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Appendix A
Water Resources and Supply

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Water Resources Management

In order to identify the potential constraints of water supply and the water environment it is necessary to understand how water resources are managed. Severn Trent Water and South Staffordshire Water are responsible for providing water supplies in this area. The following section introduces and summarises the planning process undertaken by water companies. It describes how water resources are managed at a strategic rather than local scale, which explains why sources and environmental pressures that may be a considerable distance from the study area are relevant.

Water Company Water Resource Management Plans

On a five yearly basis the water companies in England and Wales set out their long term requirements for maintaining and enhancing their water supply and wastewater infrastructure in their Strategic Business Plans. These plans are submitted to the financial regulator, the Water Service Regulation Authority (Ofwat). In addition to the Strategic Business Plans, the water companies must also submit a Water Resources Management Plan (WRMP) to Environmental regulator, the Environment Agency. These plans set out in detail how the water companies plan to balance supply and demand for water in their supply area over a 25 year period and take into account the economic, environmental and social implications of these plans. These plans, previously known as Water Resources Plans (WRPs) are reviewed and updated on a five yearly basis and submitted to the Environment Agency and Defra for approval. The last WRP was produced in April 2004. Since that time the plans have become a Statutory requirement under the Water Act 2003. The next WRMP is due to be completed later in 2009, although the water companies prepared and published their draft WRMPs for consultation in May 2008.

The Strategic Business Plans form part of the Periodic Review (PR) process whereby Ofwat, in consultation with other organisations including Defra, the Environment Agency, Natural England and consumer organisations, determines the expenditure that the water companies can make to maintain and enhance their infrastructure. The outcome of this determination is an Asset Management Plan (AMP) for the following five-year period.

The current (fourth) AMP period finishes in 2009 and the water companies are currently in the process of preparing their Strategic Business Plans covering the next AMP Period (AMP5), setting out their funding requirements for the period 2010 to 2015.

Levels of Service, Water Resource Zones and Water Company Planning

When planning future water resources the water companies aim to achieve ‘levels of service’ for customers, which are agreed with the water regulator, Ofwat. Each company has its own level of service, which states how frequently it expects to impose water use restrictions during periods of water shortage. For example, Anglian Water plans to impose hosepipe bans no more frequently than once in ten years (Anglian Water, 2008). Levels of service are important as they determine the investment required to maintain secure supplies of water and prevent more frequent restrictions than the companies’ stated levels of service.

In the WRMPs, the water companies set out their plans for water resource provision at the sub-company level, in areas called water resource zones (WRZs). A WRZ is defined as "the largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers experience the same risk of supply failure from a resource shortfall" (Environment Agency, 2008, section 5.5).

It is important to be aware that the water company plans are based on theoretical circumstances. For each water resource zone the water companies produce plans under a "dry year" scenario, ensuring that demand for water can be met for the agreed levels of service during a dry or drought period. All water companies produce plans to ensure that the annual average demand for water can be met during a dry year. The water companies use records of actual demand data and carry out a statistical process to 'normalise' this data and then they apply uplift factors to create a theoretical dry year annual average (in which the same demand is planned for every day of the year). Where water companies identify that the ability to meet short-term peaks in demand in a dry year is a driver for additional water supply investment, companies may also submit plans for a WRZ under peak or "critical period" conditions.

The forecast situation, constrained by existing policies and supply sources, is known as the 'baseline'. Where a shortfall in supply capability is identified in the baseline, the water company identifies schemes to resolve the situation. These schemes are generally a combination of demand management and resource development, in line with the 'twin-track' approach to water management. It should be noted that, to ensure secure water supply, the water companies take uncertainties into account in their Water Resource Management Plans. These uncertainties include, for example, how climate change may affect demand and resource availability in the future.

Low Flow Problems and Restoring Sustainable Abstraction (RSA)

Where water company abstractions are suspected to be contributing to pressure on habitats protected under the Habitats Directive, the abstractions and their impact on river flows and /or groundwater levels are investigated, and if determined necessary, a reduction in the volume that can be abstracted is sought by the Environment Agency. This type of reduction in abstraction quantities is called a Sustainability Reduction. The reduction of any Public Water Supply abstraction licences would require provision of alternative water resources.

South Staffordshire Water has included reductions in abstraction from groundwater sources in the vicinity of the River Mease (Habitats Directive designation) and Checkhill Bogs SSSI. These reductions total 3Ml/d. These figures are currently indicative and will continue to be reviewed and updated. South Staffordshire Water confirms that this is a significant area of uncertainty for the supply-demand balance.

In September 2008 the Environment Agency provided Severn Trent Water with indicative reductions to be included in the final WRMP. However, Severn Trent Water has not included any sustainability reductions in its draft WRMP as the sites are still under investigation and any reductions are still uncertain. No additional information is available from the Environment Agency to confirm the presence and volumes of any potential reductions in abstraction in order to comply with the Habitats Directive Review of Consents.

Water Resource Zone Forecast Supply-Demand Balance

The water companies' draft WRMPs set out how the companies intend to balance supply and demand over the next 25 years. The plan is based on forecasts of demand and supply. The demand forecast takes account of expected levels of per capita consumption and forecast population at a zonal level.

The baseline supply forecast takes account of the existing available sources, expected losses due to climate change and environmental pressures, and future additional sources which were approved in the previous WRP. Therefore, before exploring the potential environmental constraints within which future growth needs to be accommodated, it is necessary to identify the baseline situation (i.e. to identify any deficits in the forecast supply-demand balance) in each water resource zone.

The draft plan included a significant deficit in the East Midlands zone (up to 100Ml/d by 2030/31 in the baseline). However, in its Statement of Response Severn Trent Water says that in the Final WRMP (yet to be published) the Company has removed the headroom deficit by the end of AMP 5 (2014/15) and beyond that target headroom will be maintained until the end of the planning period (2034/35). Since publishing its draft WRMP STW has recalculated deployable output and it has reduced from 892Ml/d to 889Ml/d in the East Midlands zone. This is forecast to remain constant at 889Ml/d across the planning period. In its Business Plan the Company says there will be small changes to modelled baseline deployable output in the final plan. During the consultation on the draft WRMP, Natural England pointed out that the uncertainties in resource availability due to Restoring Sustainable Abstraction, the WFD, time limited licences, and CAMS are potentially huge. Severn Trent Water has said that it has removed the deficit in the Final Plan, and that the revised deployable output does not include yield from sites that are affected by RSA.

Severn Trent Water reports that pressure from population and demand is increasing as the population continues to grow, households become smaller (water use in smaller households is less efficient that in larger family based households), and population demographics change. The Company has experienced a significant reduction in industrial demand and has attributed this as the result of the recession. Future demand for water is affected by the depth and duration of the economic recession and long term projections forecast a greater reduction in commercial consumption than in the draft plan (which forecast approximately 20Mld reduction over the planning period). The Company reports that the recent decline has been extreme and this is projected to continue in 2009/10, and to be felt through AMP5. In its Statement of Response STW forecasts commercial consumption will be approx 25Ml/d less in 2010 than originally forecast in the draft WRMP. By 2025/26 commercial use could be up to 60Ml/d less than in the draft WRMP.

Per Capita Consumption Forecasts – Draft WRMP

Dry year per capita consumption.

*Severn Trent Water has reassessed its pcc forecast for issue in the Final WRMP.

Company	South Staffs:	*Severn Trent Water:				
pcc category	average	baseline measured	final strategy measured	baseline unmeasured	final strategy unmeasured	Final strategy average pcc
2006-07	153.15	123.15	123.15	145.43	145.43	139.36
2007-08	150.84	124.24	124.24	144.89	144.89	138.98
2008-09	150.34	125.33	125.33	144.36	144.36	138.66
2009-10	150.07	126.34	126.34	143.79	143.79	138.34
2010-11	149.75	127.24	127.81	143.23	141.69	137.14
2011-12	149.19	128.16	128.87	142.63	140.82	136.73
2012-13	148.44	128.96	129.77	142.02	139.91	136.29
2013-14	147.86	129.71	130.56	141.40	138.96	135.84
2014-15	147.28	130.40	131.30	140.74	137.99	135.41
2015-16	146.70	131.04	131.93	140.06	136.96	134.95
2016-17	146.24	131.63	132.49	139.36	135.91	134.49
2017-18	145.78	132.39	133.21	138.87	135.03	134.26
2018-19	145.36	133.12	133.87	138.36	134.13	134.02
2019-20	145.00	133.81	134.47	137.84	133.18	133.77
2020-21	144.72	134.47	135.03	137.30	132.20	133.52
2021-22	144.45	135.10	135.56	136.75	131.20	133.29
2022-23	144.21	135.70	136.02	136.17	130.13	133.03
2023-24	143.97	136.28	136.46	135.59	129.04	132.79
2024-25	143.77	136.83	136.85	134.98	127.89	132.53
2025-26	143.46	137.37	137.22	134.37	126.71	132.29
2026-27	142.92	137.91	137.59	133.76	125.51	132.07
2027-28	142.43	138.46	137.98	133.16	124.31	131.90

Company	South Staffs:	*Severn Trent Water:				
pcc category	average	baseline measured	final strategy measured	baseline unmeasured	final strategy unmeasured	Final strategy average pcc
2028-29	141.95	139.00	138.34	132.56	123.05	131.73
2029-30	141.46	139.54	138.71	131.94	121.76	131.58
2030-31	141.00	140.02	138.99	131.27	120.35	131.38
2031-32	140.54	140.47	139.24	130.56	118.86	131.16
2032-33	140.04	140.89	139.46	129.89	117.50	131.02
2033-34	139.54	141.29	139.65	129.05	115.61	130.70
2034-35	139.03	141.67	139.82	128.24	113.84	130.44

Water Demand Scenarios

Both companies state that their demand forecasts incorporate housing growth in line with the Regional Spatial Strategy. For the purpose of the outline water cycle study the potential range of demand has been calculated. The aim of this analysis is to test the sensitivity of total household demand to alternative growth projections and alternative per capita consumption forecasts.

Forecast demand is based on number of existing households and annual forecast of new households in the Study Area. Housing numbers within the study area were not available and so an estimate has been calculated based on the total number of households per water resource zone (provided by the water companies).

STW household property numbers are available in the draft WRMP table for East Midlands zone. There are approximately 872,000 unmeasured, 338,000 measured, and 38,000 void households: a total of 1,248,000.

SSW Approximately 500,000 existing households in the zone. The main report of the draft WRMP states that there are currently 100,000 measured and 400,000 unmeasured households.

Most households are concentrated in existing cities, towns and villages rather than being spread evenly across a resource zone. Analysis of property postcode data would enable an accurate calculation of households in the area.

Unfortunately, such information was not available to this study. Therefore, the number of households in the study area has been estimated based on the spatial proportion of the zone that is within the study area. The proportion of the zones in the study area are 8.9% of SSW, and 8.4% of East Midlands zone.

The demand sensitivity is calculated at the study area level using a single housing figure of 149,350.

The 3 local authorities have submitted their intended housing projections up to 2025/26 and a combined total for the study area has been calculated. An upper growth and a lower growth forecast (±20% respectively) has been used to test the potential impact on demand of variations against the Council's projection. A range of water demand scenarios have been applied to each growth projection, to further test the impact of differing levels of water efficiency on total household demand.

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Appendix B
Wastewater Treatment and Water Quality

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Wastewater Treatment

The mechanism for deriving DWFs has evolved over recent years. All WwTWs should now have certified flow monitoring equipment that enables effluent flows to be accurately monitored. The DWF is calculated based on the 20th percentile flow on the basis of 12 months daily data (i.e. the flow that is exceeded 80% of the time).

For water quality planning and design purposes, dry weather flow can also be estimated based on the following equation:

Box 3 Estimating Dry Weather Flow
DWF = PG + I + E where: P = Population served G = Water consumption per head per day I = Infiltration allowance E = Trade Effluent flow to sewer as applicable

Box 4 Formula A
Formula A = (PG+I+E) + 1360P

A summary of the constraints at the WwTWs serving the study area is presented in Table C.1

Key:

Little or no capacity issue

Issues that can be overcome but may present phasing issues

Issues that will be more difficult, but not impossible, to overcome

Table B1 Potential Constraints on WwTW within the Study Area

Wastewater Treatment Works	Consented DWF (m3/day)	NEF(80%) ALL (measured DWF)	Comments on flow capacity	Receiving Water Capacity	Planned Investment	Overall Score (draft conclusion based on information available for Draft Report)
DERBY	91500	81940	Capacity for growth	R. Derwent, failing to meet WFD targets. Source likely to be agricultural run-off in catchment as wells as effluent.	-	Works has capacity for growth, Development constrained by sewerage rather than works capacity
South Debryshire						
CLAYMILLS	47000	32022	Capacity for growth in terms of flow capacity. Predicted growth within works capacity.	R. Trent, failing to meet WFD targets. Source likely to be agricultural run-off in catchment as wells as effluent. Discharge controls likely to be closely monitored, and potentially tightened.	-	Capacity for growth based on draft report, which does not include assessment of growth in Burton upon Trent.

Table B1 (continued) **Potential Constraints on WwTW within the Study Area**

Wastewater Treatment Works	Consented DWF (m3/day)	NEF(80%) ALL (measured DWF)	Comments on flow capacity	Receiving Water Capacity	Planned Investment	Overall Score (draft conclusion based on information available for Draft Report)
MILTON	9273	7694	Measured DWF > Consented DWF, indicating works is already at capacity	R. Trent, failing to meet WFD targets. Source likely to be agricultural run-off in catchment as wells as effluent. Discharge controls likely to be closely monitored, and potentially tightened.	Quality driver to improve quality consent	Based on the measured DWF for 2008, works appears to be already at capacity. Investment may be required to accommodate growth.
STANTON	6936	6707	Forecast DWF in 2015 > Consented DWF, based on simple assessment, indicating works will be at capacity by 2015. Works serves Swadlincote, likely to be most affected by growth	R. Trent, failing to meet WFD targets. Source likely to be agricultural run-off in catchment as wells as effluent. Discharge controls likely to be closely monitored, and potentially tightened.	Quality driver to improve quality consent	Potential constraint on works capacity, required assessment by STW prior to development

Table B1 (continued) **Potential Constraints on WwTW within the Study Area**

Wastewater Treatment Works	Consented DWF (m3/day)	NEF(80%) ALL (measured DWF)	Comments on flow capacity	Receiving Water Capacity	Planned Investment	Overall Score (draft conclusion based on information available for Draft Report)
SHARDLOW	1900	1639	Some capacity for growth in terms of flow capacity. Predicted growth within works capacity.			Capacity for growth based on assumption of housing locations
COTON PARK	1054	1168	Measured DWF > Consented DWF, indicating works is already at capacity	Tributary of R. Trent, R. Trent failing to meet WFD targets. Source likely to be agricultural run-off in catchment as wells as effluent. Discharge controls likely to be closely monitored, and potentially tightened.	Quality driver to improve quality consent	Assessment indicates works already at capacity, however investment may be planned. Further confirmation needed between STW and Councils on growth locations and rates

Table B1 (continued) **Potential constraints on WwTW within the Study Area**

Wastewater Treatment Works	Consented DWF (m3/day)	NEF(80%) ALL (measured DWF)	Comments on flow capacity	Receiving Water Capacity	Planned Investment (awaiting from STW)	Overall Score (draft conclusion based on information available for Draft Report)
FINDERN	584	929.3	Measured DWF > Consented DWF, indicating works is already at capacity	Twyford Brook	Potential to increase consented DWF, according to EA national programme	Assessment indicates works already at capacity, however investment may be planned. Further confirmation needed between STW and Councils on growth locations and rates
MELBOURNE	950	876	Forecast DWF in 2015 > Consented DWF, based on simple assessment, indicating works will be at capacity by 2015	Carr Brook		Potential constraint on works capacity, required assessment by STW prior to development
ETWALL	900	413	Capacity for growth in terms of flow capacity. Predicted growth within works capacity.	Etwall Brook		Capacity for growth based on assumption of housing locations

Table B1 (continued) **Potential constraints on WwTW within the Study Area**

Wastewater Treatment Works	Consented DWF (m3/day)	NEF(80%) ALL (measured DWF)	Comments on flow capacity	Receiving Water Capacity	Planned Investment	Overall Score (draft conclusion based on information available for Draft Report)
OVERSEAL	455	415	Some capacity for growth in terms of flow capacity. Predicted growth within works capacity.	Overseal Brook, a tributary of the River Mease SAC which is at capacity for receiving effluent. Quality control on discharge will remain tight.	Quality driver to improve quality consent	Works has capacity for additional flow loads, however constraint exists from River Mease. Any additional flows would have to be pro-rate red with an improvement in treatment
NETHERSEAL	176	100	Some capacity for growth in terms of flow capacity. Predicted growth within works capacity.	River Mease, which is a SAC and is at capacity for receiving effluent flow. The EA will object to further development unless it can be proved that there will be no detrimental impact on the water quality. Quality control on discharge will remain tight.	Quality driver to improve quality consent	Works has capacity for additional flow loads, however constraint exists from River Mease. Any additional flows would have to be pro-rate red with an improvement in treatment

Table B1 (continued) **Potential constraints on WwTW within the Study Area**

Wastewater Treatment Works	Consented DWF (m3/day)	NEF(80%) ALL (measured DWF)	Comments on flow capacity	Receiving Water Capacity	Planned Investment	Overall Score (draft conclusion based on information available for Draft Report)
Amber Valley						
HEANOR-MILNE HAY	8582	7637	Some capacity for growth in terms of flow capacity. Predicted growth within works capacity.	R. Erewash, failing to meet WFD targets. Source likely to be agricultural run-off in catchment as wells as effluent. Discharge controls likely to be closely monitored, and potentially tightened.		Capacity for growth based on assumption of housing locations
ALFRETON	8283	5750	Capacity for growth in terms of flow capacity. Predicted growth within works capacity.	Alfreton Brook		Capacity for growth based on assumption of housing locations

Table B1 (continued) **Potential constraints on WwTW within the Study Area**

Wastewater Treatment Works	Consented DWF (m3/day)	NEF(80%) ALL (measured DWF)	Comments on flow capacity	Receiving Water Capacity	Planned Investment	Overall Score (draft conclusion based on information available for Draft Report)
BELPER	4453	3644	Capacity for growth in terms of flow capacity. Predicted growth within works capacity.	R. Derwent, failing to meet WFD targets. Source likely to be agricultural run-off in catchment as wells as effluent. Discharge controls likely to be closely monitored, and potentially tightened.	Quality driver to improve quality consent	Capacity for growth based on assumption of housing locations
KILBURN	3248	3161	Forecast DWF in 2015 > Consented DWF, based on simple assessment, indicating works will be at capacity by 2015	Bottle Brook. From the confluence with the River Trent, the EA perceive that unsatisfactory deterioration or significant investment is predicted for this stretch if the growth points are badly planned	Specific capital maintenance/growth investment required. Details not provided.	Potential constraint on works capacity, required assessment by STW prior to development

Table B1 (continued) **Potential constraints on WwTW within the Study Area**

Wastewater Treatment Works	Consented DWF (m3/day)	NEF(80%) ALL (measured DWF)	Comments on flow capacity	Receiving Water Capacity	Planned Investment	Overall Score (draft conclusion based on information available for Draft Report)
PINXTON	3907	2263	Some capacity for growth in terms of flow capacity. Predicted growth within works capacity.	R.Erewash, failing to meet WFD targets. Source likely to be agricultural run-off in catchment as wells as effluent. Discharge controls likely to be closely monitored, and potentially tightened.		Capacity for growth based on assumption of housing locations
FRITCHLEY	800	1668	Measured DWF > Consented DWF, indicating works is already at capacity	R. Amber, failing to meet WFD targets. Source likely to be agricultural run-off in catchment as wells as effluent. Discharge controls likely to be closely monitored, and potentially tightened.	Potential to increase consented DWF, according to EA national programme. Quality driver to improve quality consent	Assessment indicates works already at capacity, however investment may be planned. Further confirmation needed between STW and Councils on growth locations and rates

Table B1 (continued) **Potential constraints on WwTW within the Study Area**

Wastewater Treatment Works	Consented DWF (m3/day)	NEF(80%) ALL (measured DWF)	Comments on flow capacity	Receiving Water Capacity	Planned Investment	Overall Score (draft conclusion based on information available for Draft Report)
RIPLEY	1870	1438	Capacity for growth in terms of flow capacity. Predicted growth within works capacity.	-		Capacity for growth based on assumption of housing locations
DUFFIELD	726	1397	Measured DWF > Consented DWF, indicating works is already at capacity	R. Derwent, failing to meet WFD targets. Source likely to be agricultural run-off in catchment as wells as effluent. Discharge controls likely to be closely monitored, and potentially tightened.		Assessment indicates works already at capacity, however investment may be planned. Further confirmation needed between STW and Councils on growth locations and rates
HEAGE	1470	808	Ccapacity for growth in terms of flow capacity. Predicted growth within works capacity.	-		Capacity for growth based on assumption of housing locations

Water Quality

The table below presents the latest GQA data (2007) for key river reaches within the study area together with the WwTWs that discharge into these water bodies. Overall the chemical and biological water quality of rivers within the study area is fair to very good (with very few exceptions), while nutrients (phosphorus and nitrates) appear elevated ranging from moderately low to very high. Nutrients are essential for aquatic life; however elevated concentrations can have a significant impact on the aquatic ecology through stimulating the growth of benthic and microscopic plants. This is known as eutrophication and can result in oxygen depletion, a reduction in water clarity and even fish kills.

A comparison of upstream and downstream reaches reveals that in most cases there is little or no deterioration at downstream reaches in terms of chemical and biological quality; however increasing levels of nutrients (phosphorus and nitrates) are noted in the downstream river sections showing the effects of anthropogenic pollution (both in relation to agricultural diffuse and points sources).

Table B2 EA General Quality Assessment grades for receiving watercourses

STWs	Receiving Water	Upstream				Downstream			
		Chem	Biol	NO_3	P	Chem	Biol	NO_3	P
Belper, Duffield, Derby	River Derwent	A	A	3	4	B	B	3	5
South Wingfield, Ambergate, Fritchley	River Amber	B	C	5	6	B	C	5	6
Netherseal, (Measham, Overseal)	River Mease	B	B	6	6	A	B	6	5
(Kirkby, Pinxton), Pye Bridge, Heanor, (Ilkeston-Hallam Fields)	River Erewash	C	D	5	5	C	D	6	5
(Claymills), Swandlincote	River Trent	B	B	5	6	A	B	5	6
(Wirksworth), Idridgehay, Turnditch	River Ecclesborne	B	D	3	3	B	-	4	5
Alfreton	Alfreton Brook	C	-	5	6	C	D	6	6
Kilburn, Marehay, Little Eaton	Bottle Brook	C	C	2	3	B	D	6	6

The following table shows the WFD standards that have been provided by the EA for the watercourses in the study area. These have been used to compare against the existing set of quality data to assess if rivers would meet WFD targets.

Table B3 WFD Standards for Receiving Watercourses

River Name	DO (10%ile)	BOD (90%ile) mg/l	Ammonia (90%ile) mg/l	P (Mean) mg/l
Amber Valley				
River Derwent at Milford	60	5	0.6	0.12
Bottle Brook at Queens Head	75	4	0.6	0.12
River Ecclesborne at Confl. R Derwent	75	4	0.6	0.12
River Amber at Ambergate	75	4	0.6	0.12
River Derwent at Whatstandwell	75	4	0.3	0.12
Alfreton Brook at Toadhole Furnance	60	5	0.6	0.12
River Erewash	60	5	0.6	0.12
Erewash Canal at Shipley Gate	60	5	0.6	0.12
Derby City				
River Derwent at Wilne	60	5	0.6	0.12
Markeaton Brook at Station Approach	60	5	0.6	0.12
Cuttle Brook at Moor Lane Bridge	60	5	0.6	0.12
South Derbyshire				
River Trent - R Dove to R Derwent	60	5	0.6	0.12
River Dove - Doveridge	75	4	0.6	0.12
River Dove - Monk's Bridge	60	5	0.6	0.12
Ramsley Brook at Kings Newton	60	5	0.6	0.12
Eggington Brook original Conf. R Trent	75	4	0.6	0.12
Trent & Mersey canal Stretton	60	5	0.6	0.12
River Mease	60	5	0.6	0.06

Designations

The table below presents a list of the designated sites in the study area together with the reason for their designation.

Table B4 Designated Sites within the Study Area

Type of designation	Name	Reason for designation
Special Area of Conservation (SAC)	River Mease	The Mease is an example of bullhead Cottus gobio populations in the rivers of central England. Bed sediments are generally not as coarse as other sites selected for the species, reflecting the nature of many rivers in this geographical area, but are suitable in patches due to the river's retained sinuosity. The patchy cover from submerged macrophytes is also important for the species. The River Mease is a good example of a riverine population of spined loach Cobitis taenia. It is a small tributary of the River Trent and has retained a reasonable degree of channel diversity compared to other similar rivers containing spined loach populations. It has extensive beds of submerged plants along much of its length which, together with its relatively sandy sediments (as opposed to cohesive mud) provides good habitat opportunities for the species.
Site of Special Scientific Interest (SSSI)	Ticknall Quarries	This site has been selected for the variety of habitats which include semi-natural woodland, limestone grassland, open water and small flushes. The open water has a rich fauna and flora and differs from the other open waters in the Trent Valley as it is strongly calcareous. Some of the pools are fed by surface springs and there is one notable flush with vegetation of interest/importance.

Table B4 (continued) **Designated Sites within the Study Area**

Type of designation	Name	Reason for designation
	Hilton Gravel Pits	A range of breeding birds are located here, that are supported by a complex of open water, carr, scrub, woodland, marsh and grassland habitats, and is one of the most important sites in the middle region of the Trent valley for overwintering waterfowl.
	Cromford Canal	Part of the site is a Local Nature Reserve owned by Derbyshire County Council, and some areas managed by the Derbyshire Naturalists Trust. The site consists of approximately six miles of disused canal running from Cromford to Ambergate. It has been selected as an example of a eutrophic freshwater habitat with a rich submerged and emergent aquatic flora and a diverse marsh-wet grassland margin which supports a very rich insect fauna. The canal is fed at Cromford by water from the Carboniferous Limestone but for the most of its length there are small feeders of more acidic water from the shales and gritstone.
	Carver's Rocks	The site lies at the southern end of Foremark Reservoir. It consists of a number of habitats developed on an acid soil over sandstones. These include open water, eutrophic marsh, carr, oak and birch woodland and heath which support any plant and animal species of restricted distribution. A small part of the central area of the site is an old marsh which now surrounds the southern tip of Foremark Reservoir.

Table B4 (continued) **Designated Sites within the Study Area**

Type of designation	Name	Reason for designation
	Kedleston Park	The main interest of Kedleston Park is the rich and diverse deadwood invertebrate fauna which is primarily dependent upon the large number of mature and overmature beech. The lower lake (which shares a boundary with the wet woodland of Bottom Covert) is an important additional feature at Kedleston. It has a particularly rich dragonfly and damselfly fauna some of which are rare in Derbyshire.
	Mercaston Marsh and Muggington Bottoms	The variable conditions and soils, ranging from nutrient-rich to nutrient-poor, have resulted in an outstanding mosaic of lowland wetland habitats, comprising tall fen and swamp, marshy grassland and valley mire. Together they form the largest and most species-rich marsh in Derbyshire.
	Boulton Moor	This area is underlain by an important glacial and fluvial sequence, and can provide a crucial link between the glacial and fluvial sequence in this valley and is one of very few sites in the East Midlands which have evidence from temperate periods.
	Calke Park	Diverse habitats including aquatic, grassland and woodland habitats. The exceptional deadwood invertebrate fauna of this site is dependent upon the conservation of these veteran trees and the future continuation of the wood pasture habitat. Wood pasture habitat is now rare and very scattered, being restricted to ancient parkland and former hunting forest. This habitat provides a link through time with the ancient forests of Britain and Europe and it is only these sites which now sustain the assemblages of invertebrates associated with the ancient forests.

Table B4 (continued) **Designated Sites within the Study Area**

Type of designation	Name	Reason for designation
	Ambergate and Ridgeway Quarries	These two quarries provide very important exposures in rock of Westphalian age.
	Shining Cliff Woods	This ancient semi-natural oak woodland is one of the few remnants of the mediaeval hunting forest of Duffield Frith. Within the woodland are areas of wetter ground where springs or streams occur. In moist areas close to the stream a number of molluscs of local distribution which are associated with ancient woodland occur.
	River Mease	The River Mease represents a lowland clay river supporting nationally significant populations of two internationally notable species of native freshwater fish with a restricted distribution in England.

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Appendix C
Environment Agency's Current Position Statement on the River Mease (August 2009)

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Position Statement (2009)

Development in the River Mease Catchment

Our Role

The Environment Agency is a consultee to the planning process and makes comment on a wide range of planning applications including residential developments. Our role here is simply to protect and improve the environment. We will carry out this role by ensuring that the potential for a development to cause environmental deterioration is assessed and mitigated.

It is a requirement of the Water Framework Directive that waste water and sewage effluent produced by new developments is dealt with to ensure that there is no deterioration in the quality of the water courses receiving this extra volume of treated effluent. Furthermore part of the Environment Agency's remit here is to seek long term improvements in water quality both in terms of its chemical and biological quality.

The River Mease Catchment

Ashby de la Zouch is situated in the River Mease catchment and this is one of the most sensitive river catchments in terms of water quality within the midlands region.

Part of the River Mease and the Gilwiskaw Brook is designated a Special Area of Conservation under the EU Habitats Directive, this highlights the sensitivity of the river to pollution and the need to prevent any future deterioration of the quality of the river water in this area.

The river is at saturation point in terms of the amount of treated effluent it already receives and the River is currently failing its water quality targets for phosphate. As such the Environment Agency is seeking ways to improve the water quality in this river to ensure that it is compliant with the Water Framework Directive and Habitats Directive.

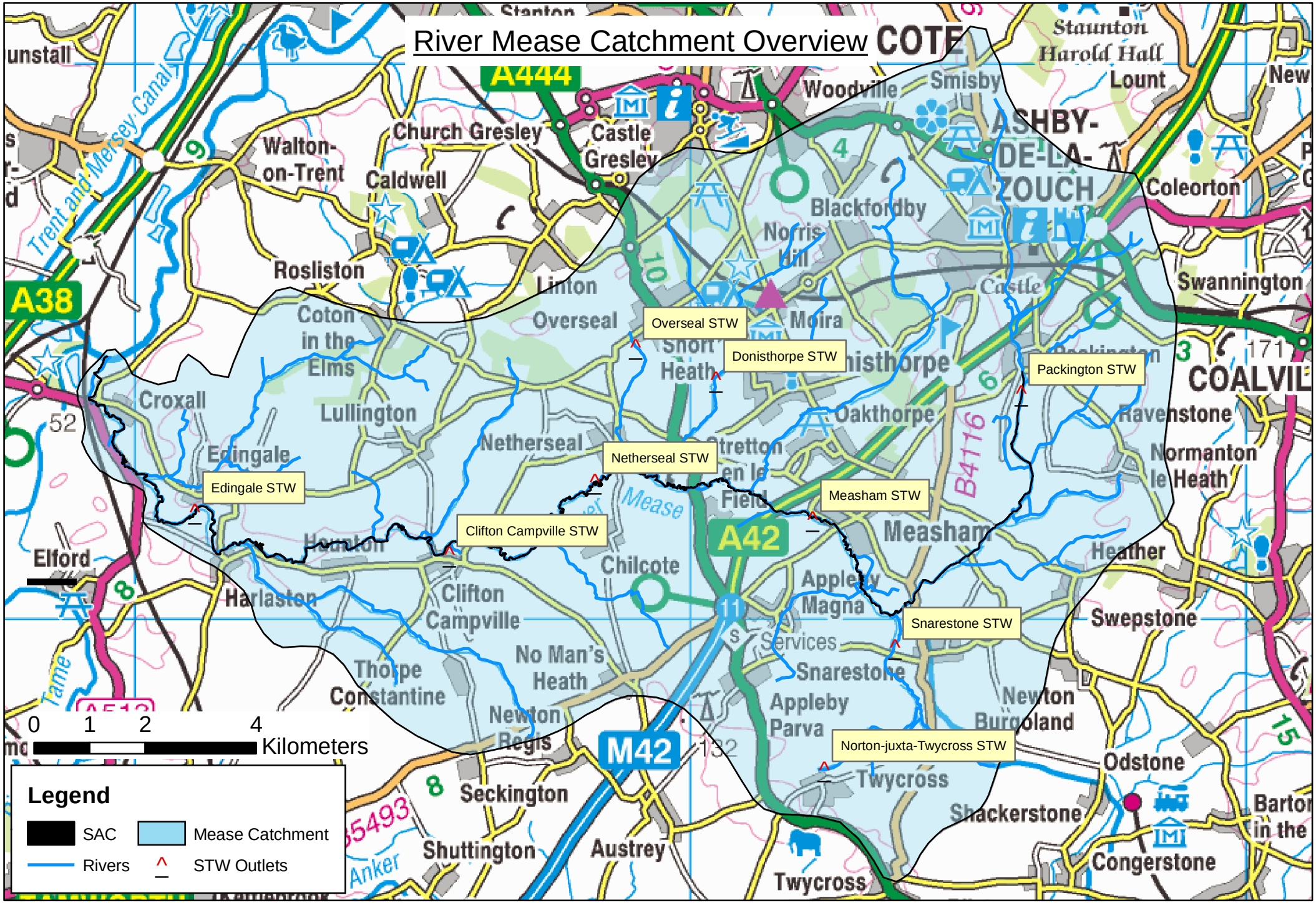
It is therefore unlikely that the River Mease would be able to deal with any increase in the amount of effluent it receives without a serious drop in the quality of its water, which would in turn threaten the wildlife that is dependant on the river for its habitat.

Applications for Planning Permission

We are advising the Planning Authority that any applicant must ensure that the sewerage treatment facility and sewage disposal systems have sufficient capacity to accommodate and adequately treat the additional sewage generated by any new development.

We will object to all discharges to the River Mease catchment unless it can be demonstrated by the applicant when submitting a planning application that the additional effluent from the proposed development will not cause deterioration of the quality of the receiving water course and/or a breach of the sewage works discharge consent.

It may be an option to expand or upgrade sewage treatment in the area, however if this is not possible we would advise that alternative arrangements are examined for the disposal of sewage in the River Mease Catchment to ensure the sustainable improvement in the quality of the water courses in this area.


River Mease Catchment Overview
Overseal STW
Donisthorpe STW
Packington STW
Netherseal STW
Edingale STW
Measham STW
Clifton Campville STW
Snarestone STW
Norton-juxta-Twycross STW
A444
A38
A42
M42
A511
Castle Gresley
Church Gresley
Walton-on-Trent
Caldwell
Rosliston
Linton
Overseal
Moira
Blackfordby
Ashby-de-la-Zouch
Coleorton
Swannington
Coalville
Coton in the Elms
Croxall
Lullington
Edingale
Netherseal
Oakthorpe
Ravenstone
Normanton le Heath
Measham
Heather
Swepstone
Elford
Harlaston
Clifton Campville
Chilcote
Appleby Magna
Snarestone
Appleby Parva
Newton Burgoland
Thorpe Constantine
No Man's Heath
Newton Regis
Seckington
Shuttington
Austrey
Twycross
Shackerstone
Odstone
Congerstone
Trent and Mersey Canal
Mease
Tame
Anker
0 1 2 4 Kilometers
Legend
SAC
Mease Catchment
Rivers
STW Outlets

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Appendix D
Draft Humber River Basin Management Plan Actions

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The Humber River Basin District is one of the most diverse regions in England ranging from the upland areas of the White and Dark Peak in Derbyshire, the Southern Pennines, Yorkshire and North York Moors to the Yorkshire Wolds and the lowlands to the east.

Agriculture dominates the landscape of the Humber River Basin District, accounting for over 70% of land use. The rural areas range from small, settlements with a continuing reliance on hill farming, forestry and quarrying, through small settlements which are also important as service and employment centres, to the urban fringe areas and communities which mining, extraction and heavy industries once supported. The lowlands in the east and river valleys such as the Trent, Ouse and Humberhead Levels support a wide range of productive arable and livestock farming.

Agriculture, forestry and moorland management all have the potential to impact on the water environment. Although overall the number of direct pollution incidents from agriculture and forestry has decreased in recent years, in some areas there is the need to reduce the impact of diffuse pollution on rivers and ground waters from manures, sediment, fertilisers and pesticides. Much can be achieved by improved soil management and adoption of best practice. Good land management not only cares for the places we value, but it can also reduce the impact on the water environment and provide cost savings for farmers as well as benefits for the wider rural economy.

The actions from the draft RBMP relevant to the study area are presented below.

Pressure	Description of the Action				Means of Delivery	Lead Organisation/ Partners	Driver for Action
	What will happen	Where it will happen	Catchment	When it will happen			
Scenario A - What is already happening and what will happen (M1, M2 and M3a measures and No deterioration actions)							
Abstraction	Availability of grants for construction of irrigation and industrial supply reservoirs	East Midlands Development Agency are offering RDPE funding for Water Resource Management projects such as irrigation reservoirs during the period 2007-	Targeted Catchments across the RBD	2008	Cooperative agreements or financial incentives	Regional Development Agencies	WFD - basic measure (Art 11.3 c)

		2013.					
Abstraction	Encourage farmers and Industry to build storage to support summer irrigation	The Midlands region in partnership with Anglian region and other external organisations has produced a booklet on irrigation reservoirs. This will be promoted at farm events and to relevant organisations eg planners, bankers etc in conjuntion with water efficiency messages.	Targeted Catchments across the RBD	2008	Cooperative agreements or financial incentives	Environment Agency, Industry	WFD - basic measure (Art 11.3 c)

Chemicals	Suspension (temporary) on use as sheep-dip	National	Targeted Catchments across the RBD	Dependent on decision on future of cypermethrin sheep dip	UK Marketing and Use Legislation	VMD	
Hazardous substances and other pollutants (GW prevent and limit)	Agri-environment schemes/ Environmental Stewardship payments for best practice to control agri-chemicals (England only)	National	Targeted Catchments across the RBD	Ongoing	Environmental Stewardship Scheme	All land managers	Groundwater Directive
Hazardous substances and other pollutants (GW prevent and limit)	Apply for permits for disposal of sheep dip and pesticides	National	Targeted Catchments across the RBD	Ongoing	Groundwater Regulations Reg 18	All land managers making relevant disposals	Groundwater Directive
Hazardous substances and other pollutants (GW prevent	Proactive targeted farmer education on control of agri-chemicals	England Catchment Sensitive Farming Delivery Initiative – current	Yorkshire Derwent, Hull and East Riding, Louth Grimsby and Ancholme,	Ongoing	Voluntary action and education	All land managers in designated catchments	Government Policy

and limit)		catchments	Swale Ure Nidd and Ouse, Derbyshire Derwent, Esk and Coast				
Hazardous substances and other pollutants (GW prevent and limit)	Enforcement of Groundwater Regs to control agri-chemicals through cross compliance	National	Targeted Catchments across the RBD	Ongoing	Rural Payments Agency Single Payment Scheme	Rural Payments Agency	Nitrates Directive, CAP Cross-Compliance and Single Farm payment
Hazardous substances and other pollutants (GW prevent and limit)	Comply with General Binding Rules, new regulatory approach from implementation of GWDD	National	GW Targeted Cathcments across RBD	2012	New Groundwater Regulations 2008	All land managers making relevant disposals	Groundwater Directive
Hazardous substances and other pollutants (GW prevent and limit)	Comply with new EC Sustainable Use of Pesticides Directive to control use of Plant Protection Products	Applies across the whole of the EU	GW Targeted Cathcments across RBD	EU timetable	EC	All land managers	Groundwater Directive

Hazardous substances and other pollutants (GW prevent and limit)	Follow Pesticides Statutory Code of Practice Published advice for operators	National	GW Targeted Catchments across the RBD	Ongoing	Voluntary action and education	All land managers	Groundwater Directive
Hazardous substances and other pollutants (GW prevent and limit)	Follow Sheep Dip Statutory Code of Practice Published advice for operators	National	GW Targeted Catchments across the RBD	Ongoing	Voluntary action and education	All land managers	Groundwater Directive
Hazardous substances and other pollutants (GW prevent and limit)	Follow Statutory Code of Good Agricultural Practice. Published advice for operators on control of agri-chemicals	National	GW Targeted Catchments across the RBD	Ongoing	Voluntary action and education	All land managers	Groundwater Directive
Hazardous substances and other pollutants (GW prevent and limit)	Groundwater Protection: Policy & Practice - external education on GW pollution prevention	National	GW Targeted Catchments across the RBD	Ongoing	Voluntary action and education	All land managers	Groundwater Directive
Hazardous substances and other pollutants (GW prevent and limit)	Local agricultural partnerships e.g. LEAF, NGOs such as Rivers Trusts, Landcare, Farming & Wildlife Advisory Group – advice on use of agri-chemicals	National	GW Targeted Catchments across the RBD	Ongoing	Voluntary action and education	All land managers	Groundwater Directive
Hazardous substances and other pollutants (GW prevent and limit)	Registrations New regulatory approach from implementation of GWDD	National	GW Targeted Catchments across the RBD	2012	New Groundwater Regulations 2008	All land managers making relevant disposals	Groundwater Directive

Hazardous substances and other pollutants (GW prevent and limit)	Voluntary Initiative Educational and advice programme to minimise the environmental impact of pesticides	National	GW Targeted Catchments across the RBD	Ongoing	Voluntary action and education	All land managers	0
Nutrients	Enforcement of 2008 NVZ Action Plan	GWB	NVZ areas - Targeted Cathcments across RBD	Ongoing	Inspection programme	Environment Agency	Nitrates Directive
Nutrients - Nitrate	Agri-environment Schemes/ Environmental Stewardship - payments for best practice to limit nitrate input (England only)	National	Targeted Catchments across the RBD	Ongoing	Environmental Stewardship Scheme	Natural England	0
Nutrients - Nitrate	Proactive targeted farmer education on nitrate control	England Catchment Sensitive Farming Delivery Initiative – current catchments	Yorkshire Derwent, Hull and East Riding, Louth Grimsby and Ancholme, Swale Ure Nidd and Ouse, Derbyshire Derwent, Esk and Coast	Ongoing	Voluntary action and education	All land managers in designated catchments	Government Policy
Nutrients - Nitrate	Enforcement of nitrate input restrictions in NVZ action plan through cross compliance	2008 Nitrate Vulnerable Zones	NVZ areas - Targeted Cathcments across RBD	Ongoing	Rural Payments Agency Single Payment Scheme	Rural Payments Agency	Nitrates Directive, CAP Cross-Compliance and Single Farm payment
Nutrients - Nitrate	Enforcement of Sludge Regs through cross compliance	National	Targeted Catchments across the RBD	Ongoing	Rural Payments Agency Single Payment Scheme	Rural Payments Agency	CAP Cross-Compliance and Single Farm payment

Nutrients - Nitrate	Enforcement of nitrate input restrictions in NVZ action plan through cross compliance	2008 Nitrate Vulnerable Zones	NVZ areas - Targeted Cathcments across RBD	Ongoing	Rural Payments Agency Single Payment Scheme	Rural Payments Agency	Nitrates Directive, CAP Cross-Compliance and Single Farm payment
Nutrients - Nitrate	Enforcement of Sludge Regs through cross compliance	National	Targeted Catchments across the RBD	Ongoing	Rural Payments Agency Single Payment Scheme	Rural Payments Agency	CAP Cross-Compliance and Single Farm payment

Nutrients - Nitrate	Comply with enhanced restriction on nitrogen loading to land	2008 Nitrate Vulnerable Zones	NVZ areas - Targeted Cathcments across RBD	2010	Action Programme for Nitrate Vulnerable Zone (England & Wales) Regulations 2008	All land managers in NVZ	Nitrates Directive, CAP Cross-Compliance and Single Farm payment
Nutrients - Nitrate	Comply with General Binding Rules - new regulatory approach from implementation of GWDD	National	GW Targeted Cathcments across RBD	2012	New Groundwater Regulations 2008	All land managers making relevant disposals	Groundwater Directive
Nutrients - nitrate	Establish and enforce Nitrate Vulnerable Zones in river catchments at a high risk from nitrate pollution, requiring farmers to follow a programme of measures to reduce nitrate entering the water from farmland.	Established by 2008 regs. Inspections will be targeted based on risk and evidence base.	Targeted Catchments across the RBD	2011	Nitrate Vulnerable Zone Regulations 1988	Environment Agency	Bathing Waters Directive, Shellfish Waters Directive
Nutrients - Nitrate	Comply with restriction on nitrogen loading to land	2002 Nitrate Vulnerable Zones	New 2008 designated zones	2005	Action Programme for Nitrate Vulnerable Zone (England & Wales) Regulations 1998	All land managers in NVZ	Nitrates Directive, CAP Cross-Compliance and Single Farm payment
Nutrients - Nitrate	Follow advice on nitrate control	2002 Nitrate Vulnerable Zones	New 2008 designated zones	Ongoing	Action Programme for Nitrate Vulnerable Zone (England & Wales) Regulations 1998	All land managers in NVZ	Nitrates Directive, CAP Cross-Compliance and Single Farm payment
Nutrients - Nitrate	Follow advice to farmers on nitrate control	2008 Nitrate Vulnerable Zones	Targeted Catchments across the RBD	Ongoing	Action Programme for Nitrate Vulnerable Zone (England & Wales) Regulations 2008	All land managers in NVZ	Nitrates Directive, CAP Cross-Compliance and Single Farm payment
Nutrients - Nitrate	Follow Statutory Code of Good Agricultural Practice. Published advice for operators on nitrate	National	GW Targeted Catchments	Ongoing	Voluntary action and education	All land managers	Water Resources Act

	control		across the RBD				
Nutrients - Nitrate	Groundwater Protection: Policy & Practice - external education on GW pollution prevention	National	GW Targeted Catchments across the RBD	Ongoing	Voluntary action and education	All land managers	Groundwater Directive
Nutrients - Nitrate	Local agricultural partnerships e.g. LEAF, NGOs such as Rivers Trusts, Landcare, Farming & Wildlife Advisory Group - Advice to farmers on nitrate control	National	Targeted Catchments across the RBD	Ongoing	Voluntary action and education	All land managers	Groundwater Directive
Nutrients - Nitrate	Registrations - New regulatory approach from implementation of GWDD	National	GW Targeted Catchments across the RBD	2012	New Groundwater Regulations 2008	All land managers making relevant disposals	Groundwater Directive
Organic pollutants, Nutrients, pesticides, sediment, faecal indicator organisms	Establish and maintain a nationally funded advice-led partnership under the Catchment Sensitive Farming Programme to reduce diffuse water pollution from agriculture in at risk catchments.		Yorkshire Derwent, Hull and East Riding, Louth Grimsby and Ancholme, Swale Ure Nidd and Ouse, Derbyshire Derwent, Esk & Coast	2009	Education and Advisory Programme through CSF	Environment Agency and Natural England	Bathing Waters Directive, Shellfish Waters Directive
Organic pollutants, Nutrients, Sediments, Habitat manipulation	Maintain the Entry Level Stewardship (ELS) Scheme offering farmers an incentive to achieve environmental benefits on agricultural land.	National	Targeted Catchments across the RBD	2009		Defra	Habitats Directive
Organic pollutants, Nutrients, Sediments, Habitat manipulation	Maintain the Higher Level Stewardship Scheme offering farmers an incentive to achieve environmental benefits over and above those required under the Entry Level Stewardship Scheme.	National	Targeted Catchments across the RBD	2009		Defra	Habitats Directive

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Appendix E
Tables D.2 and D.3 from PPS25 Annex D

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Table D.2: Flood Risk Vulnerability 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).

[19] DETR Circular 04/00 – para. 18: *Planning controls for hazardous substances*. www.communities.gov.uk/index.asp?id=1144377

[20] See *Planning for Sustainable Waste Management*: *Companion Guide to Planning Policy Statement 10* for definition. www.communities.gov.uk/index.asp?id=1500757

Table D.2: contd.

Water-compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, **subject to a specific warning and evacuation plan**.

Notes:

1) This classification is based partly on Defra/Environment Agency research on Flood Risks to People (FD2321/TR2)[21] and also on the need of some uses to keep functioning during flooding.

2) Buildings that combine a mixture of uses should be placed into the higher of the relevant classes of flood risk sensitivity. Developments that allow uses to be distributed over the site may fall within several classes of flood risk sensitivity.

3) The impact of a flood on the particular uses identified within this flood risk vulnerability classification will vary within each vulnerability class. Therefore, the flood risk management infrastructure and other risk mitigation measures needed to ensure the development is safe may differ between uses within a particular vulnerability classification.

Table D.3[22]: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability classification (see Table D2)		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (see Table D.1)	Zone 1	✔	✔	✔	✔	✔
	Zone 2	✔	✔	Exception Test required	✔	✔
	Zone 3a	Exception Test required	✔	✗	Exception Test required	✔
	Zone 3b 'Functional Floodplain'	Exception Test required	✔	✗	✗	✗

Key:

✔ Development is appropriate

✗ Development should not be permitted

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Appendix F
CFMP Actions

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Policy Unit 2 Sherwood

Policy Unit 2: Sherwood							
Policy unit	**Policy**	**Action**	**Principal Organisations**	**Priority and timescale**	**Consequence**	**Objectives**	**Indicators**
Policy unit 2	**Policy option 3** - Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline).	Investigate locations, ways and funding sources to return the river channel to a more natural state – particularly through Retford, Mansfield, Worksop, and the middle Idle, allowing a localised reduction in FRM effort to focus the finite resources where it can be more effectively deployed.	Environment Agency, Natural England, land owners, local authorities.	M4 2011 - 2015	Development of a strategy for river restoration aimed at returning the rivers to a natural state and reducing the future requirement for increasingly time consuming and costly channel maintenance or management.	Prevent a increase in the cost of flood risk management, implementing more sustainable methods, such as reduced run-off through land use change (planting more woodland in the upper areas of the catchment).	Cost of Flood Risk Management Activities(£m)

Policy Unit 2: Sherwood							
		Identify opportunities to maximise the use and benefits of SuDS, particularly in areas where the sandstone geology will support extensive use, and where a strategy for SuDS retro-fitting SuDS may be developed, allowing a localised reduction in FRM effort to focus the finite resources where it can be more effectively deployed	Environment Agency, Local Authorities	M5 2009 – 2015	Clear guidance for planners, developers and home owners regarding best practice for drainage, with a practical guide for implementation widely available. This will ensure that local drainage systems are more likely to be effective, thus reducing the burden of drainage management or need for costly catchment scale improvements.		
		Investigate the effectiveness of current flood risk management and develop a prioritised maintenance plan for the existing flood protection infrastructure, and the viability of future levels of protection. Achieve with the development of Strategic Asset Management Plans	Environment Agency	M5 2009 – 2015	Direction for works programmes and the asset review to ensure existing and future expenditure is optimised to provide value for money, i.e. continue to provide an appropriate level of flood risk management without increasing costs.		
		Review and agree the role of the IDBs within the area.	Environment Agency, IDB	M5 2009 – 2015	Clarity in roles and responsibilities for the future to help ensure existing and future expenditure is optimised to provide value for money, i.e. continue to provide an appropriate level of flood risk management without increasing costs..		

Policy Unit 2: Sherwood							
		Develop a strategy for implementing measures and schemes that will encourage land management practices and land drainage that will reduce run-off.	Environment Agency, Natural England, land owners, CLA, IDBs, local authorities	L2 2010 – 2015	Clear guidance to drive appropriate land management, and encourage collaborative schemes which will not only ensure value for money under existing flood risk management expenditure, but will also help achieve water quality objectives within the catchment by reducing the likelihood of damaging pollution incidents.	Support and encourage land management that will protect and improve water quality by reducing diffuse pollution from agricultural run-off.	
		Identify areas where efficiencies can be achieved, such as reduced channel maintenance and removal of structures to ensure the most effective use is made of the existing level of flood risk management effort.	Environment Agency	M5 2014 – 2019	Cost savings and improvements to river channels by removing structures which require costly management, whilst maintaining appropriate levels of flood risk management.	Sustain and improve the status of environmentally designated areas such as the River Idle Washlands, Sutton and Lound Gravel Pits SSSI through appropriate frequency, extent and duration of flooding.	Length of watercourse heavily managed or heavily urbanised.
		Identify potential sites for BAP habitat creation.	Environment Agency, Natural England	M4 2010 - 2015	In line with a policy 3, contribution to National targets where opportunities have been identified.	Sustain and increase the amount of BAP habitat in the catchment	BAP habitat created.

Policy Unit 5 Burton, Derby and Nottingham

Policy Unit 5: Burton, Derby and Nottingham							
Policy unit	**Policy**	**Action**	**Principal Organisations**	**Priority and timescale**	**Consequence**	**Objectives**	**Indicators**
Policy unit 5	Policy option 5 - Take further action to reduce flood risk (now and, or in the future).	Identify locations and opportunities where we can work with the aggregate extraction companies to improve planning for and restoration of gravel workings, - particularly in relation to providing additional flood storage.	Environment Agency, aggregates companies, Natural England	M4 2011 – 2015	Develop relationships with quarry operators and aggregate extraction companies that will help achieve a beneficial approach to quarry restoration. This will help return local heavily modified watercourses to a more natural state and increase biodiversity.	Return watercourses to a more natural state, increasing biodiversity and opening up green river corridors through Derby and the towns of Langley Mill, Ilkeston, Sandiacre and Long Eaton.	Additional length of improved river
		Increase green corridors through urban areas, particularly on the River Erewash through strategic planning and building partnerships with local authorities, to help ensure appropriate development controls are applied.	Environment Agency, local authorities, Natural England	M4 2014 – 2029 years	Increased flooding within green areas next to rivers through urban areas, helping to return heavily modified watercourses to a more natural state.		
		Complete Derby strategy and implement findings.	Environment Agency	M6 2008 – 2009	Reduced flood risk in Derby – achieve primary policy unit objective.	Reduce the number of people at risk from deep and fast flowing waters or fast onset of flooding due to breach of defences within towns of Nottingham, Derby or Burton.	Number of people within the 1% probability flood outline
		Implement the findings of the Nottingham strategy.	Environment Agency	M6 2008 – 2012	Reduced flood risk in Nottingham – achieve primary policy unit objective.		
		Complete the Burton-upon-Trent flood defence scheme.	Environment Agency	M6 2008 – 2009	Reduced flood risk in Burton-upon-Trent – achieve primary policy unit objective.	Reduce the cost of flood damage within the policy unit, particularly where it is high and may be economically viable, within Nottingham, Derby, Burton and other smaller towns.	Cost of flood damages measured as annual average damages (AAD)

		Review hydrometric monitoring networks in relation to flood warning, and revise flood warning areas and trigger levels to improve accuracy and resolution of flood warning, and improve the emergency response when flooding does occur.	Environment Agency	H8 2009 – 2015	With a better understanding of flood mechanisms and trigger levels, it will be possible to improve our ability to provide accurate and timely flood warnings. Refine flood warning areas will allow more targeted warnings. These developments combined with an improved emergency response will reduce the impact flooding through avoidance rather than protection, and will both reduce the likelihood of people being caught out by the rapid onset of deep and fast flowing floodwater, and if appropriate action is carried out when flood warnings are issued, will also reduce the damage resulting from flooding.	Reduce the cost of flood damage within the policy unit, particularly where it is high and may be economically viable, within Nottingham, Derby, Burton and other smaller towns.	
		The CFMP has identified a large number of gas and electricity sub stations at risk from even the more frequent 10% flood event. An investigate is needed to determine the scale of the problem and identify resilience or alternative options for maintaining critical power supplies during flood events.	Environment Agency, utility companies, including water, power, oil, gas, and telecommunication	H9 2009 – 2015	Improved resilience (include,,ing alternative routes or sources) and an understanding of how future increases in flooding in some areas might impact on key infrastructure. Level of disruption and economic loss due to flooding of infrastructure will be prevented from increasing	Reduce the disruption caused by flooding to critical energy supply infrastructure.	
		Identify locations within the urban areas where BAP habitats may be created, expanded or improved through links with other flood risk management schemes or initiatives.	Environment Agency, Local Authorities, Natural England	M4 2010 – 2015	Increased BAP habitats in line with local and regional targets.	Sustain and increase the amount of BAP habitat in the catchment by opening up green spaces within the built environment.	

		Identify problem sites and carry out a detailed assessment of polluted discharges of water during flood events.	Environment Agency, relevant mining company or authority	M4 2010 – 2015	Improved understanding of the issue, and a cooperative approach to resolving or mitigating the problems.	Support and encourage land and drainage management that will protect and improve water quality, particularly from disused mines and derelict areas as well as heavily urbanised areas.	
		Produce an integrated urban drainage strategy, for principal urban areas within the policy unit.	Local Authorities, Environment Agency, Severn Trent Water Ltd, IDBs	H7 2009 – 2012	Reduction in urban drainage problems, with clear lines of responsibility for all those involved in planning, regulation and development.		
		Implement Integrated Urban Drainage strategies – priority for principal urban areas, to reduce the incidence of surface water and foul water flooding through greater involvement of Severn Trent Water Ltd in flood risk management.	Environment Agency, local authorities, Severn Trent Water Ltd, IDBs	H7 2012 -2020	Reduction in urban drainage problems, with clear lines of responsibility for all those involved both in planning, regulation and development.		
		Develop a surface water management plan that will ensure an appropriate approach is adopted to surface water drainage.	Local Authorities, Environment Agency, Land owners, IDBs.	H7 2009 - 2012.	This will provide an improved understanding of options available to deliver cost savings and efficiencies in dealing with surface water, and the implications of their adoption.	Reduce the cost of flood damage where it is high and economically viable to do so. And Reduce the cost of flood risk management and implement more sustainable methods of flood risk management by reducing reliance on pumped discharge and hard defences.	Cost of flood damage. And Cost of flood risk management

Policy Unit 6 Mid Staffs and Lower Tame

Policy Unit 6: Mid Staffs and Lower Tame							
Policy unit	**Policy**	**Action**	**Principal Organisations**	**Priority and timescale**	**Consequence**	**Objectives**	**Indicators**
Policy unit 6	**Policy option 6** - Take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.	Complete strategy for the River Tame, focusing on opportunities to naturalise the river Tame in rural areas and to reduce flood risk in Tamworth (accepting that this may require some local increase in flood risk management). This strategy must include a wide ranging technical assessment of flood attenuation options.	Environment Agency	M6 2008-2009	Production of strategy and demonstration of feasibility and funding to help ensure appropriate levels of flood risk across the whole CFMP area.	Minimise disruption to people and communities caused by flooding in Tamworth and other smaller settlements along the Trent corridor, taking into account future climate change and development pressure.	Number of people living within the 1% AEP flood extent.
		Review hydrometric monitoring networks in relation to flood warning, and revise flood warning areas and trigger levels to improve accuracy and resolution of flood warning as a strategic option to reduce the impact of flooding. This needs to be focussed primarily on urban areas of Tamworth, but also for areas where the future implementation of Policy 6 may result in more frequent flooding – e.g. farmland with grazing animals.	Environment Agency	H8 2009 – 2015	With a better understanding of flood mechanisms and trigger levels, it will be possible to improve our ability to provide accurate and timely flood warnings. Refine flood warning areas and allow more targeted warnings. This will allow people to respond more effectively and by reducing disruption to individuals and communities, the economic cost of flooding will be reduced.		Cost of flood damages measured as annual average damages (AAD)

		Carry out a feasibility study to identify and assess locations for river restoration or improvements.	Environment Agency, Natural England	M4 2009 – 2014	Locations of future restoration project identified, with feasibility assessed and priority allocated.	Return watercourses to a more natural state, increasing biodiversity and opening up green river corridors through urban areas.	Length of river currently heavily modified and/or disconnected from the floodplain.
		Develop land use management plans which identify areas and methods where run-off can be reduced through flood attenuation ponds or wetland areas with an associated habitat improvement or creation.	Environment Agency, NFU, National Park Authority, Forestry Commission, landowners, Natural England	M4 2010 - 2015	Development of land use management plans that will help reduce run-off rates and lessen soil erosion, particularly from areas of susceptible soils such as Cannock Chase, that will result in increased BAP habitats in line with local and regional targets, and reduced flood risk downstream.	Reduce soil erosion resulting from rapid surface water run-off, particularly where there has been significant ground disturbance caused by mining (Staffordshire) and where sandy soils are prone to erosion such as Cannock Chase. And Sustain and increase the amount of BAP habitat in the catchment. And Sustain and improve the status of environmentally designated areas through appropriate frequency, extent and duration of flooding, including using rivers and floodplains to benefit nature conservation.	Area of BAP habitat
		Working closely with aggregate companies and the mineral and waste authorities prepare a plan identifying current and future opportunities to create restoration that is beneficial to both wildlife and flood risk management.	Environment Agency, Natural England, aggregates companies, Minerals and Waste Regulation Authorities,,	M4 2011-2016	Develop relationships between operating authorities and Environment Agency leading to better understanding and a formal and effective approach to quarry restoration.		Increase in area of environmental designation.

		Identify problem coal mining sites within Staffordshire where discharge during flood events causes pollution and damages habitat/species in receiving watercourses.	Environment Agency, relevant mining company or authority	M4 2011 – 2015	Improved understanding of the issue, and a cooperative approach to resolving or mitigating the problems.	Support and encourage land management and drainage practices, particularly from Staffordshire coal mining areas that will protect and improve water quality.	Incidences of pollution resulting from run-off from mines.

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Appendix G
Climate Change

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Background

Climate change is likely to have major direct impacts on the water cycle as a result on changes in patterns of rainfall and evaporation. Furthermore, climate change will affect patterns of water usage and have wider impacts on land use which will in turn affect the water cycle. Current climate change modelling broadly indicates that there will be wetter warmer winters and drier hotter summers and that some of these impacts will become evident within the timescale of the revised Regional Spatial Strategy up to 2026. Climate change has also been identified as a key issue in the East Midlands Plan and the National Water Cycle Study guidance.

In particular, climate change may have the following impacts:

- Reduction in the availability of water resources as a result of reduced rainfall. Increased temperature will tend to increase evapo-transpiration and may therefore reduce recharge of aquifers;
- Climate change will impact on water usage particularly in relation to irrigation of gardens and parkland using potable water. This is likely to increase peak demand for water. The benefits of rainwater harvesting and storage will also be affected. Leakage rates from water mains may also change if patterns of water table levels change. Demand for summer irrigation water for agriculture is also likely to increase;
- Along with increases in winter rainfall, climate change is expected to increase the intensity and frequency of storms. This is likely to increase the intensity and frequency of fluvial flooding and urban drainage related flood events;
- Increased intensity of rainfall during storms will increase surface drainage flow into combined sewerage systems and therefore increase the hydraulic loading on these systems. This increases the risk of sewer overflows and their impact on receiving waters, particularly following long dry spells when sediments accumulate in the sewers and are flushed out by the intense rainfall. Changes in water table levels may also affect infiltration and leakage of water from the sewerage system;
- Reduced summer rainfall will result in lower river flows which would reduce dilution of wastewater discharges. Compliance with environmental quality standards is, in some cases, based on 90 percentile values which tend to occur during the summer period; reduced river flows may have a magnified impact on compliance;
- Climate change is likely to place stress on wetlands. Consequently, these systems are likely to become less resilient to other perturbations such as impacts of abstractions and discharges.

The potential impacts outlined above change the context in which impacts of housing growth on the water cycle occur and should therefore be considered as part of the Water Cycle Study process.

Climate Change Modelling and UKCP09

Assessment of climate change impacts is based on global climate models which include a representation of land, air, ocean, ice, hydrological cycle and the carbon cycle. Detailed scenarios for the UK are generated using a regional climate model. This is a high resolution model which is nested in the full global climate model. This model produces the output that forms the basis of the climate change predictions produced by UKCP; a Defra funded body, based at the Environmental Change Institute in Oxford. UKCP are facilitators, providing people with free access to the UK climate change scenarios and tools to help understand climate impacts and adaptation. The climate range models have been run for a range of scenarios to account for uncertainty regarding future carbon emissions.

The first set of scenarios was produced in 1998 and is known as UKCIP98. These were superseded in 2002 by UKCIP02. Recently in June 2009 output has been released, known as UKCP09. The latest output uses the same climate change models as were used for UKCP02 but in contrast to previous output, probabilistic output has also been produced based on a range of model set ups and referencing output from other climate change models. The output is also at a higher resolution than previous UK scenarios, with data being available at a 25km resolution. This provides much greater spatial detail but also means that topographic features, such as air flow over hills and descriptions of catchments, should be more accurate.

For the first time, daily and sub daily data will be available thanks to the use of a weather generator. This is a tool which provides information on future climate which is statistically consistent with the probabilistic climate projections. It is based upon empirical relationships with stochastic variation applied to provide variability in the generated time-series. The UKCP09 weather generator is based upon EARWIG, a weather generator previously developed for the Environment Agency by the same team who are developing the UKCP09 weather generator. The weather generator output that will be available through UKCP is based on a 5km resolution grid of the UK and will be consistent with the projections.

Climate Change and the Study Area

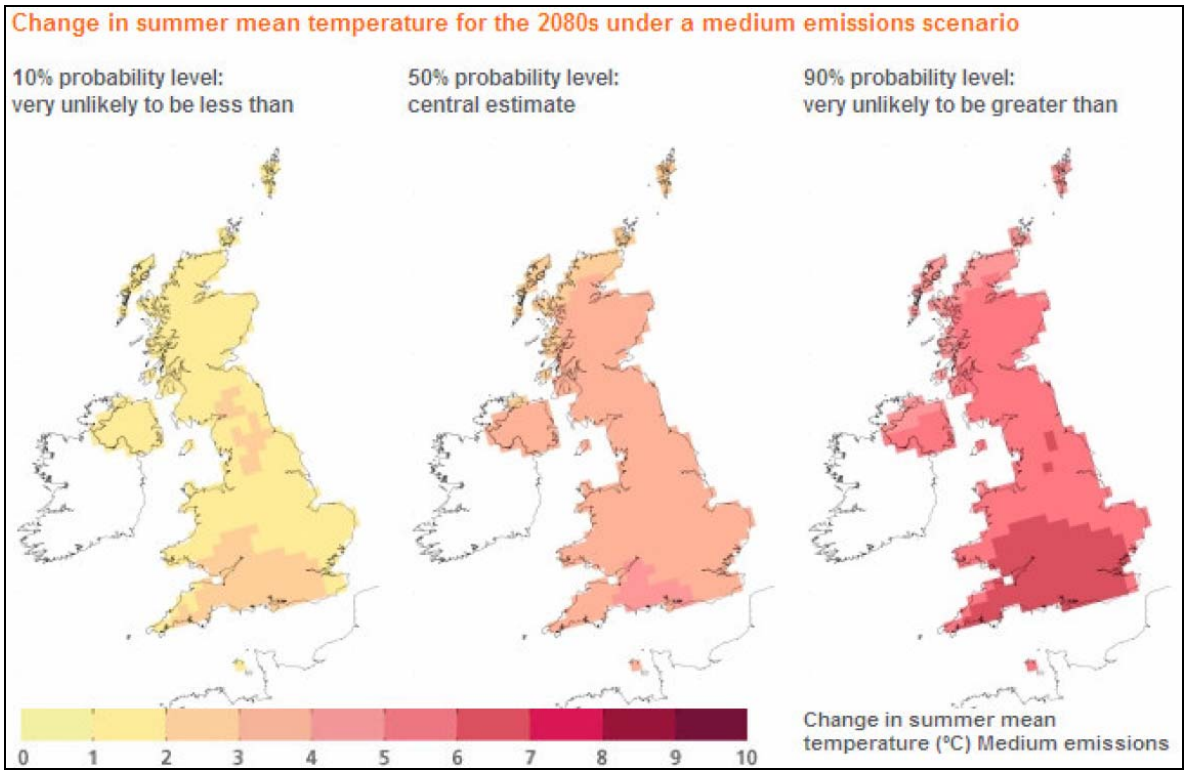
Figure G1 shows predicted changes in average annual temperature, summer precipitation and winter precipitation for the Medium Emissions scenario.

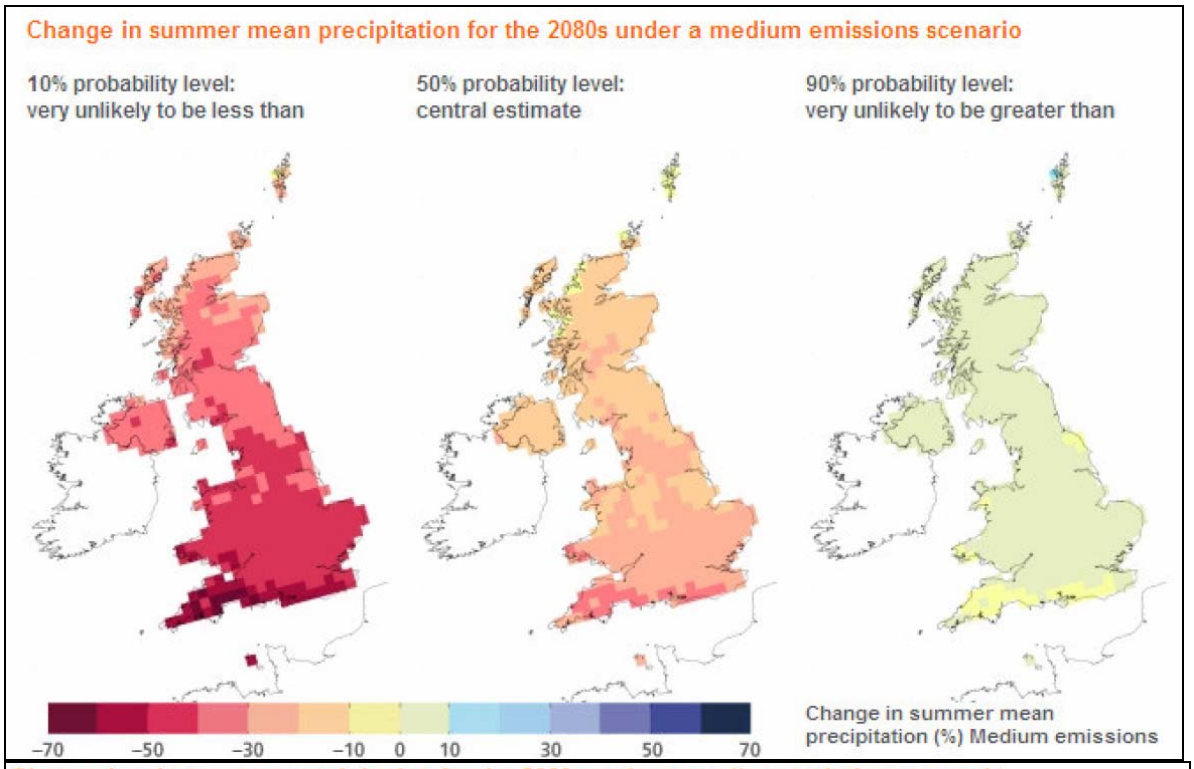
The key findings for the East Midlands in the 2050s under the medium emissions scenario are listed below:

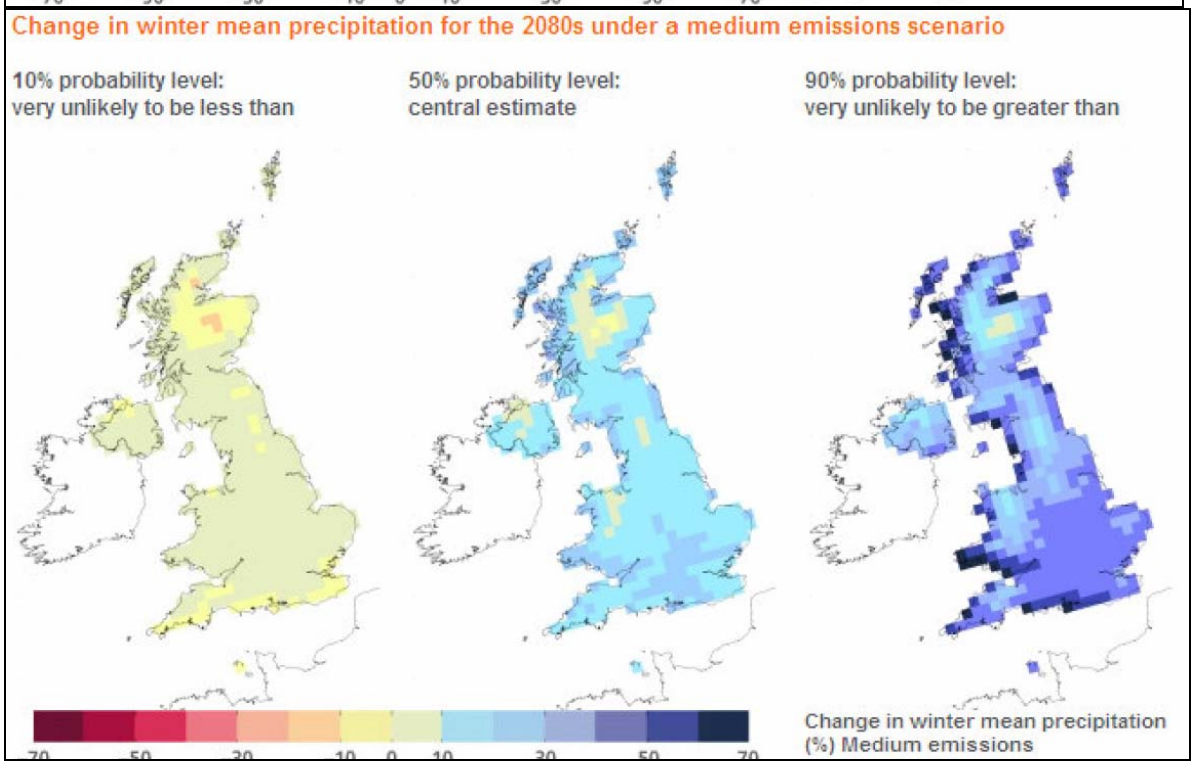
- The central estimate of increase in **winter mean temperature** is 2.2ºC; it is very unlikely to be less than 1.1ºC and is very unlikely to be more than 3.4ºC;
- The central estimate of increase in **summer mean temperature** is 2.5ºC; it is very unlikely to be less than 1.2ºC and is very unlikely to be more than 4.2ºC;
- The central estimate of change in **winter mean precipitation** is 14%; it is very unlikely to be less than 2% and is very unlikely to be more than 29%; and

- The central estimate of change in **summer mean precipitation** is –16%; it is very unlikely to be less than –36% and is very unlikely to be more than 6%.

Figure G1 Climate Change Impacts in the 2080's Under the Medium Emissions Scenario




Change in summer mean precipitation for the 2080s under a medium emissions scenario
10% probability level:
very unlikely to be less than
50% probability level:
central estimate
90% probability level:
very unlikely to be greater than
−70 −50 −30 −10 0 10 30 50 70
Change in summer mean
precipitation (%) Medium emissions


Change in winter mean precipitation for the 2080s under a medium emissions scenario
10% probability level:
very unlikely to be less than
50% probability level:
central estimate
90% probability level:
very unlikely to be greater than
Change in winter mean precipitation
(%) Medium emissions

The rainfall patterns in the study area and high percentage of surface water resources are likely to be particularly vulnerable to climate change impacts in the immediate term. Furthermore, agricultural demand for water will be increased as temperature rises in addition to reduced summer rainfall; this is likely to affect some rural parts of the study area, particularly where restrictions to the supply of water exist to protect low flows.

Increased winter rainfall and more intense summer storms will increase flood risk. Flood defences along the River Derwent are nearing the end of their lifetime and are below the required level of protection for a 1% annual probability flood event. Whilst there are robust plans to mitigate flood risk, much of the Derby City area and parts of Amber Valley and South Derbyshire are at risk of flooding if defences fail in the future.

Assessment of Environmental Capacity and Water Infrastructure Provision

Assessment of climate change issues by the Environment Agency and water infrastructure operators is mostly based on a national guidance produced by the regulators (OFWAT, DEFRA and Environment Agency) and water industry (e.g. UKWIR). This ensures that a consistent approach is followed to the complex issue of climate change. This Section presents information on national guidance and the assessments carried out in the study area.

Water Resources

Severn Trent Water's PR09 Business Plan (April 2009) outlines the company's strategy toward climate change. Assessment of options and proposals for the period 2010-2015 has been carried out using DEFRA's 'social cost of carbon'. The key elements of STW's plan to reduce their carbon footprint are:

- Measures to achieve significant efficiencies in energy use;
- Taking into account carbon impacts in assessing the case for further quality and environmental improvements;
- Additional electricity generation projects, in particular using sewage sludge as a renewable energy source.

The document outlines STW's approach of small, incremental adaptation measures which are generally viewed as preferable to large one-off changes, due to the uncertainty relating to climate change effects. In addition, changes which contribute to climate change mitigation are likely to be preferred to those which add to the water compnay's carbon impact. STW state that they will continue to review solutions in the light of the latest climate change research, such as the UKCIP09.

Severn Trent Water has forecast the impacts on its sources and customers' consumption using the UKCIP02 climate change data based on methodologies developed by the Environment Agency.

The impact of climate change on water resources will vary depending on the nature of the sources in a particular zone. It is generally considered that surface water sources will be more vulnerable than groundwater sources to changes in rainfall patterns in the shorter term. Surface water dominated resource systems may need to be changed to respond to more extreme weather events (heavy downpours, prolonged dry periods). South Staffordshire Water has forecast a loss of 2.3Ml/d by 2030/31 due to climate change. Severn Trent Water has reassessed the impact of climate change and now predicts a loss of just under 40Ml/d. In its Strategic Direction Statement, Severn Trent Water states that climate change is one of the most significant uncertainties facing the Company over the next 25 years.

Table G1 Impact of Climate Change on Deployable Output

Water Resource Zone	Deployable Output (Ml/d) (2007/08)	Reduction due to climate change (2034/35)	Reduction as percentage of 07/08 DO
East Midlands zone	892 Ml/d	38.8 Ml/d	4.4%
South Staffordshire Water	398 Ml/d (excl export to STW)	2.3 Ml/d	0.6%

Flood Risk

Guidance on assessment of climate change impacts on flood risk from part of Planning Policy Statement 25 (PPS25, Appendix B). This provides guidance on how to make allowances for climate change impacts in the application of the recommended methodologies to assess flood risk.

With regard to fluvial flooding the guidance recommends and allowance of a 10% increase in peak flow for the period 1990 to 2025 and an allowance of 20% beyond this. The guidance recommends that it is important that the analysis is incorporated into Strategic Flood Risk assessments. A recent review of the UKCIP09 climate change impacts has been undertaken by the Environment Agency, and they have recommended that the climate change allowances within PPS25 should still be used.

Consideration of the effects of climate change was undertaken in all three SFRAs to varying degrees. It is noted in the Derby City SFRA that the effect of climate change will mean that the risk of inundation and flooding frequency to sites along the River Derwent corridor will become greater in the future. It is a requirement of Derby City Council that 100 year (plus climate change allowance) rainfall volumes and flows are retained on the site and must not flow onto other 3rd party land.

In the Amber Valley SFRA, sensitivity testing of the Environment Agency's Flood Map was undertaken, using the 20% allowance for the increase in peak flows from 2025 to 2115, as suggested in Table B2 of PPS25. The results

indicated that changes in the extent of inundation are negligible in well-defined floodplains, but can be significant in flatter areas with less well defined floodplains. There are currently no hydraulic modelling results available for watercourses within Amber Valley that allow for the effects of climate change and hence it has not been possible to produce accurate future flood category envelopes for the "with climate change" scenario. When considering the effects of climate change on future developments, the current envelope for Flood Category 2 should therefore be taken as the future "with climate change" envelope for Category 3. It is recommended that the Level 2 SFRA undertakes climate change scenarios on the Environment Agency's Flood Zone 3.

To account for climate change in South Derbyshire, the SFRA acquired modelled flood outlines for Flood Zone 3a including the effects of climate change from the EA for several watercourses. Where no modelled climate change results were available, the Flood Zone 2 outlines were used as a proxy to estimate of the impacts of climate change This is based on the assumption that the depth and extents of flooding would increase to somewhere between the 1 in 100 year (1% AEP) and 1 in 1000 year (0.1% AEP) outlines. This is a conservative approach designed to help strategic planners identify where increased detail and resolution in the flood outlines is needed at either the Level 2 SFRA or Site Specific FRAs.

Ofwat Letter PR09/12 provides an instruction to water companies of their planning requirements for assessment of resilience of their assets to flood hazards. Guidance is provided a supporting guidance document produced by Halcrow (Halcrow, 2008) that takes into account assessment of climate change impacts. Severn Trent Water has followed this guidance in assessing flood resilience of their assets.

Wastewater

Severn Trent Water carries out climate change analysis in their design of the hydraulic capacity of wastewater infrastructure by applying additional rainfall allowances in their sewer network modelling. Additional flows are also factored into analysis of the frequency and magnitude of their assessments of combined sewer overflows. Ofwat recommend (guidance letter PR09/13 - Sewerage System Design and Climate Change) that this should be in line with Defra's guidance (Defra, 2006) on climate change in planning and designing public sewerage systems which should be incorporated into water asset management planning for PR09. Further guidance on drainage design is provided by a review by Atkins which was commissioned by Ofwat (Atkins 2008). The Ofwat letter recommends that sewerage flooding should not occur more frequently than 1 in 20 years and that no net increase in sewerage flooding should occur. Sewerage systems for new development should not occur with a return period of less than 1 in 30 years in accordance with the requirements for Sewers for Adoption (Atkins 2008). Investment should be based on a risk assessment approach based on the frequency of flooding and the sensitivity of the properties affected. With regard to climate change the letter requests that the water companies carry out "sufficient climate change sensitivity analysis on investment decisions to identify those which are sensitive to potential changes from UKCIP [ouput]". In the absence of more accurate guidance each company should take account of increasing rainfall intensity in line with DEFRA's guidance on climate change in planning and designing sewerage systems. The assessment should take into account the entire asset life (e.g. over the next 100 years).

Climate change will also affect the capacity of waters to receive wastewater flows particularly during low flow periods which are expected to increase. Impacts from CSO first flush of sewer sediments, due to intense rainfall following a long antecedent dry weather flow, may also become more pronounced as low river flows may be unable to provide sufficient dilution. Moreover, the strength of raw wastewater arriving at WwTWs in dry weather may increase due to less surface water entering combined sewers; this may in turn affect the operation of certain wastewater treatment processes . At present these impacts are not considered in the setting of wastewater quality and flow consents or in future asset planning. Analysis of these impacts could be carried out by sensitivity analysis using existing water quality models such as SIMCAT (e.g. reducing Q95 flows by 20%) or by using hydrological models to simulate changes in river flow based on output from UKCIP09. Such analysis would be undertaken by (or on behalf of) the Environment Agency and carried out at the river catchment scale rather than the Water Cycle Study area.

Research and Development of Guidance

Research into climate change impacts and the development of guidance is an ongoing process and release of UKCP09 output is likely to result in changes in the requirement for climate change assessment in relation to the water cycle. Table G2 summarises current developments in this area which may affect future Water Cycle Study work.

Table G2 Key Developments in Climate Change Assessment

Topic area	Developments
Water Resources	Improved guidance on water resources and development of improved climate change factors. Initial UKWIR project scheduled to release information in September 2009, but further work on incorporating the latest UKCP projections into the water resource planning process is likely to continue for 2-3 years.
Water Resources	UKWIR study on climate change impacts on groundwater levels. Ongoing work building on previous study; Effects of Climate Change on River Flows and Groundwater Recharge: A practical Methodology - Synthesis Report. UKWIR 2006,
Flooding	Joint CEH/JBA guidance currently being developed

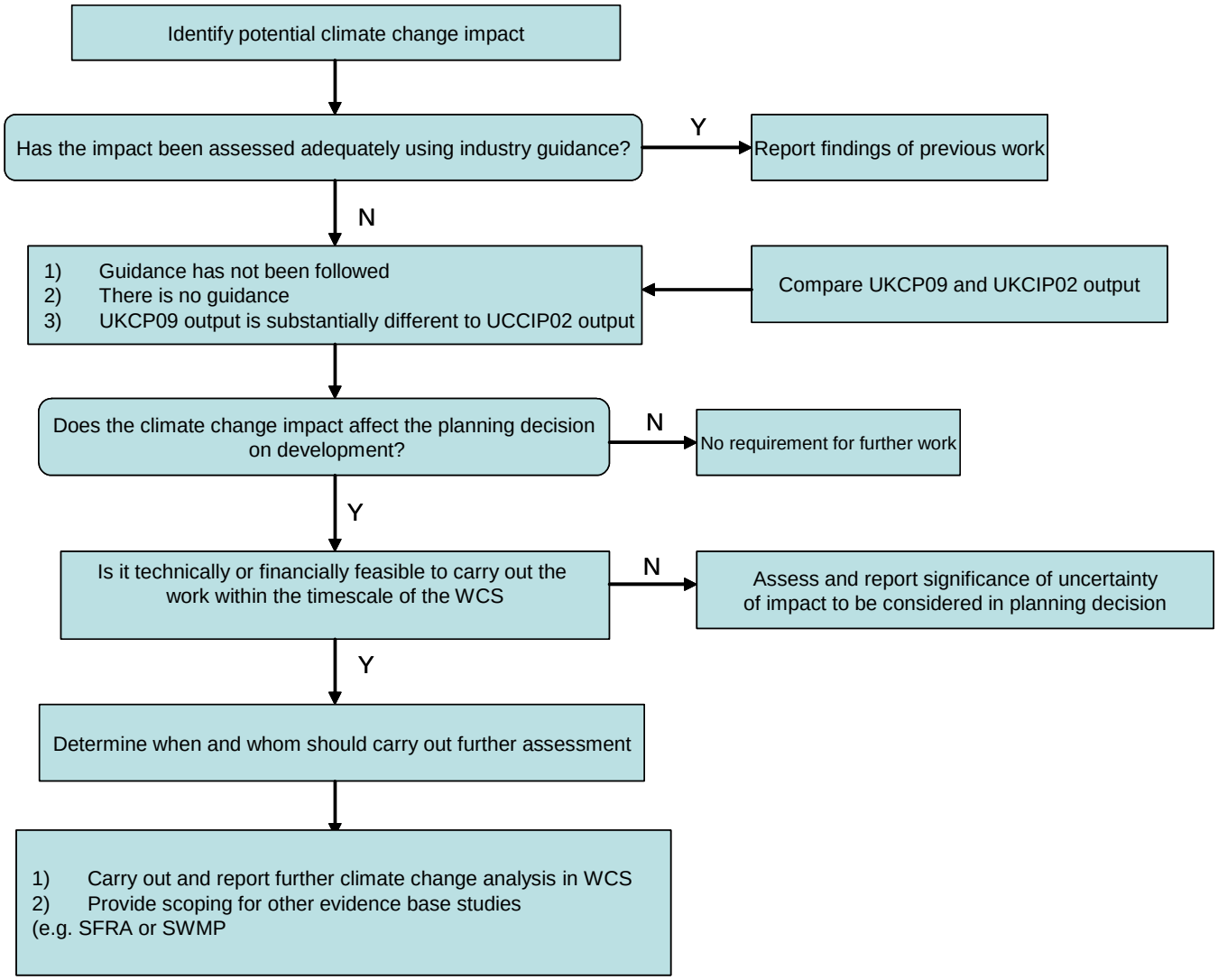
Climate Change Impacts and the WCS Process

Water Cycle Studies should aim to identify any weakness in existing water infrastructure and environmental capacity assessments with regard to climate change and address these weaknesses if these are relevant to planning decisions on development. It should also aim to ensure that climate change is taken into account in further work

related to the assessment of environmental capacity and the design of water infrastructures. Key factors in this process are listed below which are also illustrated in the flow diagram

- Review of existing assessments of climate change with regard to national guidance and best practise;
- Updating of the assessments to take into account UKCP09 output. Recent asset management planning and, in particular, STW's asset management plans submitted for PR09 are based on UKCIP02 output. The implications of the more recent and improved information needs to be taken into account in future planning;
- Guidance related to climate change impacts does not cover all parts of the water cycle.

Bearing in mind the wide ranging requirements to assess climate change impacts on the water cycle and ongoing work by the Environment Agency, it is important to be clear about when climate change work should be carried out as part of a Water Cycle Study. Assessment of climate change should focus on climate change impacts on environmental constraints on housing growth and on the timing of delivery of water infrastructure if existing or ongoing work does not adequately address these issues. This detailed assessment tends to be carried out in the Detailed Phase of a Water Cycle Study. The table below key areas where climate change should be incorporated into the various phases of a Water Cycle Study.


Identify potential climate change impact
Has the impact been assessed adequately using industry guidance?
Y
Report findings of previous work
N
1) Guidance has not been followed
2) There is no guidance
3) UKCP09 output is substantially different to UCCIP02 output
Compare UKCP09 and UKCIP02 output
Does the climate change impact affect the planning decision on development?
N
No requirement for further work
Y
Is it technically or financially feasible to carry out the work within the timescale of the WCS
N
Assess and report significance of uncertainty of impact to be considered in planning decision
Y
Determine when and whom should carry out further assessment
1) Carry out and report further climate change analysis in WCS
2) Provide scoping for other evidence base studies
(e.g. SFRA or SWMP

Topic area	Key Issue	Action	Justification for further work	Comments	By when and by whom
Water Resources	Has current guidance from the Environment Agency been followed in developing the water resource plan for the study area?	Review differences between the existing methodology and guidance to identify any deficiencies related to housing growth (e.g. impacts on water resource availability and demand). Carry out further work following the guidance.	This additional work should only be carried out where the further work is required to inform planning decisions within required timescales.	May not be feasible in project timescale if involves major reworking of WMRP analysis.	Detailed phase. By consultants in collaboration with Severn Trent Water.
	Is assessment of the key water resources issues identified WRMP and WCS Scoping Phase likely to be significantly affected by differences between the UKCP02 and UKCP09 output?	Carry out comparison between UKCIP02 and UKCP09 output. If differences significant in relation to housing growth carry out additional work using UKCP09 output.	This additional work should only be carried out where the further work is required to inform planning decisions within required timescales.	May not be feasible in project timescale if involves major reworking of WMRP analysis.	Detailed phase. By consultants in collaboration with Severn Trent Water.

Topic area	Key Issue	Action	Justification for further work	Comments	By when and by whom
	Are there key habitats in the study area that are affected by abstractions (e.g. identified in Site Action Plans). Are abstractions affected by housing growth? Are the findings of previous investigations likely to be affected by climate change?	Where previous work has indicated abstraction impacts of the habitat are significant and where housing growth may affect abstraction rate – re-run previous assessment using output from UKCP09 output.	This additional work should only be carried out where uncertainty in relation to the impacts on wetlands may affect planning decisions.	Would be expensive and time consuming if it involves running hydrological and groundwater models.	Collaboration between Severn Trent, Environment Agency and consultants.
	Has or will climate change be assessed in relation to flood resilience of water supply assets?	Review previous work to determine whether OFWAT guidance has been followed. Carry out further work following guidance.	This additional work should only be carried out where the further work is required to inform planning decisions within required timescales.		Detailed phase. By consultants in collaboration with Severn Trent.

Topic area	Key Issue	Action	Justification for further work	Comments	By when and by whom
	Has climate change been assessed in the design of water demand management systems (e.g. grey water recycling, rain water harvesting).	Provide guidance to developers regarding incorporation of climate change allowances in their design.	Provide guidance if developers have not considered already.		Detailed phase. Consultants and developers.
Flood Risk	Has PPS25 guidance been followed in the existing Flood Risk Assessments?	Provide scoping for addition Flood Risk Assessment Work.	Statutory requirement.		Separate study to be commissioned by local authority; ideally to coincide with Detailed Phase.
	Ensure that climate change assessment is incorporated into the design of SuDs and drainage systems?	Provide guidance to developers regarding incorporation of climate change allowances in their design.	Provide guidance if developers have not considered already.		Detailed phase. Consultants and developers.

Topic area	Key Issue	Action	Justification for further work	Comments	By when and by whom
	Has resilience to flooding been considered in the design of drainage assets (e.g. Internal Drainage Board).	Provide scoping for further work to be incorporated into Surface Water Management Plans.	Ensure drainage systems are designed adequately within developments and downstream.		Separate study to be commissioned by local authority; ideally to coincide with Detailed Phase.
Wastewater	Has or will sensitivity assessment in relation to climate change been taken into account in planning of wastewater infrastructure following OFWAT guidance (wastewater treatment and sewerage)?	Carry out analysis using climate change allowances to inform design of wastewater systems (e.g. INFOWORKS modelling).	Ensure systems designed adequately.		Detailed phase. By consultants in collaboration with Severn Trent Water.

Topic area	Key Issue	Action	Justification for further work	Comments	By when and by whom
	Has climate change been taken into account in the assessment of environmental capacity of environmental waters to receive additional wastewater flows in relation to the development.	Carry out further modelling work to assess changes in flow in receiving waters that result from climate change using UKCP09 output and assess impact using water quality models.	Compliance with Environment Quality Standards under current conditions may not indicate future compliance.	Would require setting up a rainfall run-off model and using time series output from UKCP09 weather generator (EARWIG).	Detailed phase. By consultants in collaboration with Environment Agency and Severn Trent Water.
	Has resilience to flooding been considered in the design of wastewater assets	Review previous work to determine whether OFWAT guidance has been followed. Carry out further work following guidance.	This additional work should only be carried out where the further work is required to inform planning decisions within required timescales.		Detailed phase. By consultants in collaboration with Severn Trent Water.

Mitigation

Sustainability and carbon accounting should form part of the options appraisal and cost benefit analysis that is likely to form part of the Detailed Phase Water Cycle Study. Carbon accounting for direct carbon emissions and embedded carbon have developed greatly in recent years and OFWAT have required water companies to report on green house gas emissions as part of their PR09 submissions (Part C8 of company guidance information requirements). UK Water Industry Research have also recently produced guidance documents for operational carbon production (UKWIR 2005) and embedded carbon (UKWIR 2008). Severn Trent Water has followed this guidance and monitors its carbon emissions and carries carbon accounting as part of the options appraisal and cost benefit analysis related to the provision of water infrastructure. Guidance on carbon accounting and mitigation are also available from the Carbon Research Centre and Carbon Trust.

Approaches to carbon budgeting will vary greatly between stakeholders and it will be important to develop a consistent approach particularly in relation to indirect emissions which may rely on information along supply chains. Adaptation of the water industry approach to other sectors such as drainage would provide the most straight forward way to achieve this.