the timetable for the Water Framework Directive (WFD) spans the next 18 years in three six-year cycles, the water companies expect to use the first period to carry out the majority of investigations to establish the necessary investment. This will provide an opportunity to assess the improvements delivered through other quality investments. The WFD is discussed in more detail in Section 3.2.

The primary pieces of legislation which set the context relating to the water cycle are summarised in Table 2.1 below.



Table 2.1 Primary Water Related Legislation

Legislation	Description
Water Framework Directive	<p>The Water Framework Directive sets out a requirement to achieve good ecological status in rivers, estuaries and coastal waters, together with good status of groundwater by at least 2027. It presents a unique opportunity for holistic environmental management for all users of the water environment. A cross body Technical Advisory Group (UKTAG) has recently published a set of environmental standards. Whilst there is no certainty that these standards will become statutory in the current form, they form the best current knowledge of how the standards may change. It is considered likely they will be finalised later this year.</p>
Habitats Directive	<p>As people make increasing demands on the environment our wildlife habitats are coming under more and more pressure. The Habitats Directive recognises this and aims to protect the wild plants, animals and habitats that make up our diverse natural environment. The European Directives created a network of protected areas of national and international importance. These are called 'Natura 2000' sites and include Habitats Directive Special Areas of Conservation (SACs).</p> <p>The Habitats Directive has been transposed into English law as the Conservation (Natural Habitats &c) Regulations 1994, now known as the Habitats Regulations.</p> <p>Existing and future water management has the potential to affect a number of these designations and the Environment Agency Review of Consents process has identified a series of amendments that will be required to existing abstraction licences and discharge consents if adverse effects on the European Sites are to be avoided.</p>
Urban Wastewater Treatment Directive	<p>The Urban Wastewater Treatment Directive (UWWTD) regulates the collection and treatment of wastewater from residential properties and industry. Under this Directive receiving waters can be designated as 'Sensitive' where additional levels of treatment are required at significant contributing discharges. These can either be direct discharges or those upstream of the designated reach / water body that serve a population equivalent in excess of 10,000. One type of sensitive area is the "Sensitive Area [Eutrophic]", where elevated nutrient concentrations, mainly nitrogen or phosphorus, present a risk to the ecological status of the receiving water. In these areas, larger sewage discharges must be treated to reduce nutrient loads.</p>



Table 2.1(continued)Primary Water Related Legislation

Legislation	Description
Nitrates Directive	<p>Adopted by the European Union in 1991, this directive aims to reduce water pollution caused by nitrogen from agricultural sources and to prevent such pollution occurring in the future. The directive requires Defra and the Welsh Assembly Government to identify surface or groundwaters that are, or could be high in nitrate from agricultural sources. Nitrogen is one of the nutrients that can effect plant growth. Surface waters also have to be identified if too much nitrogen has caused a change in plant growth which affects existing plants and animals and the use of the water.</p> <p>Once a water has been identified, all land draining to that water is designated as a Nitrate Vulnerable Zone. Within these zones, farmers must observe an action programme of measures which include restricting the timing and application of fertilisers and manure, and keeping accurate records.</p>
Floods Directive	<p>The Floods Directive is designed to help Member States prevent and limit floods and their damaging effects on human health, the environment, infrastructure and property. The Floods Directive came into force on 26 November, 2007 and is due to be transposed into UK law in 2009, but at the time of writing this had not yet occurred. The Directive requires Member States to first carry out a preliminary assessment by 2011 to identify the river basins and associated coastal areas at risk of flooding. For such zones they would then need to draw up flood risk maps by 2013 and establish flood risk management plans focused on prevention, protection and preparedness by 2015. The Directive applies to inland waters as well as all coastal waters across the whole territory of the EU</p>
Floods and Water Management Bill	<p>The draft Flood and Water Management Bill was published for consultation in April 2009. It is designed to improve how the UK prepares for and responds to flood emergencies and better protect water supplies during drought and will implement the key recommendations made in Sir Michael Pitt's independent review into the summer 2007 floods. The draft Floods & Water Management Bill includes provisions that will transpose the requirements of the Flood Directive into law in England and Wales</p>



Entec

Creating the environment for business



3. The Water Cycle

3.1 Introduction

The water cycle describes the pathways and processes through which the water we use moves through the natural and built environment, as well as through the above and below ground infrastructure on which the domestic population and industry depend. Figure 3.1 illustrates the traditional image of the water cycle showing how water enters a river catchment, how it runs through and over the land, before returning to the river system and ultimately returning to the sea.

Figure 3.1 Traditional View of the Water Cycle Without Artificial Influences

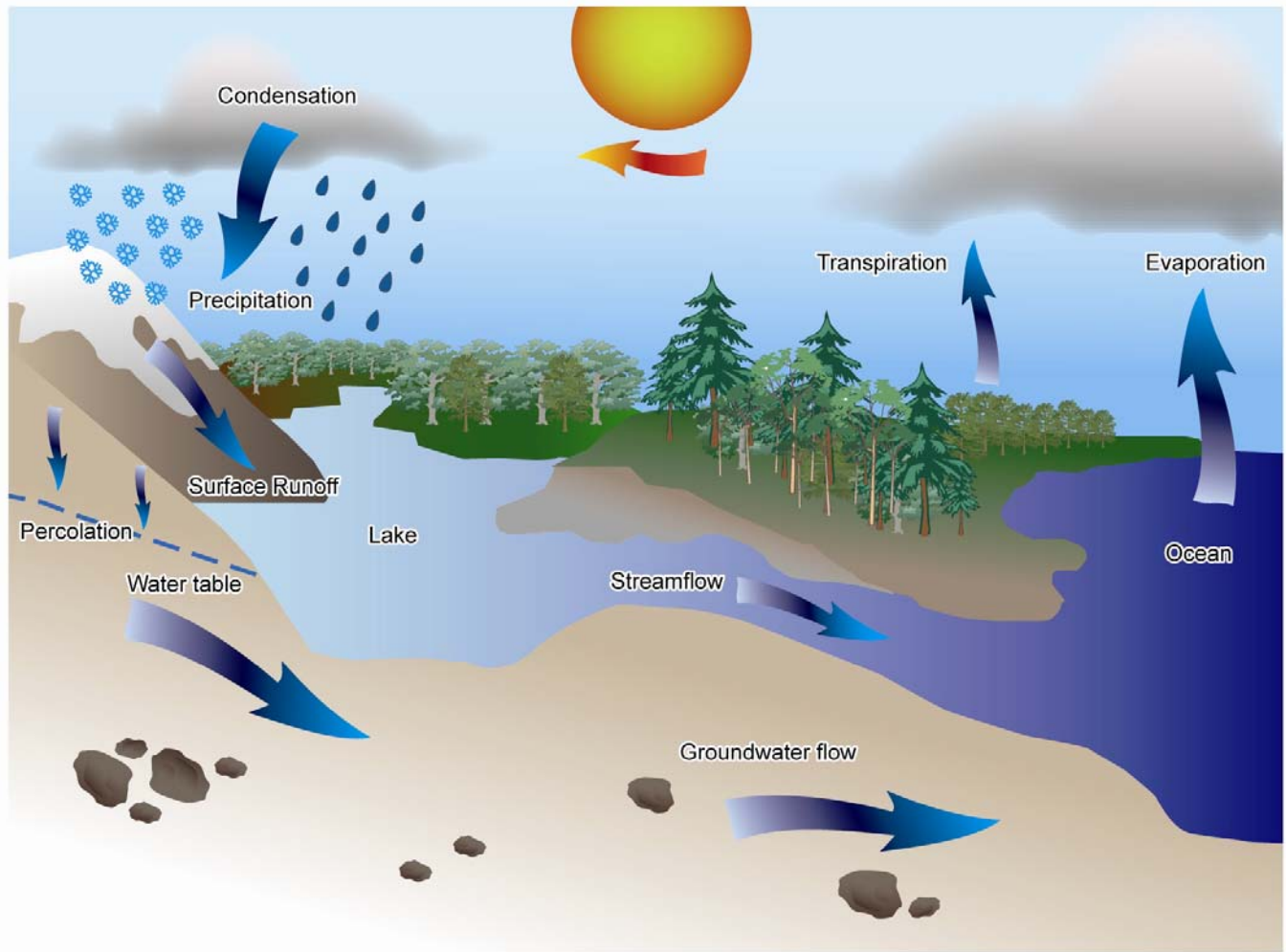
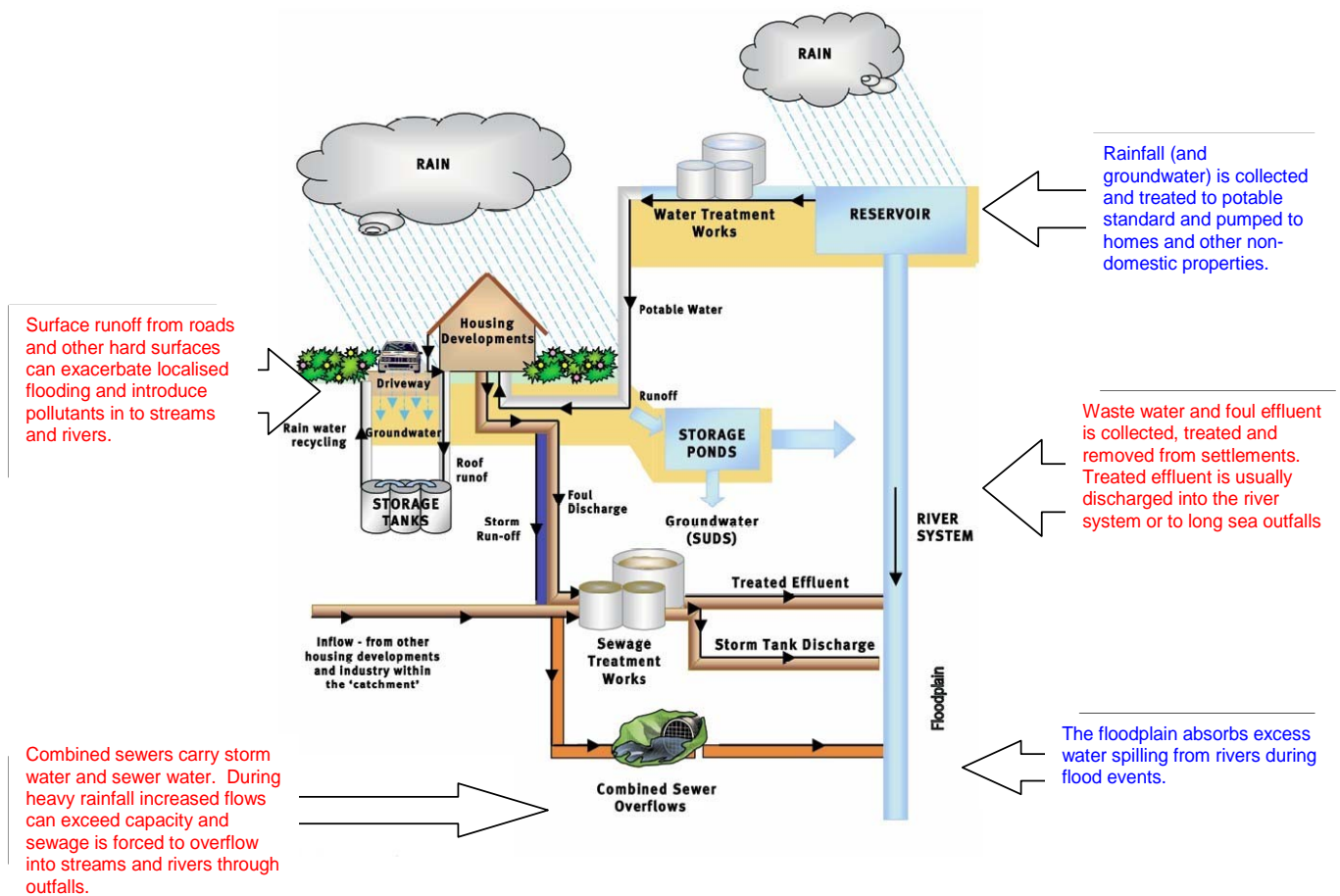


Figure 3.2 illustrates the added complexities within the urban water cycle (in schematic form) as a result of housing development and the infrastructure required to support it. The figure represents the existing urban water cycle for generic settlements. The main differences between the natural and the urbanized water cycle relate to the rate of surface runoff (and percolation in to the ground), and the streamflow. In the urbanised cycle water is captured and stored for use, and this water only re-enters the river network once it has been used and then treated at wastewater treatment works. Hence, the timing and quality of water entering the river network can be significantly different in the urban version of the cycle.

Figure 3.2 Schematic of the Urban Water Cycle Based on Current Practice



Source of background figure: Environment Agency website

The capacity of the water infrastructure needs to be sized appropriately to ensure the sufficient supply of clean water to homes and industry and to receive foul drainage, whilst preventing the discharge of polluted runoff and untreated foul drainage to protect the quality of the receiving water and any dependant habitats, whilst also reducing the risk of flooding.



3.2 Integrated Catchment Management

The capacity of the receiving water environment and thus development in the study area is constrained by environmental quality objectives enforced by UK and European legislation. The Water Framework Directive (WFD) is European legislation that aims to consolidate existing legislation. It came into force in December 2000, and was transposed into UK law in 2003. It introduces some new environmental standards that will help to improve the ecological health of inland waters to achieve 'good status'.

The main aims of the WFD are to prevent deterioration and enhance the status of the water environment, including groundwater. This will be achieved within a framework of River Basin Planning by:

- Reducing pollution;
- Promoting sustainable water use; and
- Contributing to mitigating the effects of floods and droughts.

The Environment Agency published draft River Basin Management Plans for consultation in December 2008 and the final plans are due to be published in December 2009.

Sustainable drainage systems that encourage infiltration and slow down the movement of rainfall runoff in the catchment can reduce the amount of urban pollutants entering watercourses, encourage infiltration into groundwater sources and mitigate the impact of intense rainfall events on surface water flooding. Reducing the amount of potable water that is wasted by implementing water efficiency measures will help to reduce the pressure to abstract, reducing the pressure on aquatic ecosystems, increasing the volume of water available for diluting both point source and diffuse loads whilst also reducing flow in the sewer network.

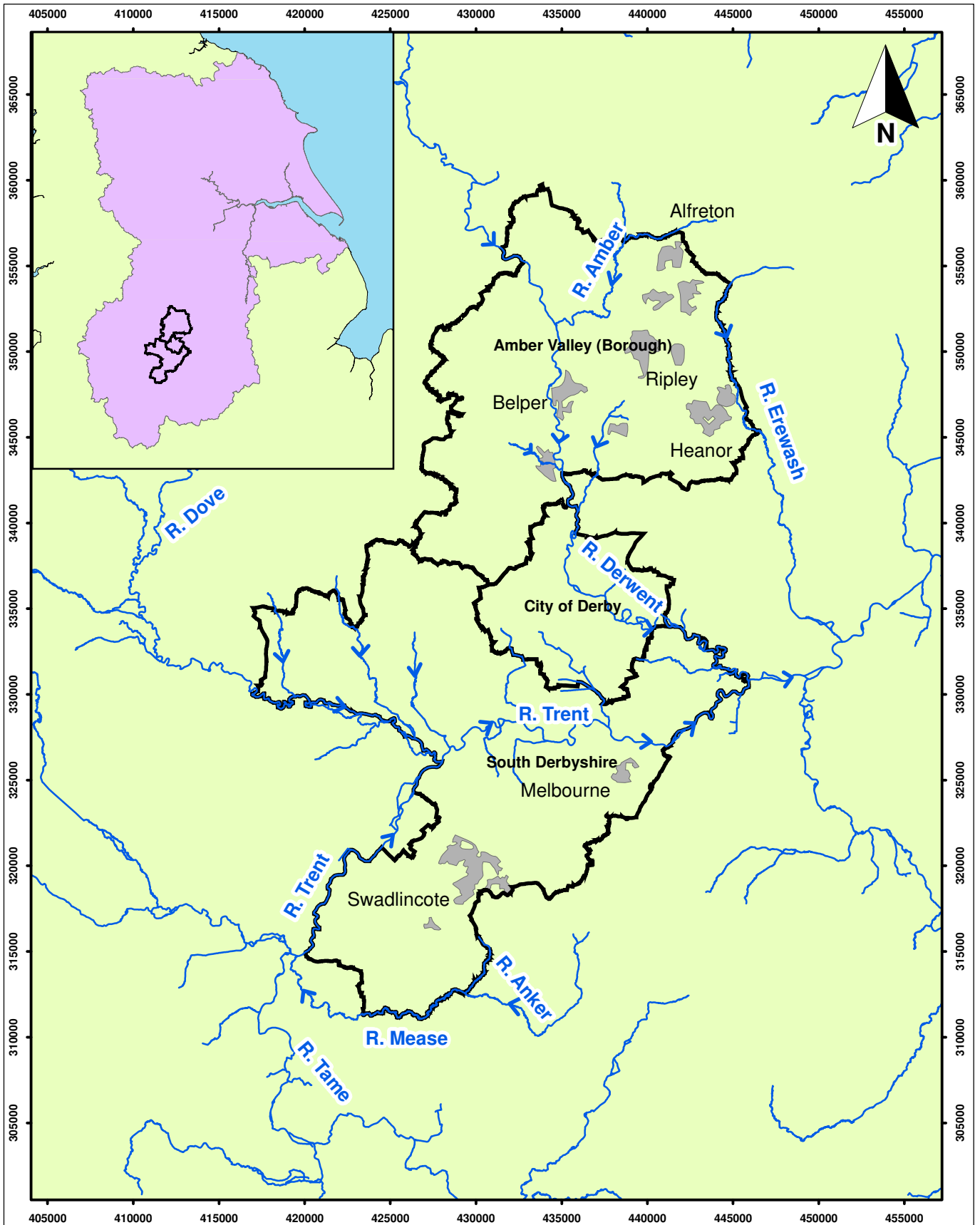
The urban water cycle is complex and highly integrated with many feedback mechanisms. Advanced planning and appropriate management helps to ensure that the water cycle contributes to a safe, clean and healthy environment, rather than being a source of long term problems.

3.3 The Study Area

This study is required for the Derby Housing Market Area (HMA), whose partners are Derby City Council, Amber Valley Borough Council, South Derbyshire District Council and Derbyshire County Council. It was agreed at the project inception meeting that the study area should be defined by the local authority boundaries that cover the HMA: Derby City, Amber Valley and South Derbyshire (see Figure 3.3).

In order to advise on the most sustainable approach water management, an understanding of the existing natural environment and drainage infrastructure is required. The hydrology, ground conditions and drainage of the study area have been summarised using information from various sources, including the Environment Agency and consultations with the water companies and the Councils.





- Key:**
- Derby Housing Market Area
 - Main River
 - Approximate Urban Areas
 - Humber River Basin District

Derby HMA Scoping and Outline
Water Cycle Study

Figure 3.3
Hydrological Context

3.3.1 River Basin District

For the Water Framework Directive, the Environment Agency has divided England and Wales into nine river basin districts in order to manage targets on both surface water and groundwater quality. The study area is located within the Humber River Basin District, one of the largest river basin districts which include the Rivers Trent and Humber. For each district, a draft River Basin Management Plan has been prepared detailing how water quality targets should be monitored and managed. The main watercourses in the study area are the River Derwent, which flows through the centre of Derby City, the River Amber, a tributary of the Derwent, and the River Trent and relevant tributaries of the River Dove and River Mease, which flow through South Derbyshire (Figure 3.3).

The River Derwent (Derbyshire Derwent) is a major tributary of the River Trent. It rises on Howden Moor in the Peak District above the reservoirs of Howden, Derwent and Ladybower, before flowing southwards through Derbyshire and to the city of Derby. The confluence with the River Trent is located at Shardlow to the south east of Derby City. The main tributaries of the Derwent in the study area are the rivers Amber and Ecclesbourne.

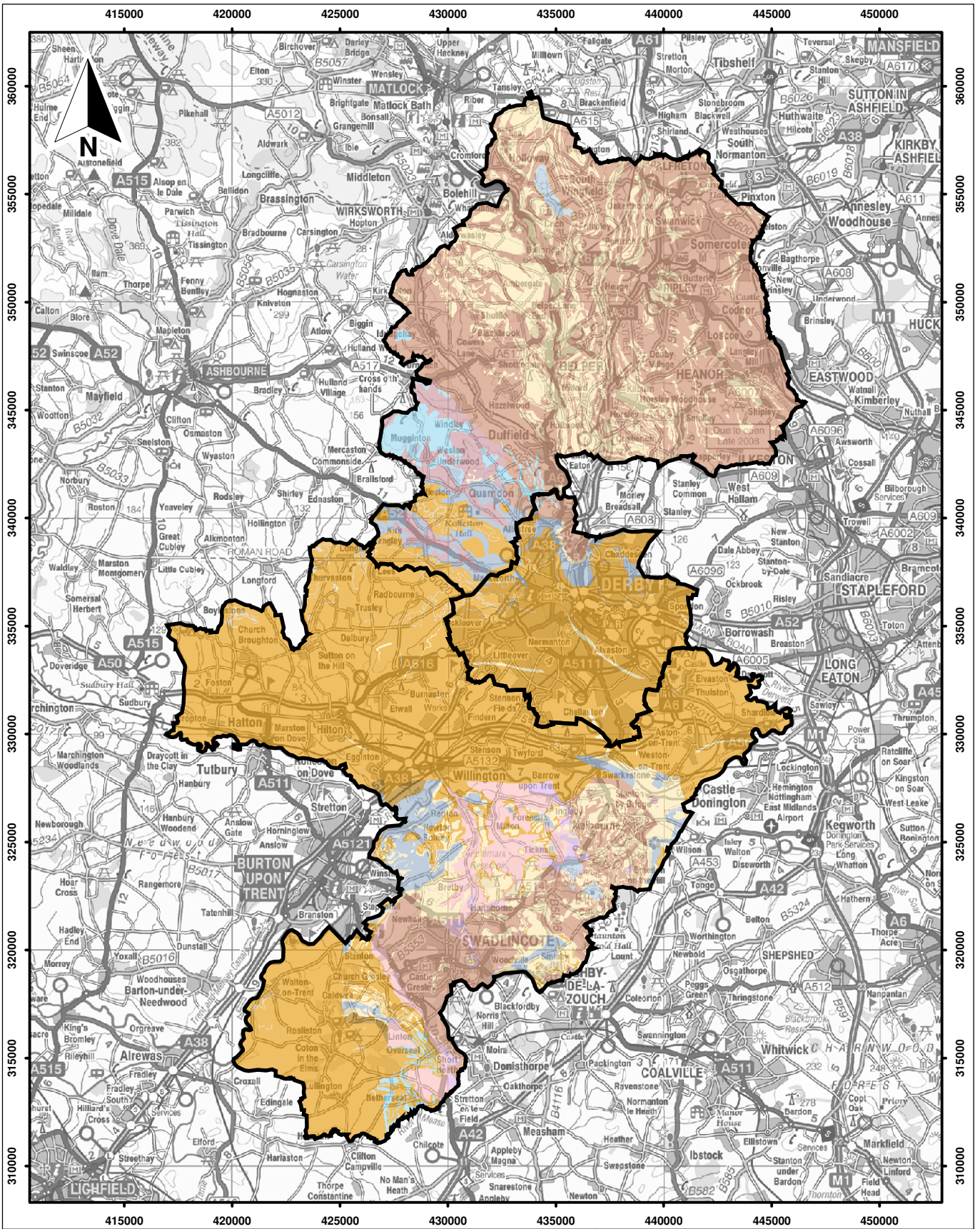
The River Dove rises to the west of Buxton and flows south and then westwards to the confluence with the River Trent, forming much of the western boundary of South Derbyshire District. Upstream from this point (upstream of Burton upon Trent) the River Trent flows northwards along part of the South Derbyshire District boundary. The main tributary in the south of the study area is the River Mease; a small lowland river designated as a Special Area of Conservation. From its confluence with the Dove, the River Trent flows in a wide floodplain with a range of habitats eastwards through South Derbyshire where it is by passed by the Trent and Mersey Canal.

The ecological status of the rivers in the study area is presented in Chapter 5.

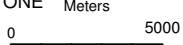
3.3.2 Geology and Hydrogeology

Most of the study area is underlain by Triassic mudstones, a low permeability formation and is classified as a Minor Aquifer. The status is a reflection of the inability of the formation to yield significant amounts of groundwater. Rain falling onto low permeability formations will tend to form run-off, rather than infiltrate into the ground, hence the dominance of surface water rivers and reservoirs in the study area. Carboniferous Limestone and the Inferior Oolite series outcrops to the centre and north-west of the Derby HMA, Millstone Grist is present in Amber Valley whilst Sherwood Sandstone (Permo-Triassic sandstone) outcrops in the south of the area. The Limestone and Sandstone support Major Aquifers, able to produce more significant volumes of groundwater of public abstraction, which in parts of the area support the water resources. Drift deposits of Alluvium and River Terrace Deposits are present along the river valleys.





Key	
	DerbyHMA
Bedrock Geology	
	BRECCIA
	DOLOMITIC SILTSTONE
	LIMESTONE
	LIMESTONE & MUDSTONE
	MUDSTONE
	MUDSTONE & SILTSTONE
	MUDSTONE, SILTSTONE & SANDSTONE
	SANDSTONE
	SANDSTONE & CONGLOMERATE
	SILTSTONE & SANDSTONE



Derby HMA Scoping and Outline Water Cycle Study

Figure 3.4
Bedrock Geology