7 Integrated Drainage Strategy and SUDS Options Appraisal

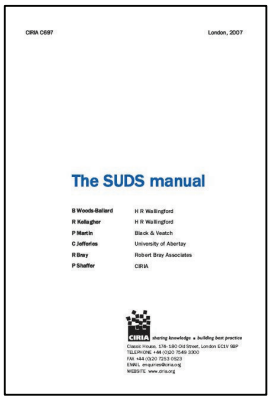
Flood risk generated as a result of any development is an important consideration with respect to the assessment of development area potential and current national planning policy with regards to flood risk management.

In areas where development runoff is likely to be discharged to a river system, it is important that new development does not increase the risk of flooding downstream by increasing runoff rates to greater than that of the runoff generated by existing land use. In addition, it is important that new development does not increase the risk of overland flow to adjoining development areas by increasing the amount of impermeable area.

In order to reduce runoff rates from developed sites to that of existing (and where possible to achieve "betterment"), PPS25 and its companion guidance[36] recommend that Sustainable Drainage Systems (or techniques) are used, known collectively as SUDS. Development within the new Development Corridors will need to include for SUDS both at a site specific level but also a strategic scale level. In general, there are advantages to be gained to developing drainage strategies for site wide developments such that strategic scale options such as balancing ponds can be developed at lower overall cost, but also to:

- Strategically manage flood risk and surface water;
- Maximise green infrastructure linkage;
- Maximise ecological enhancement;
- Maximise water quality benefits from retention and filter type SUDS; and
- Contribute towards the point system for Code for Sustainable Homes grading.

Consideration of the potential SUDS options is a key consideration for this strategic WCS. The following Sections outline some of the key strategic considerations for SUDS implementation in the development areas, and it is recommended that any subsequent Detailed WCS study develops site wide strategic drainage plans for the development areas taken forward into the next planning stage.



7.1 The Surface Water Management Train

The EA and Defra currently suggest that the SUDS management train (as per the CIRIA SUDS manual) is applied when considering SUDS techniques to be adopted for new development. This lists the order in which different SUDS techniques should be considered for a site in terms of their requirement to mitigate against surface water and flood risk[37].

[36]Communities and Local Government, *Planning Policy Statement 25: Development and Flood Risk - Practice Guide*, 12 June 2008.
[37] Environment Agency, SUDS – A Practical Guide, October 2006.

The management train considers SUDS options which first "prevent" the generation of runoff i.e. green roofs, rainwater harvesting at the communal scale; followed by techniques which control runoff at the source, such as infiltration to ground through permeable paving; then followed sequentially by site and regional techniques. When considering disposal of attenuated surface water, Part H of the Building Regulations[38] requires that the first choice of surface water disposal should be to discharge to infiltration systems where practicable. In development sites over 1 hectare the EA will usually seek that infiltration is the method of surface water disposal, if feasible, as the method mimics natural drainage methods.

A SUDS hierarchy should be followed looking at infiltration methods first, then attenuation techniques followed by discharge straight to the sewer. The last options to consider are hard engineered solutions such as attenuation tanks. Infiltration for developments can occur via individual house soakaways through to infiltration lagoons. Attenuation, as a second option, should be provided so the runoff post-development is, as a minimum, no higher than the pre-development (brownfield) runoff rates. The EA will usually have more restrictive requirements, with the runoff from a development site not exceeding the un-developed (greenfield) runoff rate.

In accordance with PPS25: *Development and Flood Risk*, Councils must consult the Environment Agency under the following circumstances:

- Development other than minor development is proposed in Flood Zones 2 or 3
- Development in Flood Zone 1 where there are critical drainage problems
- Any development exceeding 1 hectare in extent
- Development within 20m of the bank top of a main river
- Any culverting, operation or development which controls the flow of any river or stream.

A site specific Flood Risk Assessment (in accordance with Annex E of PPS25) should accompany a planning application where any of the above points apply.

All new developments will be expected to incorporate Sustainable Drainage Systems to reduce the risk of surface water flooding, both to the site in question and to the surrounding area. Where the potential for surface water flooding has been identified, Flood Risk Assessments FRA's should ensure suitable Sustainable Drainage Systems (SUDS) techniques are incorporated as part of redevelopment and where possible attenuate surface water flows to equivalent greenfield rates. As a minimum requirement surface water flows should not exceed those of pre-development rates where greenfield rates are unachievable.

Table 7-1 lists the order in which different SUDS techniques should be considered for a site in terms of their considered mitigation against surface water and flood risk. SUDS techniques at the top of the hierarchy are preferable for their infiltration and runoff prevention benefits. The management train provided below also states the additional potential ecological and water quality benefits that could be achieved by employing the proposed SUDS techniques.

[38] Building Regulations 2000 - Part H: Drainage and Waste Disposal, 2002, Office of the Deputy Prime Minister (http://www.planningportal.gov.uk/uploads/br/BR_PDF_ADH_2002.pdf)

Table 7-1 - SUDS Management Train (Surface Water and Flood Risk Mitigation) – adopted from CIRIA SUDS manual

Management Train	Component	Description	Water Quantity	Water Quality	Amenity Biodiversity
Source Control – Prevention	Green roofs	Layer of vegetation or gravel on roof areas providing absorption and storage.	●	●	●
	Rainwater harvesting	Capturing and reusing rainwater for domestic or irrigation uses.	●	○	○
	Geocellular or Modular building materials	Manufactured blocks/crates with a cellular network of voids that can store and attenuate stormwater underneath/surrounding buildings.	●	○	○
	Permeable pavements	Infiltration through the surface into underlying layer.	●	●	○
Site Control	Attenuation Infrastructure	Large Diameter Pipes, Culverts and Tanks to store and attenuate stormwater from site	●	○	○
Source Control	Filter drains	Drain filled with permeable material with a perforated pipe along the base.	●	●	
	Infiltration trenches	Similar to filter drains but allows infiltration through sides and base.	●	●	
	Soakaways	Underground structure used for store and infiltration.	●	●	
	Bio-retention areas	Vegetated areas used for treating runoff prior to discharge into receiving water or infiltration	●	●	●
	Swales	Grassed depressions, provides temporary storage, conveyance, treatment and possibly infiltration.	●	●	○
	Sand filters	Provides treatment by filtering runoff through a filter media consisting of sand.	●	●	
Site Control / Regional Control	Basins (infiltration & Detention)	Dry depressions outside of storm periods, provides temporary attenuation, treatment and possibly infiltration.	●	●	○
	Ponds	Designed to accommodate water at all times, provides attenuation, treatment and enhances site amenity value.	●	●	●
	Wetland	Similar to ponds, but are designed to provide continuous flow through vegetation.	●	●	●

7.1.1 Infiltration SUDS

Infiltration is a key factor in reducing runoff rates and volumes, as it reduces reliance on surface or engineered storage systems such as balancing ponds or storage tanks. Some infiltration SUDS have the additional benefit of being able to encourage habitat creation and water quality benefits. Natural infiltration by creation of open grassland landscaping (where land contamination is not an issue) should be encouraged, first for large developments to maximise natural runoff rate reduction, and second to encourage natural recharge of groundwater systems.

Green areas and open space should be maximised for large development areas where the soil and geology is sufficiently permeable to make it a feasible option. Infiltration can also be encouraged via managed SUDS techniques such as soakaways, swales or infiltration trenches. Given that parts of the study area are underlain by permeable geology, infiltration is a key consideration for new development in Black Country. Section 7.2 and Figures 7-1 to 7-4 give further technical guidance on the location and suitability of infiltration techniques in the Black Country.

Despite this, the Sherwood Sandstone Aquifer underlying the Black Country is considered a Major Aquifer used for public supply therefore due regard needs to be paid to protection of groundwater from pollution pathways that can be created by poorly managed or badly located infiltration SUDS, and as such, there may be restrictions on the types of infiltration SUDS systems permitted within developments.

Determination of infiltration sensitive areas is considered by reviewing soil type and geology via groundwater vulnerability maps, and catchment areas which feed public water supply sources via Source Protection Zone mapping.

Table 7-2 shows potential SUDS options taking permeability and SPZs into consideration.

7.1.2 Surface Water Runoff Attenuation

Once it is known which development areas and scenarios are being taken forward, and once more is known about the numbers of housing and likely layouts of the sites, it is recommended that the detailed requirements for different types of SUDS is undertaken in any subsequent Detailed WCS. At detailed stage however, the volume of attenuation to be provided (either by infiltration or by storage) can be calculated to give an idea of the scale of mitigation and costs that would be required in order to mitigate flood risk from the development.

Attenuation storage aims to limit the peak rate of runoff from the development to the receiving watercourse to the corresponding Greenfield runoff rate for a range of annual flow rate probabilities (100%, 33% and 1%). The outlet structure dictates the rate at which the attenuation volume will drain. Should balancing / retention ponds be selected as the preferred storage option, they should have a catchment of at least 5 hectares each[39] and / or a reliable source of baseflow to be successful as an amenity.

[39] Environment Agency, Sustainable Drainage Systems (SUDS) - An introduction, p.17, May 2003.

Table 7-2 - SUDS Options

Soil Permeability	Source Protection Zone	SUDS Method													
		Attenuation Systems						*Combined Systems*				*Infiltration Systems*			
		Green or Brown Roofs	Rainwater Harvesting and Water Butts	Geocellular/Modular	Large Diameter Pipes, Culverts or Tanks	Detention Basins	Ponds	Wetlands (Stormwater)	Swales	Bio-Retention Area	Filter drains (strips/Trenches)	Soakaways	Permeable Pavement	Infiltration Basins	Sand Filters
Low	SPZ 1	✓	✓	✓L	✓	✓L	✓L		✓L	✓L					✓L
	SPZ 2	✓	✓	✓		✓	✓		✓	✓	✓				
	SPZ 3	✓	✓	✓		✓	✓		✓	✓	✓				
Medium	SPZ 1	✓	✓	✓L	✓	✓L	✓L		✓L	✓L	✓L		✓L		✓L
	SPZ 2	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		
	SPZ 3	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓		
High	SPZ 1	✓	✓	✓L	✓	✓L	✓L	✓L	✓L	✓L	✓L		✓L		✓L
	SPZ 2	✓	✓	✓		✓	✓L	✓L	✓	✓L	✓	✓	✓	✓	
	SPZ 3	✓	✓	✓		✓	✓L	✓L	✓	✓L	✓	✓	✓	✓	

N.B. L = Lined (system)

7.2 Suitability of Infiltration Techniques in the Black Country – SUDS Maps

Geological data from the British Geological Society has been used to prepare high-level SUDS maps presented on Figures 7-1 to 7-4. These maps provide the evidence base at an early stage of planning to inform the future drainage strategies for each Development Corridor, but can also be used elsewhere to assess the feasibility of infiltration techniques for SUDS retro-fitting.

7.2.1 Methodology

The drift and solid geology layers were plotted by rock types. Each rock type was allocated into two simplified permeability classifications (permeable or impermeable). Classifying the highly complex geology of the Black Country into two permeability categories inevitably leads to simplifications. These SUDS maps provide information on the gross *feasibility of infiltration* techniques rather than on the *degree of permeability* of the soil. Therefore, localised assessment surveys of the soil permeability within each Development Corridor are required to fully assess the suitability of infiltration SUDS, regardless of the geology. Also, localised infiltration assessments will allow laboratory analysis to determine the presence of contaminants in the soil.

Solid and drift geology has been superimposed to determine a simplified infiltration feasibility assessment in the six scenarios shown in Figure 7.5.

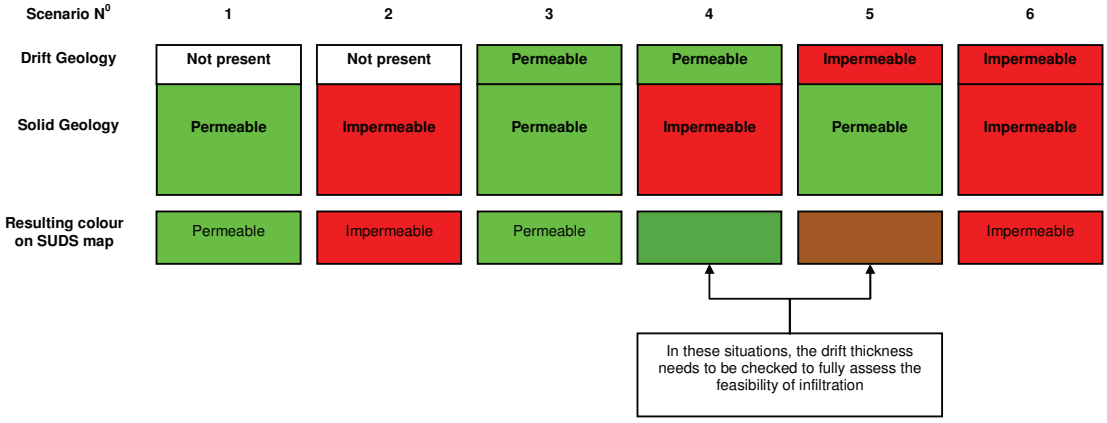


Figure 7.5 – Results of Simplified Infiltration Feasibility Assessment

7.2.2 Results

Soil permeability assessment forms an essential part of any drainage strategy, allowing assessment of the overall potential weight of source control components, and the identification of suitable areas for implementation. In this respect, the SUDS maps, although prepared at a high level, are likely to influence and shape final drainage layouts.

The areas delineated as "impermeable" on Figures 7-1 to 7-4 roughly follow the Coal Measures. Most of the Development Corridors are located within this area and consequently a significant proportion of land will not benefit from infiltration techniques due to insufficient soil permeability. Numerical results are presented in Table 7-3.

In Development Corridors 10 and 14 (Kingswinford and Halesowen) ground conditions are widely favourable to infiltration-based drainage techniques like soakaways or permeable pavings. In these areas, significant runoff attenuation may be achieved through source control SUDS, reducing the pressure on hard engineering solutions and other infrastructure requirements (sewer extensions and upgrades) and land and open space (extensive flood storage areas).

In most Development Corridors however, the mixed permeability means that infiltration SUDS will not be suitable as a corridor-wide drainage strategy.

For Development Corridors 4 (Wolverhampton-Bilston), 7 (Bloxwich-Walsall) and 16 (Coseley-Tipton), the future drainage strategy and attenuation is likely to rely heavily on storage. Where ground conditions do not permit infiltration, or where numerous small scale source control elements are not used, the volume of detention storage required at a site will indeed increase as very little to no runoff will be lost to ground and the major attenuation components then need to store the full volume of runoff.

Under the current scope, we have not undertaken a specific SUDS appraisal assessment for strategic town centres. However, a more detailed assessment of SUDS for the development corridors and centres should be considered as this will enable greater clarity for both Development Control Planners at the Councils as well as local Developers in the selection of SUDS.

In order for sustainable drainage to be most effective, a specific series of site tailored elements for the runoff to pass through should be implemented. A suitable Management Train (or SUDS Hierarchy) for the Black Country will combine source, site and regional control components. Flood attenuation ponds will often prove to be necessary to store large volumes of runoff, but SUDS elements should also be introduced at property-level or street-level to provide source control. The final selection of the most suitable SUDS system is likely to depend on the following four key-factors:

1. Hydrology of the area and the infiltration rate of the upper soil layers;
2. Groundwater Source Protection Zones and contaminated land;
3. Scale and drainage strategy for the catchment area;
4. Pollutants present in the runoff (which in turn depends on the catchment characteristics and land uses: residential, industrial, etc.).

Table 7-3 - Breakdown per Development Corridor of feasibility of infiltration-based drainage techniques, based on drift and solid geology.

Development Corridor Number	Area (ha)	A – Scenarios 1 & 3 Proportion of area where ground permeability **is** favourable to infiltration techniques	B – Scenarios 4 & 5 Proportion of area where further investigation regarding drift thickness is required	C – Scenarios 2 & 6 Proportion of area where ground permeability **is not** favourable to infiltration techniques
1	99	22%	78%	0%
2	214	8%	64%	28%
3	88	6%	60%	34%
4	516	2%	17%	81%
5	191	5%	18%	76%
6	829	8%	43%	49%
7	697	0%	16%	84%
8	776	37%	30%	33%
9	819	72%	11%	17%
10	306	96%	2%	2%
11a	655	39%	0%	61%
11b	402	71%	10%	19%
12	1,333	29%	47%	24%
13	992	56%	14%	30%
14	193	98%	0%	2%
15	305	4%	37%	59%
16	386	1%	0%	99%
Total Development Corridors within Black Country	8,802	34%	24%	42%
Production of maps identifying areas of favourable infiltration drainage should be produced during the Outline SWMP				

7.2.3 Limitations

These SUDS maps consider suitability for infiltration techniques based on drift and solid geology only. Due to data gaps, contaminated land and areas with a water table close to ground level have not been considered, but would likely lead to further limitations regarding the use of infiltration-based drainage techniques.

Groundwater Source Protection Zones are also presented in Figure 4.3 and Figures 7-1 to 7-4 and need to be taken into account when preparing the Development Corridors' detailed drainage strategies. In the vicinity of a groundwater source, and depending on the soil permeability, the use of a number of SUDS components will be restricted (no soakaway can be located within a SPZ 1 for instance) and/or their design will have to adapted (primarily pond lining requirements). Please refer to Table 7-2 for further guidance on how the suitability of SUDS components relates to each SPZ.

Finally, the data provided in this chapter does not preclude the need for detailed, site-specific infiltration tests at development stage. Infiltration techniques may not be effective if the infiltration rate is below 10 mm hr^{-1} for the upper soil layers[40].

[40] Environment Agency, Sustainable Drainage Systems (SUDS) - A guide for developers, p.8, March 2003.

7.2.4 Conclusion - Scope for Further Investigations

This work has highlighted several critical data gaps that have to be filled, should an overall Detailed Drainage Strategy be implemented throughout the Black Country or by individual Councils.

- **Land Contamination:**

The industrial heritage of the Black Country has left significant land contamination issues that have an impact upon water sustainable management. Even in areas where ground conditions may be favourable to infiltration techniques, land contamination needs to be systematically investigated to determine whether SUDS are suitable as this will restrict the range of available drainage options.

- **Groundwater Levels:**

Generally, where the groundwater table is less than 5 metres below the ground surface, there is very limited potential for the pollutants to be dispersed, absorbed or otherwise neutralised before they enter the groundwater. Therefore the depth to groundwater and in particular the *seasonal maximum* must be known. From this information, a detailed risk assessment can be determined. For shallow groundwater the risk assessment should be detailed. Only one borehole record was obtained from the EA for the purpose of this study. More borehole records are thus needed, in particular from ST and SSW.

- **Drift Thickness:**

Almost a quarter (see Table 7-3, column B) of the total proposed Development Corridors area is either covered by:

  - permeable superficial deposits underlain by impermeable bedrock (scenario 4)
  - impermeable superficial deposits underlain by permeable bedrock (scenario 5)

In both situations, infiltration techniques may still be possible, provided the drift thickness is proved to be deep enough (see Figure 7.6 overleaf) (scenario 4) or shallow enough (scenario 5). To this end, borehole logs can be retrieved from the BGS and analysed to assess the drift thickness. In any case, detailed geological surveys should be undertaken by developers as required, as part of the planning application process to define the most suitable SUDS options.

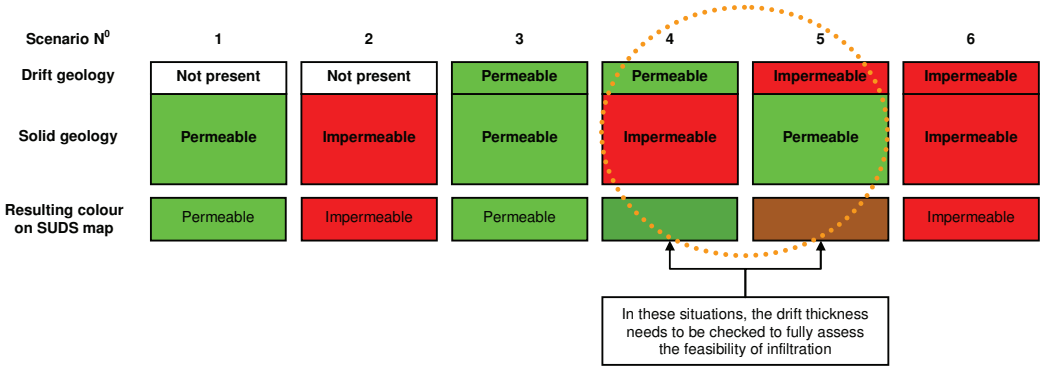


Figure 7.6 – Results of Simplified Infiltration Feasibility Assessment

- **Consideration of SPZs:**

As shown in Figure 4.3 and Figures 7-1 to 7-4, some of the proposed Development Corridors lie within groundwater Source Protection Zones. Careful consideration of any proposed infiltration arrangements and/or any upstream treatment needs to be made to ensure that the requirements of the Groundwater Regulations 1998 to protect groundwater from pollution are complied with.

- **Infiltration Tests:**

Localised surveys should be requested within the planning application submission along with the SUDS strategy.

7.3 Institutional Arrangements - SUDS Adoption and Maintenance

One of the key elements of the design of sustainable drainage systems is to ensure their long-term management and maintenance. The adoption and maintenance of SUDS features can be a task that is often overlooked in the early stages of the planning process. Section 2.2.5 of the National SUDS Working Group's "Interim Code of Practice for Sustainable Drainage Systems" states the *"Maintenance of SUDS differs from that for conventional systems, so it is important to allocate responsibility for the maintenance of SUDS early in discussion before planning approval for the development is given"*. It is therefore important that SUDS adoption and maintenance is given consideration during the Detailed WCS to ensure that developers and planners sign-up at an early stage to the proposed flood mitigation measures and drainage systems.

Problems may arise if SUDS are not well maintained and maintenance requirements for SUDS differ from those for conventional systems. Hence it is crucial that responsibilities for the maintenance of SUDS are allocated early in discussions before planning approval for each development is granted.

No legally binding obligation relating to the provision and maintenance of SUDS currently exists, as opposed to conventional foul and surface water drainage systems. The most appropriate way of achieving adoption, operation and long-term maintenance of SUDS is presently an agreement under Section 106 of the Town and Country Planning Act, 1990 that provides greater security for the implementation of SUDS and for which templates have been developed. This does not preclude the need for additional negotiations and legal preparatory works on a case-by-case basis, in order to assess the preparedness and willingness to adopt SUDS systems by each stakeholder.

As part of a future detailed WCS & outline SWMP, we recommend the preparation of tailored Outline Model Agreements providing guidance for Operation & Maintenance, in order to improve uptake by providing a mechanism for maintenance. The choice of a Model Agreement and the mechanism for implementation is usually under the responsibility of the LPA.

To assist the four Boroughs and the local developers in the Black Country, we recommend the identification, at an early stage of planning, of the most appropriate legal framework for the various components of the integrated drainage strategy to be managed, most likely in the following situations:

- Implementation and maintenance of SUDS through the planning process, either as a Planning Obligation under Section 106 of the Town and Country Planning Act 1990 or as a condition attached to planning permission
- Implementation and maintenance of SUDS between two or more parties (outside of the requirements for planning permission), i.e. Private SUDS Model Agreements. These are primarily setup to help facilitate ongoing maintenance of SUDS that are in private ownership (large landowner, housing association, corporate body or single household).

The following table, based on Defra's Interim Code of Practice for Sustainable Drainage Systems (2004) provides guidance on the most suitable mechanisms for maintenance. As the overall drainage strategies for the proposed Development Corridors reach their final stage, each component or group of components of the drainage system should be attributed one of the following three Model Agreements. The choice of Model Agreement and the mechanism for implementation will usually be determined by the Local Authorities.

Table 7-4 - SUDS Adoption & Maintenance Guidance

Type of Model Agreement	Planning obligation under Section 106 of the Town and Country Planning Act		Condition attached to Planning Permissions which require SUDS	Private Model Agreement
	Incorporating Maintenance Framework Agreement	With stand alone Maintenance Agreement		
Description	Legal agreement to enforce a properly implemented and maintained SUDS scheme. The Maintenance Framework Agreement sets out responsibilities for implementation and maintenance.		Requires the developer to use SUDS within the development. An agreement should be produced to facilitate ongoing maintenance.	Contract between the property owner/tenant (landowner, housing association, corporate body or single household) and the maintenance provider, setting out the responsibilities of the parties, the number of maintenance visits and the charges for the services.
SUDS implementation and maintenance required as part of the planning process?	YES		YES	NO
Type of SUDS Scheme	Large / Complex		Small / Simple	Small / Simple
Level of control required by Local Authority	High	Low	Low	None
Advantages	- Offers more security as it may only be varied by agreement. - Allows for financial contributions in the form of a bond or a periodic payment.		More flexible approach	- Facilitates ongoing maintenance of SUDS that are in private (freehold) ownership. - Suitable for either existing or new developments.
Drawbacks	The Section 106 route requires negotiations and legal preparatory work in advance of the development taking place.		- Planning conditions can be appealed against. - Enforcement can be difficult.	Shared responsibilities between the customer and the maintainer may become a problem in case of a failure of SUDS that affects downstream areas.

Also, it is recommended that the Councils consider establishing criteria for the performance of SUDS systems. Even though no conditions have been placed on the maintainer for the performance of the SUDS, it is crucial to secure funding in order to demonstrate the long term impact of SUDS on both the quantity and quality of water leaving the site as well as environmental and social implications.

8 Wastewater Treatment and Collection

8.1 Introduction

The wastewater treatment and collection section addresses two key issues:

1. baseline with respect to treatment of wastewater and how much 'spare' capacity is available in existing wastewater treatment facilities; and
2. baseline with respect to wastewater or sewer network and whether there is scope to use the existing network system[41] before upgrades are required.

It is important to establish the baseline and hence spare capacity of wastewater treatment facilities and network because a basic assumption of the WCS is that it is preferable to maximise the use of existing facilities where feasible and also develop strategic upgrade solutions. By maximising existing infrastructure, costs may be minimised, and potentially the most sustainable options could be encouraged (e.g. minimising initial carbon footprint of new development). Adopting such an approach may also reduce impact on existing neighbouring communities and allow the early phasing of some new development, which would not have to rely on longer lead in times associated with securing funding for new infrastructure through the statutory water company planning process.

An important aspect of the spare capacity of the existing wastewater treatment facilities is the assessment of the environmental capacity of the receiving watercourses. Discharge of additional treated wastewater from new development could have a detrimental impact on the water quality of receiving watercourses, the hydrological/hydraulic regime of receiving waters and associated habitats and the flood risk downstream of the discharge.

As part of any future WCS, it will be important to fully assess existing wastewater infrastructure and also determine any spare capacity of local wastewater treatment works (WwTW).

8.2 Data Availability

Various types of information have been supplied by the Environment Agency and Severn Trent (ST) for the wastewater baseline assessment including:

- Dry Weather Flow (DWF)[42] and Quality Consent details for wastewater treatment works (WwTW) in the Black Country;
- WwTW size and population details;
- Sewer network records in GIS format. These show the layout of the sewer network and include information such as sewer pipe sizes, sewer type and gradient; and
- Infrastructure and Deliverability Study (Mott MacDonald, 2009).

[41] the network of pipes and pumping stations which are used to transmit wastewater from buildings to treatment facilities

[42] Dry Weather Flow (DWF) is a unit of measure, used by the Environment Agency in a consent, to describe the maximum daily volume Seven Trent Water (ST) can discharge from a wastewater treatment works (WwTW). It is defined as "The average daily flow of sewage during seven consecutive days without rain following seven days during which the rainfall did not exceed 0.25mm on any one day, averaged over a summer and winter period". In industrial towns the seven days are replaced by five working days. In practice this is very difficult to measure and is usually estimated using a formula.

8.3 Wastewater Treatment Baseline and Capacity

8.3.1 Introduction

The wastewater treatment and baseline capacity assessment identifies the WwTW in the Black Country study area that are likely to be impacted by proposed growth within the area and assess the current and future potential volumetric (headroom) capacity.

Severn Trent Water (ST) are responsible for operation and maintenance of the existing foul sewerage system and surface water drainage within the Black Country, but they are not responsible for soakaways, land drainage, highways drainage, SUDS or septic systems.

For the purposes of the Outline WCS, ST did not provide information pertaining to the 'process capacity' at the WwTWs. Process capacity refers to the amount of flow that can be treated to the required quality standards as set under the discharge consent. Therefore, it has been agreed that the headroom capacity at the WwTW is calculated from the volumetric capacity (i.e. the difference between the maximum dry weather flow (DWF) that ST are permitted to discharge under the discharge consent and the current DWF that is treated from the existing population). This is based on the assumption that ST would seek the funding required to upgrade the processes in the works (if necessary) to treat the additional flow to the standard required under the existing licence.

Whilst this assumption is acceptable for the Outline WCS to determine the feasibility of using the volumetric headroom at the WwTWs, any Detailed WCS will need to revisit these assumptions in conjunction with ST who will assess the actual process capacity and need for process improvements. The review process should take into account finalised housing figures, occupancy rates and consumption (based on water efficiency targets). As a final output, any proposed Detailed WCS review should also provide information on if/when funding is required to upgrade the process capacity at the WwTWs. Any new upgrades or infrastructure requires funding to be sought by ST and as such, there is an associated lead in time for the upgrade works which would limit the amount of development that could take place before the upgrades are in place.

It was noted in the Infrastructure and Deliverability Study that in general there should not be any major capacity issues at the main WwTWs serving development in the Black Country (Minworth and Barnhurst), due to the size of the WwTWs in comparison to the scale of proposed development. The study did however identify that the complex systems across the Black Country are heavily influenced by rainfall do the prevalence of combined systems, however it also notes that "whilst the water company are aware of the current performance issues across the catchment in relation to sewer flooding problems, they are already developing solutions to alleviate known problems but as with all new development proposals they would look to ensuring future sewer performance is not detrimentally affected by new development".

8.3.2 Assumptions

The following global assumptions, based on latest available data, have been used for the Black Country WCS wastewater baseline and capacity assessment:

- The resident (domestic) population (Pd) and non-resident (holiday) population (Ph) represent the current population being served by the WwTWs at June 2008;

- The per capita consumption for the domestic population (Gd – water used per head, per day) is taken as 137 l/h/d. This is based on the ST regional average between metered and unmetered houses (Draft WRMP[43]);
- The per capita consumption for the non-resident population (Gh – water used per head, per day) is taken as 55 l/h/d;
- The per capita consumption for commercial jobs (Gc) is taken as 28 l/h/d;
- The infiltration (I) rate[44] will be calculated as 25% of the domestic and holiday population multiplied by the stated per capita consumptions (PG = (Domestic Population (Pd) x Domestic Consumption (Gd)) + (Holiday Population (Ph) x Holiday Consumption (Gh))) and that for future calculation of I, the additional infiltration is calculated as 25% of future PG;
- Dry Weather Flow (DWF) is calculated as PG + I + E where E is the volume of trade effluent discharged in the catchment (m^3d^{-1});
- Flow to Full Treatment[45] (FtFT) is calculated as 3PG + I + 3E;
- The future per capita consumption for new development (Gf – water used per head, per day) is taken as 133 l/h/d. This is based on ST's statement of response to their consultation on the draft WRMP (Draft WRMP[46]);
- No increase in non-resident consumption has been assumed; and
- The occupancy rate is 2.4 per dwelling (Draft WRMP[47]).

8.3.3 Existing Wastewater Treatment Works

There are six WwTW located within and serving the Black Country study area, with a further eight WwTWs bordering and serving some of the population within the study area. Some of these works have the potential to be impacted by development within the Black Country itself, and therefore a review of the wastewater network has been undertaken to identify those works likely to be impacted by growth up to 2025). All WwTWs within and bordering the study area are summarised in Table 8-1 and the locations shown in Figure 8-1. Eight WwTWs have been identified as being likely to be impacted by growth in the study area and will therefore be assessed as part of this Outline WCS. These assumptions need to be confirmed as part of any future Detailed WCS.

[43] Severn Trent (2009) Draft Water Resources Management Plan – Statement of response to consultation, Severn Trent, February 2009.
[44] Infiltration in this sense is defined as the amount of water that enters the drainage system from other sources such as ingress of groundwater through defective pipes or joints in either public sewers or private sewers and drains.
[45] Flow to Full Treatment (FtFT) is the maximum rate of flow that can be treated at a WwTW.
[46] Severn Trent (2009) Draft Water Resources Management Plan – Statement of response to consultation, Severn Trent, February 2009.
[47] OFWAT (2008): Security of Supply Report 2006-2007.

Table 8-1: Summary of WwTW Within and Bordering the Black Country Study Area

	WwTW	Principle Local Authority	Receiving Watercourse	NGR	DWF Consent (m^3d^{-1})	WCS Assessed
Inside Study Area	Barnhurst	Wolverhampton	Shropshire Union Canal	SJ9000001650	47,500	✓
	Goscote	Walsall	Rough Brook	SK0219001920	24,900	✓
	Lower Gornal	Dudley	Bobs/Holbeche Brook	SO9020090910	8,500	✓
	Ray Hall	Sandwell	River Tame	SP0290093700	60,826[a]	✓
	Walsall Wood	Walsall	Ford Brook	SK0355003880	4,784	✓
	Willenhall	Walsall	River Tame (Wolverhampton Arm)	SO9796098160	14,000	✓
Outside Study Area	Cannock	-	Staffordshire & Worcestershire Canal	SJ9727008650	17,600	×
	Coven Heath	-	-	SJ9109004730	8,210	×
	Codsall	-	-	SJ8836003740	2,784	×
	Gospel End	-	-	SO9029094350	2,890	×
	Minworth	Birmingham	River Tame	SP1650092355	450,000	×
	Rugby	-	River Avon	SP4942076350	18,670	×
	Roundhill	-	Gallows Brook/River Stour	SO8708083820	59,836	✓
	Trescott	-	-	SO8549097630	6,460	×
	Wombourne	-	Smestow Brook	SO8559091980	3,289	✓

Note: a – Only Total Daily Flow was available for this WwTW and therefore for the purposes of the wastewater treatment assessment the flow has been converted into DWF.

8.3.4 Wastewater Treatment Volumetric Capacity

8.3.4.1 Current Volumetric Capacity

Headroom is calculated by determining the difference between the consented upper limit on DWF, and the DWF that the WwTW currently treats. Using the assumptions defined in Section 8.3.2, the number of future homes and population equivalent that could be accommodated in the future can be estimated, and when new infrastructure upgrades to the WwTW may be required. Dependent on the number of new housing being assessed, the spare capacity will vary because infiltration allowance (calculated as 25% of the population multiplied by the per capita consumption) increases with population, which further reduces the capacity.

The discharge consent information supplied by the Environment Agency indicates the current consented DWF, and from this, and using the population equivalent information provided by ST and the assumptions in Section 8.3.2, the volumetric (headroom) capacity for the five WwTWs has been estimated. The headroom in terms of the numbers of new dwellings that can be served at each of the works has also been calculated. A summary in terms of current volumetric capacity each of the works is provided below.

Table 8-2: Current WwTW Capacity

WwTW	DWF Consent (m^3d^{-1})	Calculated DWF (m^3d^{-1})	Headroom		
			%	DWF (m^3d^{-1})	Dwellings
Barnhurst	47,500	20,400	57%	27,100	67,925
Goscote	24,900	17,280	31%	7,620	19,100
Lower Gornal	8,500	5,425	36%	3,075	7,700
Ray Hall	60,826	13,225	78%	47,600	119,300
Roundhill[1]	59,836	46,725	22%	13,111	32,860
Walsall Wood	4,784	3,780	21%	1,004	2,515
Willenhall	14,000	6,610	53%	7,390	18,526
Wombourne[2]	3,289	-	-	-	-

Note: 1. No information was provided from this works so an estimated population, based on publicly available information, was used.
2. No information was provided for this WwTW

8.3.4.2 Barnhurst WwTW

Barnhurst WwTW has a DWF consent, and therefore volumetric capacity, of 47,500 m^3d^{-1}. The calculated DWF for the works is 20,400 m^3d^{-1}, giving rise to a headroom capacity of around 27,100 m^3d^{-1}, 57% of the current DWF consent. Using the assumptions provided in Section 8.3.2, this headroom is sufficient to allow the WwTW to treat flow from around 67,900 new homes before an upgrade or new WwTW will be required.

8.3.4.3 Goscote WwTW

Goscote WwTW has a DWF consent, and therefore volumetric capacity, of 24,900 m^3d^{-1}. The calculated DWF for the works is 17,280 m^3d^{-1}, giving rise to a headroom capacity of around 7,620 m^3d^{-1}, 31% of the current DWF consent. Using the assumptions provided in Section 8.3.2, this headroom is sufficient to allow the WwTW to treat flow from around 19,000 new homes before an upgrade or new WwTW will be required.

8.3.4.4 Lower Gornal WwTW

Lower Gornal WwTW has a DWF consent, and therefore volumetric capacity, of 8,500 m^3d^{-1}. The calculated DWF for the works is 5,425 m^3d^{-1}, giving rise to a headroom capacity of around 3,075 m^3d^{-1}, 36% of the current DWF consent. Using the assumptions provided in Section 8.3.2, this headroom is sufficient to allow the WwTW to treat flow from around 7,700 new homes before an upgrade or new WwTW will be required.

8.3.4.5 Ray Hall WwTW

Ray Hall WwTW has a DWF consent, and therefore volumetric capacity, of 60,826 m^3d^{-1}. The calculated DWF for the works is 13,225 m^3d^{-1}, giving rise to a headroom capacity of around 47,600 m^3d^{-1}, 21% of the current DWF consent. Using the assumptions provided in Section 8.3.2, this headroom is sufficient to allow the WwTW to treat flow from around 119,300 new homes before an upgrade or new WwTW will be required.

8.3.4.6 Roundhill WwTW

Roundhill WwTW has a DWF consent, and therefore volumetric capacity, of 59,836 m^3d^{-1}. The calculated DWF for the works is 46,725 m^3d^{-1}, giving rise to a headroom capacity of around 13,111 m^3d^{-1}, 22% of the current DWF consent. Using the assumptions provided in Section 8.3.2, this headroom is sufficient to allow the

WwTW to treat flow from around 32,860 new homes before an upgrade or new WwTW will be required.

8.3.4.7 Walsall Wood WwTW

Walsall Wood WwTW has a DWF consent, and therefore volumetric capacity, of 4,784 m^3d^{-1}. The calculated DWF for the works is 3,780 m^3d^{-1}, giving rise to a headroom capacity of around 1,004 m^3d^{-1}, 78% of the current DWF consent. Using the assumptions provided in Section 8.3.2, this headroom is sufficient to allow the WwTW to treat flow from around 2,515 new homes before an upgrade or new WwTW will be required.

8.3.4.8 Willenhall WwTW

Willenhall WwTW has a DWF consent, and therefore volumetric capacity, of 14,000 m^3d^{-1}. The calculated DWF for the works is 6,610 m^3d^{-1}, giving rise to a headroom capacity of around 7,390 m^3d^{-1}, 53% of the current DWF consent. Using the assumptions provided in Section 8.3.2, this headroom is sufficient to allow the WwTW to treat flow from around 18,256 new homes before an upgrade or new WwTW will be required.

8.3.4.9 Wombourne WwTW

Wombourne WwTW has a DWF consent, and therefore volumetric capacity, of 3,289 m^3d^{-1}. No information was made available to calculate the capacity of the works. The DWF consent at the works allows a total of 8,243 houses to be served by the works before an upgrade would be required.

8.3.4.10 Future Volumetric Capacity

As an indication of where potential future capacity constraints may exist, based on proposed housing and employment figures at the time of this study, a calculation of future capacity at the eight WwTWs has been undertaken making the following assumptions:

- Growth from Regeneration Corridors RC2 and RC3 and Strategic Centre SC1 (Wolverhampton) will be discharged to and treated at Barnhurst WwTW;
- Growth from Regeneration Corridors RC7 will be discharged to and treated at Goscote WwTW;
- Growth from Regeneration Corridors RC10 and RC11 and Strategic Centre SC3 (Brierley Hill) will be discharged to and treated at Lower Gornal WwTW;
- Growth from Regeneration Corridors RC8, RC9, RC12, RC16 and Strategic Centre SC2 (Walsall) will be discharged to and treated at Ray Hall WwTW;
- Growth from Regeneration Corridors RC11, RC13, RC14 and Strategic Centre SC3 (Brierley Hill) will be discharged to and treated at Roundhill WwTW;
- Growth from Regeneration Corridors RC15 will be discharged to and treated at Walsall Wood WwTW;
- Growth from Regeneration Corridors RC4, RC6 and Strategic Centre SC1 (Wolverhampton) will be discharged to and treated at Willenhall WwTW; and
- Growth from Regeneration Corridors RC11, RC13, RC14 and Strategic Centre SC3 (Brierley Hill) will be discharged to and treated at Wombourne WwTW.

Where growth from a regeneration corridor or strategic centre has been identified as falling within the catchment of more than one WwTW, the growth has been evenly split between the identified works.

The results of the capacity assessment are provided in Table 8-3. It is important to note that the future capacity assessment is only provided as an indication of potential future constraints at present and will need to be revisited at an early stage of the Detailed WCS. The assessment shows that there is adequate capacity at all works (where data has been made available) to accommodate the proposed growth

Table 8-3: Potential Future WwTW Capacity

WwTW	Development Areas	Proposed Growth	Future (2025) Capacity (%)	Headroom[1]	
		Dwellings		DWF (m^3d^{-1})	Dwellings
Barnhurst	RC2, RC3, SC1	3,202	54%	25,825	64,724
Goscote	RC7	765	29%	7,315	18,333
Lower Gornal	RC10, RC11, SC3	2,765	23%	1,971	4,940
Ray Hall	RC8, RC9, RC12, RC16, SC2	16,928	67%	40,846	102,371
Roundhill	RC11, RC13, RC14, SC3	8,657			
Walsall Wood	RC15	544	16%	787	1,972
Willenhall	RC4, RC6, SC1	7,277	32%	4,489	11,251
Wombourne[2]	RC10, RC11, SC3	2,764	-	-	-

Note: 1 - The headroom is calculated in terms of housing/dwellings only
2 - No information was provided for this WwTW

8.3.4.11 Assumption Sensitivity

The conclusions for the housing that can be accommodated by the existing capacity of the WwTW are sensitive to assumptions applied to the calculations, and in particular to the assumption applied to the per capita consumption and infiltration (which is calculated as 25% of the population consumption). With the publication of the Code for Sustainable Homes this is a considerable drive to move towards more water efficient developments where water consumption is reduced by a number of measures. A reduction in water usage would significantly reduce the wastewater generated from new properties which could result in more properties being able to be treated at the WwTWs using any existing headroom capacity. However, whilst water efficiency will reduce the volume of sewage produced from new housing, this will tend to increase the strength of the sewage. Consequently, as the volumetric capacity is increased, the biological capacity is reduced, and therefore the capacity at the works is not necessarily released for more housing as result of these measures.

Detailed trade flow information was not made available for this study by ST and therefore calculations have been based on provided trade population equivalent figures and the assumptions provided in Section 8.3.2. In terms of trade flow, the volume of wastewater generated is likely to be underestimated and therefore it is likely that there is less capacity at the WwTWs than that calculated. These assumptions will need to be revisited and assessed on a site by site basis as part of the Detailed WCS in conjunction with ST to confirm the current capacity at each of the works and the future capacity.

8.3.5 Wastewater Treatment Process Capacity

8.3.5.1 Legislation

There are several pieces of legislation which are relevant to WwTW's, of these the Urban Waste Water Treatment Directive (UWWTD) and Freshwater Fish Directive (FFD) are particularly important in terms of the setting of quality consents for WwTWs. Implications of new water classification and standards under the Water Framework Directive are discussed in Chapter 9.

8.3.5.2 Urban Waste Water Treatment Directive

The Urban Wastewater Treatment Directive (UWWTD) is designed to make sure all wastewater in the EU is treated to the appropriate standard. An essential element of the Directive is that quality standards for effluent fall into categories depending on size of the treatment works and the sensitivity of the receiving water. As populations grow in each sewerage catchment, some sewage treatment works may exceed the Urban Waste Water Treatment Directive threshold that requires nutrient removal.

For works discharging into a Sensitive Area (Eutrophic) a population equivalent exceeding 10,000 will require phosphate removal to a standard of 2 mgl^{-1} (as an annual average). If however the population equivalent is increased to exceed 100,000, then a tighter standard of 1 mgl^{-1} (as an annual average) phosphorous is required. It is clear that growth in some areas could result in tighter limits on the quality of the effluent and this could have implications for investment in new sewage treatment infrastructure.

8.3.5.3 Fresh Water Fish Directive

The Fresh Water Fish Directive is designed to protect fish from harmful chemicals such as ammonia. The East Midlands has a significant number of rivers designated under this Directive. Many sewage treatment works on rivers such as the Trent have already had major investment in order to meet the tight ammonia standards required in this Directive. Any new discharges into these rivers must also meet the Fresh Water Fish Directive standards. There may be implications for the capacity of current works and the cost of investment in new works.

8.3.5.4 Current Process Capacity

The consents for the eight WwTWs principally serving the Black Country have been supplied by the Environment Agency and are shown in Table 8-4.

Table 8-4: WwTW Quality Consents for Black Country

WwTW	DWF	BOD ATU as O2	Ammonia as N	Solids Suspended @ 105C	Phosphorus as P (by 2014)
		95%ile	95%ile	95%ile	Mean
	m^3d^{-1}	mgl^{-1}	mgl^{-1}	mgl^{-1}	mgl^{-1}
Barnhurst	47,500	10	3	15	1
Goscote	24,900	20	10	30	1
Lower Gornal	8,500	25	10	45	2
Ray Hall	60,826	25	3	45	1
Roundhill	59,836	10	5	20	1
Walsall Wood	4,784	25	10	45	2
Willenhall	14,000	20	-	30	2
Wombourne	3,289	20	10	40	-

These consents are likely to require tightening to meet the proposed WFD water quality standards under current conditions. Current Best Available Technology (BAT) consents are 5 mgl^{-1} BOD (95%ile), 1 mgl^{-1} Ammonia (95%ile) and 1 mgl^{-1} Phosphorus; with current technology it is not possible to treat effluent below this quality. Therefore works that are currently treating effluent close to BAT i.e. Barnhurst WwTW will have less capacity to treat further effluent flow to a tighter standard and therefore may need to seek alternative treatment options to deal with increased effluent discharges as a result of proposed development in the Black Country. This issue should be considered as part of the Detailed WCS with potential options ranging from membrane bioreactor (package treatment) options to lower the levels of BOD and ammonia (in particular), to considering the need for a new WwTW to serve future development. For an area where future development is planned, ST have an obligation to serve that development and therefore this issue should not prevent any related development, however the Detailed WCS would need to determine the most feasible and sustainable options.

Only Barnhurst and Roundhill WwTW currently have UWWTD schemes in place at the works but all other works will introduce UwWTD schemes over the next five years. This will see a Phosphorus consent of 1 mgl^{-1} being set at the larger works of Goscote and Ray Hall, and 2 mgl^{-1}at the smaller works of Lower Gornal, Walsall Wood and Willenhall. These may improve the water quality downstream of the works.

8.3.5.5 Future Process Capacity

The proposed growth in the Black Country is likely to require a tightening of consents even further than that identified above to ensure that 'good ecological status' is achieved and there is no deterioration in water quality downstream of the works as a result of increased effluent discharges. Due to the lack of data from ST and the EA, the required consents will need to be calculated as part of a Monte Carlo modelling exercise for the Detailed WCS, and the results discussed with ST and the Environment Agency to determine whether wastewater from future proposed growth in the Black Country can be adequately treated and discharged at the existing works without causing deterioration in the downstream water environment. The costs associated with any associated upgrades or treatment options will need to be assessed to help guide the decision of where and when future infrastructure to support growth identified in the Core Strategy can be accommodated within the Black Country.

A study produced by the West Midlands Regional Planning Body, Environment Agency and ST, in 2005 reviewed the capacity of WwTWs in the West Midlands to accommodate more houses. The study categorises large sewage treatment works into risk grouping based on the 2005 Environment Agency discharge consent limit. The works to the west of the region were assessed for BOD, ammonia and volume while to the east they were assessed for BOD and volume. This is because many works in the west of the region have an additional ammonia limit to protect fish in rivers designated as fisheries under the Fresh Water Fish Directive.

Table 8-5 shows the risk assessment for both flow and water quality based on increases to effluent discharges as a result of growth in the region. The assessment aimed to identify works which fell into the following two categories:

- The sewage treatment works is already producing a good quality effluent. It may be difficult to improve the quality still further with the current technology; and

- The sewage treatment works can not increase the volume of water discharged without an increase in the risk of downstream flooding.

Several WwTW's were of 'Low risk' or 'Medium risk; to changes in flow, but only two, (Lower Gornal and Walsall Wood) were of 'Low risk' to water quality. As a result, most WwTw's were classed as 'High risk', with process capacity seemingly the main issue to be addressed.

Table 8-5 Analysis of risks resulting from housing increases in the Black Country on watercourses from WwTW discharges

WwTW	Flow Risk	Water Quality Risk	Overall Risk
Barnhurst	L	H	H
Goscote	M	H	H
Lower Gornal	M	L	M
Ray Hall	M	H	H
Roundhill	M	H	H
Walsall Wood	M	L	M
Willenhall	L	H	H
Wombourne	M	L	M

8.4 Current Sewerage Network

Information has been provided by ST on the wastewater network serving the Black Country area.

A high level assessment of the wastewater network has been undertaken for each of the strategic centres and regeneration corridors based on projected housing growth figures provided in the Joint Core Strategy Preferred Options Report (2008) for each area (as described in Section 2). The outline assessment for each area is given in Table 8-6 The assessment does not take into account the capacity generated by demolition and therefore is based on the number of dwellings proposed for each regeneration corridor or strategic centre, a total of 42,900 dwellings.

Table 8-6: Wastewater Network Options and Possible Restrictions

Area No.	Name	Proposed No. of Dwellings	WwTW Serving the Area	Comments on Existing Wastewater Network & Possible Restrictions
SC1	Wolverhampton	2,400	Barnhurst & Willenhall	The area is located relatively close to Barnhurst WwTW and is served by a number of strategic sewers in the centre of the town which drain to both Barnhurst and Willenhall WwTW. There is flexibility to transfer to either catchment within existing pipe network and therefore the proposed development should be able to be accommodated within this area.
SC2	Walsall	500	Ray Hall	There is a relatively small amount of development planned for this area. The town is served by a number of strategic sewers is located relatively close to Ray Hall WwTW. The area is unlikely to require upgrades to the sewer network, but any proposed development and upgrades to the sewer network will need to be considered alongside RC7.
SC3	Brierley Hill	3,000	Lower Gornal & Wombourne & Roundhill	There is a reasonable level of development planned for this area which due to its location has the potential to drain to the three WwTWs of Lower Gornal, Wombourne and Roundhill. However, it is located at the upstream end of the Wombourne and Lower Gornal catchments which may make it difficult to support the planned level of development. If the development was planned to drain to Roundhill WwTW, then the impacts of the increased wastewater in the network will need to be assessed in combination with the proposed developments in RC11, RC13, RC14. A more detailed assessment will need to be carried out for this area as, unlike the other strategic centres, there are no existing strategic sewers serving the towns.
RC2	Stafford Road	1,173	Barnhurst	The area is located close to the Barnhurst WwTW and is served by an existing strategic sewer network. The area is likely to have the capacity to accommodate most of proposed development but this will need to be confirmed in a detailed assessment.
RC3	South of Wolverhampton City Centre	829	Barnhurst	The area is located at the upstream end of the sewer network that drains to Barnhurst WwTW and a relatively small volume of development is planned for the area. As there are strategic sewers there is the possibility that wastewater generated by the proposed development could be drained by these pipes.
RC4	Wolverhampton - Bilston	3,910	Willenhall	Given size of the development planned for this area and that it is located towards the top of the Willenhall WwTW catchment there may be a requirement for upgrades and reinforcements to the existing sewer network. Alternatively there may be the option for transfer between catchments to Barnhurst WwTW. These will need to be assessed as part of a detailed modelling exercise.
RC6	Wednesfield/ Willenhall/ Darlaston	2,167	Willenhall	The area is located close to Willenhall WwTW. There is an existing strategic sewer network throughout the area and this could have the potential to accommodate most of proposed development, which is likely to be dispersed across the relatively large development area.
RC7	Bloxwich/	1,530	Ray Hall &	The area is served by both Ray Hall and Gosote WwTWs providing the potential to link to either

Area No.	Name	Proposed No. of Dwellings	WwTW Serving the Area	Comments on Existing Wastewater Network & Possible Restrictions
	Birchills/ Bescot		Goscote	of these sewer networks. There is a large strategic sewer flowing through centre of area with the potential to add connections to this to serve the new development. However, the area is located at the top end of the Ray Hall WWTW and impacts on the downstream network will need to be assessed in conjunction with proposed development at Walsall (SC2).
RC8	Hill Top	5,160	Ray Hall	There is a large amount of development proposed for this area but it is likely that this will be spread out over quite a large area. There are existing strategic sewers serving the area and these drain to Ray Hall WwTW. Additionally the area is located relatively close to Ray Hall WwTW. The sewer capacity for this development will need to be assessed in combination with the proposed development upstream in RC9, RC12 and RC16 as these are likely to drain into the same strategic network.
RC9	Tipton/ Dudley Port/ Brades Village	5,228	Ray Hall	The area is located upstream of RC8 and therefore the capacity will need to be assessed in combination with the proposed development in the upstream RC12 and RC16 and the downstream RC8. There is a good coverage of strategic sewers throughout the area.
RC10	Pensnett/ Kingswinford	625	Lower Gornal & Wombourne	There is a relatively small amount of development planned for this area and the generated wastewater could drain to either Lower Gornal and/or Wombourne. It is likely that the proposed level of development will be able to be accommodated within the existing sewer network.
RC11	(North) Dudley – Brierley Hill - Stourbridge	4,356	Lower Gornal & Wombourne & Roundhill	There are several options for the distribution of wastewater in this development area. The area is located at the upstream end of Lower Gornal and Wombourne WwTW catchments and the downstream end of the Roundhill WwTW catchment. Development at southern end of the Roundhill sewer network will be relatively easy to accommodate within the existing sewer network which has a number of sizeable pipe connections. However, with the additional proposed development in RC13 and RC14, these pipes may need upgrading.
RC12	Oldbury/ West Bromich/ Smethwick	3,119	Ray Hall	The area is located at the upstream end of the sewer network that drains to Ray Hall WwTW. It is upstream of RC8 and RC9 and therefore the capacity within the downstream sewer network will be dependent on development from these areas and RC16 which drains into the same strategic sewer. A detailed network capacity assessment will need to be undertaken for these regeneration corridors to determine the existing capacity in the sewers and any required upgrades to the sewer network to accommodate the proposed level of development.
RC13	Rowley Regis – Jewellery Line	5,780	Roundhill	There is a significant level of development planned for this area which is located at the upstream end of the sewer network that drains to Roundhill WwTW. Upgrades of the sewer network may be required to accommodate the development. The existing capacity in the sewer network needs to be assessed in conjunction with development in RC14 (upstream) and RC11 (downstream) which drain to same sewer at the downstream end of catchment.

Area No.	Name	Proposed No. of Dwellings	WwTW Serving the Area	Comments on Existing Wastewater Network & Possible Restrictions
RC14	Coombs Wood – Halesowen	425	Roundhill	The area is located upstream of RC14 and is located at the upstream end of the sewer network that drains to Roundhill WwTW. Therefore the capacity will need to be assessed in combination with the proposed development in RC13 and RC11 which are located downstream.
RC15	Brownhills	544	Walsall Wood	The area is located close to Walsall Wood WwTW and there are existing connections to the sewer network. The small volume of development planned for this area means that it is likely that there will be existing capacity in the sewer network to accommodate the development.
RC16	Cosley – Tipton – Princes End	2,154	Ray Hall	The area is located at the upstream end of the sewer network that drains to Ray Hall WwTW. There is also the potential to connect to sewer network that drains to Willenhall WwTW. Capacity within the existing sewer network needs to be assessed for this development area alongside proposed development in RC8, RC9 and RC12 which drain into the same sewer downstream.

A summary of the main points of the wastewater network capacity assessment are as follows;

- The urban nature of the Black Country means that there is a good coverage of existing strategic sewers across the study area. However, any upgrades to the existing sewer network are likely to need to pass through already developed areas which can be relatively expensive and the timescales for delivery of this could be relatively long;
- A detailed modelling exercise should be undertaken for all regeneration corridor and strategic development areas to assess the current capacity within the existing sewer network;
- Key strategic upgrades are likely to be required to deliver the significant development in RC8, RC9, RC12 and RC16. These will feed into the same sewer network which drains to Ray Hall WwTW and therefore development within these areas needs to be assessed in combination through a detailed modelling exercise to determine existing capacity within the sewer network serving these areas and the potential to accommodate the proposed development;
- A significant volume of development is planned for RC11, RC13 and RC14 which will feed into the sewer network that drains to Roundhill WwTW. Key strategic upgrades are likely to be required to deliver development in these areas which feed into sewer network that drains to Roundhill WwTW. Development within these areas needs to be assessed in combination through a detailed modelling exercise to determine existing capacity within the sewer network serving these areas and the potential to accommodate the proposed development;
- The Strategic Centre of Brierley Hill is likely to require key strategic upgrades to the sewer network to deliver the proposed development. Whilst the proposed area has the potential to drain to the three WwTWs of Lower Gornal, Wombourne and Roundhill, the town is located at the upstream end of these catchments and, unlike the other strategic centres, does not currently have a large strategic sewer network.

Given the nature of difficulty in providing upgrades to the sewer network within the Black Country, a key component of the Detailed WCS should be the modelling of the sewer network for the regeneration corridor and strategic centres to confirm the capacity within the existing sewer network. In particular development planned to drain to Ray Hall and Roundhill WwTWs should be investigated along with the wastewater drainage options for the Strategic Centre development of Brierley Hill. The modelling exercise and wastewater capacity assessment will need to be undertaken in conjunction, and agreed, with ST.

8.5 Wastewater Treatment and Collection Summary

- There are six WwTWs located within the study area and a further eight bordering the area. Eight of these works have been identified as potentially being impacted by proposed development within the study area and have therefore been assessed as part of the Outline WCS;
- Only limited information has been made available by ST for this assessment;

- All WwTWs (where information was available to undertake the assessment) have sizeable spare capacity to treat flows from new development in the area. However, no detailed information on trade flow was provided and therefore the assumptions that have been made as part of this assessment will need to be revisited in the Detailed WCS to refine the calculated volumetric capacity at the WwTWs;

- The existing sewer network has been used to identify the volume of proposed development that is likely to be served by each of the WwTWs and this has been used to calculate the future wastewater flows to be treated at the works and therefore future capacity;

- Based on the proposed housing development in the area, all WwTWs have the capacity to treat the new development without requiring any upgrades to the existing wastewater treatment works (in terms of volumetric capacity);

- WwTW quality consents are likely to require tightening under the WFD and as a result of the proposed growth within the area to comply with WFD standards. Some of the consents, particularly at Barnhurst WwTW are already close to BAT and therefore alternative treatment options may be needed to treat the additional effluent generated from the proposed development in the study area. A Monte Carlo modelling exercise will need to be carried out as part of the Detailed WCS to determine the future consents required under the WFD for future effluent discharges; and

- The wastewater network assessment showed that there is a good coverage of existing strategic sewers across the study area which will facilitate new connections to the existing network. However, detailed modelling will need to be undertaken to assess the capacity in the network especially in areas where more than one regeneration corridor will feed into the same sewer i.e. Ray Hill and Roundhill catchments, or the area does not currently have an existing strategic network but significant growth is planned, i.e. Brierley Hill.

9 Water Quality

9.1 Introduction

Discharge of new, or additional, treated wastewater from the proposed growth areas could have a detrimental impact on the water quality of receiving waters. A review of water quality in the WCS is therefore important to ensure that:

- The water related environment has the capacity to absorb further discharges to the receiving watercourse;
- There is no unacceptable deterioration in the quality of the water related environment as a result of the development; and
- Any water quality mitigation measures are planned in a strategic manner.

The aim of assessing the current and potential water quality of watercourses within and surrounding the Black Country is to identify the current water quality situation and the potential impacts the development may have on this and the surrounding water environment.

Given the large area of the Black Country, and several catchments, this assessment will be an overview of the main water quality issues, focussing specifically on a high–level assessment of water quality impacts from the main Wastewater Treatment Works (WwTW) as identified in Chapter 8.

9.2 Current Water Quality Baseline

9.2.1 Introduction

9.2.1.1 Environment Agency's River Ecosystem Classification and General Quality Assessment

Historically the Environment Agency have used River Quality Objectives (RQOs), planned targets for water quality, to help protect and improve the quality of the water in watercourses. The principal non-statutory RQO system is the River Ecosystem (RE) Classification scheme which comprises five hierarchical classes in order of decreasing quality, ranging from 'very good quality' to 'poor quality' (Table 9-1). Each stretch of river is given a RE target such that if the river achieves this target it means that the river will be of adequate quality to support the required ecosystem.

Table 9-1: Environment Agency's River Ecosystem Classification Summary

Class	Quality	Description/Use
RE1	Very good quality	Suitable for all fish species
RE2	Good quality	Suitable for all fish species
RE3	Fairly good quality	Suitable for high-class coarse fisheries
RE4	Fair quality	Suitable for course fisheries
RE5	Poor quality	Likely to limit fish populations

Whereas the Environment Agency use RQOs for planning purposes (i.e. for setting water quality targets and assessing compliance with those targets), the General Quality Assessment (GQA) scheme is designed to provide an assessment of the general state of water quality and changes in this state over time. The GQA scheme comprises several separate aspects of water quality falling under chemical (inc. nutrients) and biological monitoring and assessment (Table 9-2). A monitoring programme at a set number of sites has been undertaken on a monthly basis to assess the quality of individual stretches of river.

Table 9-2: General Quality Assessment (GQA) Classes for Chemistry and Biology

Chemistry Assessment			Biology Assessment		
Grade	**Quality**	**Likely Uses and Characteristics[48]**	**Grade**	**Quality**	**Description**
A	Very Good	• All abstractions • Very good salmonid fisheries • Salmonid fisheries • Cyprinid fisheries • Natural ecosystems	A	Very Good	• Biology similar to that expected for an unpolluted river
B	Good	• All abstractions • Cyprinid fisheries • Ecosystems at or close to natural	B	Good	• Biology is a little short of an unpolluted river
C	Fairly Good	• Potable supply after advanced treatment • Other abstractions • Good cyprinid fisheries • Natural ecosystems, or those corresponding to good cyprinid • Fisheries	C	Fairly Good	• Biology worse than expected for unpolluted river
D	Fair	• Potable supply after advanced treatment • Other abstractions • Fair cyprinid fisheries • Impacted ecosystems	D	Fair	• A range of pollution tolerant species present
E	Poor	• Low grade abstraction for industry • Fish absent or sporadically present, vulnerable to pollution[49] • Impoverished ecosystems[50]	E	Poor	• Biology restricted to pollution tolerant species
F	Bad	• Very polluted rivers which may cause nuisance • Severely restricted ecosystems	F	Bad	• Biology limited to a small number of species very tolerant of pollution

[48] Provided other standards are met
[49] Where the grade is caused by discharges of organic pollution

[50] As footnote 5

As well as the chemical and biological quality, river systems are also sampled to determine the concentration of nutrients in given reaches. Excessive nutrients (especially phosphorus) can allow eutrophication if other factors are not limiting. This allows nuisance species such as algae to proliferate at an undesirable level and at the expense of other aquatic life which rely on the system (fish and aquatic plants); the overall effect is to reduce biodiversity. The two most important nutrients in terms of eutrophication are nitrogen (N) and phosphorus (P); these are each assessed using a separate GQA grade (Table 9-3).

Table 9-3: General Quality Assessment (GQA) Classes for Nutrients

Nitrate Grades	Grade limit (mg NO3/l) (Mean)	Description	Phosphate Grades	Grade limit (mg P/l) (Mean)	Description
1	5	Very Low	1	0.02	Very Low
2	10	Low	2	0.06	Low
3	20	Moderately Low	3	0.1	Moderate
4	30	Moderate	4	0.2	High
5	40	High	5	1.0	Very High
6	>40	Very High	6	>1.0	Excessively High

Nutrient concentrations in rivers exhibit considerable spatial and seasonal variability, and in common with other GQA sampling, monthly 'grab' samples will not reflect the true temporal variation. Storm events, for example, can mobilise nutrients from several sources and transient, but potentially very important, large concentrations of substances such as N and P will not be captured by monthly sampling regimes. There are also seasonal effects, such as a natural 'flush' of nitrate from soil during early autumn as the soil reaches field capacity and field drains begin to flow.

A grade from 1 to 6 is derived for both phosphate and nitrate based on the average concentration over the previous three years. There are no set 'good' or 'bad' concentrations for nutrients in rivers in the way that is used to describe chemical and biological quality. Rivers in different parts of the country have naturally different concentrations of nutrients. 'Very low' nutrient concentrations, for example, are not necessarily good or bad; the classifications merely state that concentrations in this river are very low relative to other rivers.

Of all forms of P, it is desirable to determine the concentrations of Soluble Reactive Phosphorus (SRP) as this form of P is most immediately available to aquatic macrophytes and algae. Phosphorus is usually the limiting nutrient in inland freshwaters and gives an indication of the likelihood of eutrophication within a water environment.

9.2.1.2 Freshwater Fish Directive

As well as the RE Classification scheme and GQA, waters are also designated and assessed against the Freshwater Fish Directive. The EC Freshwater Fish Directive (78/659/EEC) was adopted in 1978 and updated in 2006 (2006/44/EC), and seeks to protect those fresh water bodies identified by Member States as waters suitable for sustaining fish populations51. For those waters it sets physical and chemical water quality objectives for salmonid and cyprinid waters:

[51] Further information on the EC Freshwater Fish Directive (78/659/EEC) can be found at http://www.defra.gov.uk/environment/water/quality/fwfish/

- **Salmonid fish** (salmon and trout) - these are generally fast flowing stretches of river that have a high oxygen content and a low level of nutrients; and
- **Cyprinid fish** (coarse fish - carp, tench, barbel, rudd, roach) - these are slower flowing waters, that often flow through lowlands.

The Directive sets different standards for salmonid and cyprinid.. There are two types of standards within each water category:

- **Imperative values -** these are standards that must be met if the stretch is to pass the Directive (for the stretch to be 'compliant'). Values have been set for dissolved oxygen, pH, non-ionised ammonia, total ammonium, total residual chlorine, zinc and (for thermal discharges) temperature; and
- **Guideline values -** these are quality standards that should be achieved where possible. Values have been set here for other chemical parameters, such as copper, biochemical oxygen demand and suspended solids.

In 2013, this directive will be repealed and waters currently designated as Fish Directive waters will become protected areas under the Water Framework Directive.

9.2.2 Baseline Assessment

Water quality within surface water systems has the potential to be affected primarily by increases in effluent discharges from WwTWs and urban diffuse runoff as a result of development within the catchment. Therefore, water quality assessment and baseline has been focused on those stretches of main river[52] likely to be impacted by development, i.e. downstream of WwTWs and near major development areas.

There are six WwTWs in the Black Country study area: Barnhurst, Goscote, Lower Gornal, Ray Hall, Walsall Wood and Willenhall. These discharge into watercourses as shown in Table 9-4 respectively. The River Stour (Roundhill STW to Cookley Road Bridge) and Smestow Brook are both designated Cyprinid Fisheries.

Recent RE compliance information and GQA grades for the river stretches upstream and downstream of the WwTWs are reported in Table 9-4, covering three most recent reporting periods i.e. the 2007 reporting period covers the period 2005 – 2007; 2006 period the period 2004 – 2006.

[52] Under the Water Resources Act, 1991, the Environment Agency has powers to maintain and improve 'main rivers' for the efficient passage of flood flow and the management of water levels. These powers are permissive only, so there is no obligation on the Environment Agency to carry out either maintenance or new works on main river. Main rivers are usually larger streams and rivers, but also include smaller watercourses of strategic drainage importance. The Environment Agency's powers to carry out flood defence apply to main river only. The riparian landowner is ultimately responsible for the maintenance of the watercourse.

Table 9-4: Water Quality Assessment for Rivers in the Black Country

Stretch	River	Year	Chemistry	Biology	Nitrates	Phosphates	RQO Compliant
Atherley Jn to Pendeford Br *(d/s Barnhurst WwTW)*	Shropshire Union Canal	2007	D	E	6	6	-
		2006	C	C	6	6	✓
		2005	D	C	6	6	✓
Slacky Ln Br. To Conf. Ford Bk *(d/s/ Goscote WwTW)*	Rough Brook	2007	C	-	6	6	-
		2006	C	-	6	6	✓
		2005	D	-	6	6	✓
L.Gornal Outfall To Bobs/Holbeche Conf *(d/s Lower Gornal WwTW)*	Bobs/ Holbeche Bk	2007	E	-	6	6	-
		2006	E	-	6	6	✓
		2005	E	-	6	6	✓
Junction Of Arms - Bescot To Sandwell Pk *(d/s Ray Hall WwTW)*	River Tame	2007	E	E	5	6	-
		2006	E	E	5	6	✓
		2005	E	E	5	6	✓
Roundhill Stw To Cookley Road Br *(d/s Roundhill WwTW)*	Gallows Bk, River Stour	2007	B	D	6	6	-
		2006	B	D	6	6	✓
		2005	B	D	6	6	✓
Walsall Wood Stw to Conf. Rough Bk *(d/s Walsall Wood WwTW)*	Ford Bk	2007	E	E	6	6	-
		2006	E	E	6	6	✓
		2005	E	E	6	6	✓
Westacre Willenhall To Conf. Ford Bk *(d/s Willenhall WwTW)*	River Tame (Wolverhampton Arm)	2007	E	-	4	5	-
		2006	E	-	4	5	✓
		2005	D	-	4	5	✓
Conf Wom Bk To Conf Bobs Bk *(d/s Wombourne WwTW)*	Smestow Bk	2007	C	C	6	6	-
		2006	C	C	6	6	✓
		2005	C	C	6	6	✓

Table 9-4 shows that, in general, water quality is poor downstream of the WwTWs. The GQA grades confirm that overall chemical quality (for BOD, Ammonia and Dissolved Oxygen (DO)) and biological quality range between 'fairly good' and 'poor'. However, all river stretches were compliant with River Quality Objectives during the reporting periods.

Nutrient concentrations are high in all watercourses, which could be attributed to the industrial nature of the catchment, poor quality urban runoff and the number of WwTWs discharging into the catchment.

9.3 Water Framework Directive (WFD)

9.3.1 WFD Introduction

The Water Framework Directive (WFD) was passed into UK law in 2003. The competent authority responsible for its implementation is the EA in England and Wales. The overall requirement of the directive is that all water bodies in the UK must achieve "good ecological and good chemical status" by 2015 unless there are grounds for derogation.

The WFD will for the first time combine water quantity and water quality issues together. The directive combines previous water legislation and in certain areas strengthens existing legislation. An integrated approach to the management of all freshwater bodies, groundwaters, estuaries and coastal waters at the river basin

level will be adopted. Involvement of stakeholders is seen as key to the success in achieving the tight timescales and objectives set by the directive. The WFD states that all countries in the European Union have to:

- prevent deterioration in the classification status of aquatic ecosystems, protect them and improve the ecological condition of waters;
- aim to achieve at least good status for all waters. Where this is not possible, good status should be achieved by 2021 or 2027;
- promote sustainable use of water as a natural resource;
- conserve habitats and species that depend directly on water;
- progressively reduce or phase out releases of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment;
- progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants; and
- contribute to mitigating the effects of floods and droughts.

The water environment within England and Wales has been divided into units called 'water bodies' and designated as rivers, lakes, estuaries, the coast or groundwater. Some water bodies have been designated as artificial or heavily modified if they are substantially modified or created for water supply, urban purposes, flood protection and navigation. This designation is important because it recognises their uses, whilst making sure that ecology is protected as far as possible. All water bodies will be designated a status. For surface waters, the status has an ecological and a chemical component; Ecological status is measured on the scale high, good, moderate, poor and bad; and good chemical status as pass or fail. For groundwater, good status has a quantitative and a chemical component, which together provide a single final classification: good or poor status. Good ecological status is defined as a slight variation from undisturbed natural conditions, but artificial and heavily modified waters are not able to achieve natural conditions. Instead the target for these waters is good ecological potential. This is also measured on the scale high, good, moderate, poor and bad. The chemical status of these water bodies is measured in the same way as natural water bodies.

Standards are being developed with which to measure status covering a range of criteria including water quality, biological quality, and morphology. As stated, the aim is for all water bodies to reach 'good status' or higher by 2015. In order to do so, the EA are developing a series of River Basin Management Plans (RBMPs) for the major river basins in England and Wales. The draft RBMPs, which sets out detailed proposals for the next 6 years, were published on 22nd December 2008 and contain the Programme of Measures to bring about the changes necessary in order to bring the water bodies which are currently failing the required standards up to good status. The measures in the draft plans have been developed with the assistance of the River Basin Liaison Panels, and include Government and EA actions, as well as actions delivered by others. The River Liaison Panels include representatives from businesses, planning authorities, environmental organisations, agriculture, forestry, consumers, fishing bodies, ports, drainage boards and regional government, which will all have key roles to play in implementing the plan. The draft plans were the subject of a six-month consultation which closed on 22nd June 2008. The final versions of the RBMPs are due to be published in December 2009.

The draft RBMP focus on achieving the protection, improvement and sustainable use of the water environment including surface freshwaters (lakes, streams and rivers), groundwater, ecosystems such as some wetlands that depend on groundwater, estuaries and coastal waters (out to one nautical mile). The draft plans set out the proposed measures to improve water quality to the required standard and achieve the set environmental objectives. The WFD allows the EA, where costs would be disproportionate or where it isn't technically feasible to achieve the objectives by 2015, to work on a longer timescale (to 2021 or 2027) or to set lesser objectives, provided certain conditions are met.

The WFD water quality standards are currently in draft form and will not be finalised until the RBMPs are published in December 2009. However, because the WFD requirements will largely supersede the current statutory and guideline environmental standards from 2010, it is important that the WCS considers the requirements for meeting them such that the impact of growth on future compliance with legislative requirements is understood and can be managed at an early stage in the planning.

The EA's current system of measurement, the General Quality Assessment (GQA), shows over 70% of rivers in England and Wales are currently achieving a good standard. Under the new WFD classification system this figure falls to 23% of water bodies achieving good status. This is a result of revised standards and a larger number of standards to be assessed, in combination with a principle of 'one-out, all-out'; i.e. a waterbody is now classed according to its lowest scoring standard. A large proportion of failures are known to be caused by one or two parameters, with phosphorus causing a significant number of failures.

On that basis, the plans in their current form would bring the number of water bodies meeting good status to 28% by 2015. Some quite substantial improvements will be masked by that apparently modest degree of achievement. Many water bodies will improve significantly, maybe even from one class to another, without yet getting to good status, and many may only fail to reach good because of perhaps one indicator in future compared with several at present.

9.3.2 WFD Standards

In terms of water quality standards, the EA's current GQA programme has been very successful, particularly in assessing the impact of point source discharges on watercourses. In conjunction with the Urban Wastewater Treatment Directive (UWWTD), investment to the larger WwTWs has improved discharges considerably. There are still problems however, particularly with regards to rural sources including agricultural diffuse pollution (mainly nutrients, sediment, pesticides), smaller WwTWs, industry, urban areas and roads which can all affect water quality.

In relation to development considered in this WCS, the key concerns are water availability, quantity and quality of runoff from urban areas and roads, and discharges from domestic houses, and diffuse pollution from agriculture and rural areas. These can all have a large impact on the water environment, and are interrelated. For example, river flow can affect concentrations of substances such as nitrate. However, existing schemes do not adequately assess the impact of such sources. In particular, they do not quantify the effect on the aquatic environment.

The WFD classifies water in a different way, using new and revised environmental standards to assess whether environmental conditions are good enough to support

appropriate aquatic life for the system in question. The Directive requires that all inland and coastal water bodies reach at least "good" status by 2015 – subject to certain exemptions, which allow alternative objectives to be set in cases where it is infeasible or disproportionately expensive to achieve good status.

From 2007 to 2009, England and Wales will continue to report results based on the GQA monitoring system, with separate indicators for biology and chemistry. In England, however, a reduced network will be used, so that resources can be re-directed to implementing the WFD monitoring programme. During this time, the existing GQA and WFD approaches will report in parallel. This will enable differences between the two approaches to be distinguished.

The status of each surface water body is judged using separate 'Ecological classification' and 'Chemical classification' systems. The overall status of the water body will be determined by whichever of these is the poorer. To achieve 'good status' overall, a water body must achieve both good ecological and good chemical status.

9.3.2.1 Ecological Classification

The Ecological classification system has five classes, from high through good, moderate, poor to bad, and uses biological, physico-chemical, hydromorphological and chemical assessments of status as follows;

- Biological assessment uses numeric measures of communities of plants and animals (e.g. fish and rooted plants);
- Physico-chemical assessment documents parameters such as temperature and nutrient concentrations; and
- Hydromorphological assessment to document water flow and physical habitat.

The standards will differ based on the 'typology' of each water body; rivers, lakes, transitional and coastal waters, groundwater. The general typology for rivers is based on alkalinity and altitude.

9.3.2.2 Nutrients

The impacts of elevated concentrations of nutrients in freshwater systems, especially phosphorus, are widely studied. The most common impact is enhanced growth of plants and algae, which can affect watercourses in several ways. River channels can become blocked, exacerbating low flow conditions; diurnal fluctuations of oxygen content in the water can occur due to respiration of macrophytes during the hours of darkness, potentially affecting fish; growths of blue-green algae can be stimulated which can cause adverse affects in animals.

For revised nutrient standards in rivers, UKTAG identified that ecological sensitivity could be related to alkalinity and altitude.

Diatoms show greater sensitivity to nutrients than macrophytes, and these were subsequently used to develop the standards shown in Table 9-5, which also includes GQA and Habitats Directive guideline values.

Table 9-5 Phosphorus Standards in Rivers under WFD Standards, Existing GQA Guidelines and Habitats Directive, for Comparison

	SRP[53] (μgl^{-1}) (annual mean) under WFD			
Type	**High**	**Good**	**Moderate**	**Poor**
1n	30	50	150	500
2n	20	40	150	500
3n & 4n	50	120	250	1,000

	SRP (μgl^{-1}) (annual mean) under Existing GQA Guidelines				
	1	**2**	**3**	**4**	**5**
	20	60	100	200	1,000
	Very low	Low	Moderate	High	Very high

	SRP (μgl^{-1}) (annual mean) under Habitats Directive		
	Headwaters	**Most rivers**	**Large rivers**
Natural (1)	0-20	20-30	20-30
Guideline (2)	20-60	40-100	60-100
Threshold (3)	40-100	60-200	100-200

UKTAG recognise that the relationship between nutrients and water quality is not straightforward. Thus, it is recommended that an indication of 'actual or potential' biological impact is needed in addition to finding large concentrations of SRP.

Nitrate is already covered by legislation which proscribes a Statutory Limit of 50 mg $NO3l^{-1}$ (11.3 mg $NO3\text{-}Nl^{-1}$) as described previously. However, these limits are largely based on protection of freshwater for the purposes of drinking water. UKTAG consider that although nitrate may have a role in eutrophication in some types of freshwaters, there is insufficient understanding for new standards or conditions. For this reason, no new standards for nitrate in water have been recommended.

One of the key objectives of the WFD is to 'prevent deterioration of the status of all water bodies of surface water'. This states that there should be a prevention of deterioration between status classes, which applies to each water body. The status class reported for a surface water body will be dictated by the quality element worst affected by human activity. However, a 'less stringent objective' does not mean that:

(a) the other quality elements are permitted to deteriorate to the status dictated by the worst affected quality element; or

(b) the potential for improvement in the condition of other quality elements can be ignored[54].

Tighter standards under the WFD are likely to require a tightening of consents and reduction in diffuse sources.

9.3.3 WFD and Black Country

Past and present activities within the river catchments put pressures on the water environment. Rural land management is a source of diffuse pollution from nutrients, sediments and pesticides. Sewage treatment works and other intermittent discharges from the sewerage network also increase nutrient levels whilst these and other point sources increase the pressure from ammonia and dangerous

[53] SRP = soluble reactive phosphorus, relating to the P which is readily available for uptake by organisms
[54] EU Commission, 2005

substances. Run-off and drainage from urban areas can contain a range of pollutants whilst historic mining activity has left a legacy of metal and other pollution. Abstractions from rivers and groundwaters for public water supply and to a lesser extent for industry and agriculture can impact on river flows and groundwater levels. Many rivers and lakes have been subject to some form of physical modification which have had negative impacts on habitats and wildlife.

Under the WFD, the Black Country falls within the Humber and Severn River Basin Districts (RBD). The draft Humber RBMP was published on 22 December 2008 and sets out detailed proposals for the next six years and beyond, to be refined as an iterative response model. Amongst the components of the Draft Humber RBMP is to 'lower the impact of transport and built environments'.

The main causes of the problem have been linked to:

- Flood defences – for example with artificial river embankments;
- Housing growth, leading to pressures on water quality and water resources;
- Leaks from sewerage systems and private sewage treatment works;
- Discharge of industrial waste containing organic matter;
- Using fertilisers and pesticides in parks and gardens; and
- Run-off from roads, driveways, car parks, car washing, contaminated land.

The draft Humber RBMP also notes that: "The main responsibility for implementing measures that will contribute to lowering the impact of transport and the built environment will fall on a number of different sectors including urban and transport, the water industry and the construction industry. A significant lead will have to be provided by Local Government, particularly LPAs. The Regional Planning Body (RPB) will have a significant role to play in ensuring that the RSS and proposed Integrated Regional Strategy actively seek to endorse the requirements of the WFD and promote sustainable development across the River Basin District." (EA, 2008).

A description of the main catchments in the Black Country are taken from the respective WFD draft RBMP's in Box 9.1 and Box 9.2.

Box 9.1 Description of catchments in the Black Country from the draft Severn RBMP

Worcestershire Middle Severn Catchment (Severn RBD)
"The Worcestershire Middle Severn catchment is predominantly rural, but contains significant urban areas including parts of Telford, Wolverhampton, Dudley, Kidderminster and Worcester. As well as the River Severn itself, the main watercourses are the rivers Worfe, Stour and Salwarpe which are subject to unsustainable levels of abstraction at low flows. The area has many water dependent sites protected for their biodiversity and designated Sites of Special Scientific Interest. There are also two Special Areas of Conservation (SAC).

Proposed actions to tackle the issues in the catchment include improvements to discharges at a number of sewage treatment works to reduce inputs of ammonia and phosphorus, the provision of advice to farmers to reduce the levels of nutrients and sediments entering watercourses and various actions to improve the management of water resources. There are also a number of investigations ongoing to assess the impacts of abstraction on the environment.

Currently 10km (2%) of river length assessed in this catchment are achieving good ecological status or potential. The elements most commonly preventing good status in all water bodies by 2015 are phosphorus and invertebrates. 48km (9%) of river has yet to be assessed."

Source: EA, 2008

Box 9.2 Description of catchments in the Black Country from the draft Humber RBMP

Tame, Anker and Mease Catchment (Humber RBD)
"This area includes the Rivers Tame, Anker, Mease, Sence, Rea, Cole and Blythe and the Trent from its confluence with the River Tame to the River Dove. The rivers pass through the urban areas of Birmingham, Solihull, Nuneaton, Tamworth and Burton-on-Trent.

Heavy industry in the area has declined over recent years but pockets remain in urban areas. To the east and the north much of the land outside the Birmingham conurbation is used for agriculture, particularly arable farming.

Due to the highly urbanised nature of a large part of the catchment the largest inputs to the system come from sewage treatment works. During low flow periods a large proportion of the river flows are made up of these discharges. By far the largest input comes from Minworth Sewage Treatment Works (STW) which discharges treated effluent from Birmingham into the River Tame at Water Orton. As the water supply for Birmingham comes from the Severn catchment the Tame catchment is a net importer of water. Water pumped from quarries constitutes the second largest input of water into the catchment. Discharges from other sources make up very little of the total volume in comparison to these two contributors. However discharges of trade effluent, cooling water, effluent from a fish hatchery and treated minewater also make up river flow.

Many collieries have closed in recent years due to the decline in coal mining which means that minewater needs to be carefully managed, particularly in the South Derbyshire and Warwickshire coalfields. Water quality has improved in recent years. This is a result of investments to improve sewage works and a reduction in the number of combined sewer overflows in addition to tighter regulations on discharges.

The major use of water in the Burton area is for brewing, mineral washing, cooling water and dust suppression are also purposes for which water is abstracted within the catchment. These reflect the number of quarries, particularly for gravel, in the catchment and the occurrence of power stations along the Trent.

Poor water quality has been the main impact on the fisheries in the River Tame for the last century. Parts of the River Tame (downstream of the River Rea), the River Blythe and the River Cole are designated as Cyprinid Fisheries. Six miles of the River Sence are managed as a trout fishery. Adult salmon are currently returning to the River Dove at the downstream end of this section of the Trent so flows are important to stimulate and facilitate this migration. This whole catchment is a very important angling leisure resource for the highly populated area which it serves, including the thousands of anglers comprising some 80 or more clubs and individuals.

The River Mease is a small lowland river designated as a Special Area of Conservation under the Habitats Directive as a result of the presence of bullhead (Cottus gobio), spined loach (Cobitis taenia), otters and crowfoot beds (Ranunculus). The River Blythe is a Site of Special Scientific Interest designated as a fine example of a lowland river on clay.

More than 72,000 new houses are planned in the Regional Spatial Strategy for this catchment mainly in the areas around Birmingham, the Black Country, Burton and Tamworth, although these figures are still being finalised.

Currently 0% of surface water bodies in this catchment are achieving either good status or potential. We are proposing that by 2015, no deterioration will take place and improvements to 49% will be made by 2027. All water bodies in this catchment have been assessed."

Source: EA, 2008b

Table 9-6 provides a summary of the WFD assessment for watercourses likely to be impacted by proposed growth within the Black Country. Four of the watercourses are designated as candidate Heavily Modified Water Bodies, with the

Shropshire Union Canal being classed as candidate Artificial. None of the water bodies currently achieve 'good ecological status'

None of the surface water bodies assessed as part of this catchment currently achieve 'good ecological status' or 'good ecological potential' under the WFD. Measures proposed to address this and improve water quality would still result in the majority failing by 2015, the date set by the WFD by which the water bodies should be achieving 'good ecological status' or 'good ecological potential'. Biological quality and orthophosphate is generally classed as poor or bad throughout the catchment. Even with proposed measures it is unlikely that the phosphate concentrations will be sufficiently lowered by 2015 to reach 'good ecological status' or 'potential'. The phosphate standards are particularly onerous and will require a range of planned and further measures and/or controls for point and diffuse sources. However, it should be noted that further investigations may be required to assess whether the higher recorded concentrations of phosphates are actually having negative impacts on the natural environment.

The current GQA water quality assessment showed that water quality within the Black Country is currently of fairly poor quality, but compliant with current river quality targets, and the WFD assessment concurs with this. However, the WFD imposes more stringent requirements on the watercourses and therefore though the majority of the watercourses are heavily modified, they still need to reach 'good ecological improvement' by 2015 or 2027. Assessing the impacts of future growth on river quality is particularly difficult in these circumstances. All future discharges will need to comply with the WFD's aim to meet 'good ecological status' or 'potential' and other measures may be in place within the catchment to address existing water quality problems. It is likely that future growth at WwTWs will tighten existing consents to comply with the objectives of the WFD. This will need to be assessed as part of the Detailed WCS. Alongside this it is recommended that the Stage 2 WCS considers the overall catchment considerations for improving water quality in the Black Country area by making use of, or building on, previous water quality based modelling where available.

Table 9-6: WFD Assessment Summary

WB ID	Name of River Stretch	Des.	Current Overall Status	Current Ecological Status	Current Chemical Status	Biological	Ammonia	Ortho-phosphate	Dissolved Oxygen
GB70410256	Shropshire Union Canal, Wolverhampton to Belvide Reservoir feeder (d/s Barnhurst WwTW)	cA	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GB104028046990	Ford Brook from Source to River Tame (d/s Goscote & Walsall Wood WwTW)	cHMWB	Moderate	Moderate	Good	Poor	Moderate	Moderate	Bad
GB109054044830	Bobs-Holbeche Bk - source to conf Smestow Bk (d/s Lower Gornal WwTW)	-	Bad	Bad	Good	Bad	Bad	Poor	High
GB104028046840	River Tame from Conf of two arms to R Blythe (d/s Ray Hall WwTW)	cHMWB	Moderate	Moderate	Not Good	Bad	Moderate	Bad	Poor
GB109054044710	R Stour (Worcs) - conf Smestow Bk to conf R Severn (d/s Roundhill WwTW)	-	Poor	Poor	Not Good	Poor	Good	Bad	High
GB104028046930	R Tame (W/hampton Arm) from Source to Sneyd Brook (d/s Willenhall WwTW)	cHMWB	Moderate	Moderate	Good	Poor	Moderate	Moderate	Good
GB109054049340	Smestow Bk - source to conf Wom-Penn Bk (d/s Wombourne WwTW)	cHMWB	Moderate	Moderate	N/A	Poor	Poor	Bad	Moderate

9.3.4 WFD and Water Company Planning

An important consideration in the WFD planning process is the timing with respect to the statutory water company planning and funding process. At present, there is a discrepancy between the two planning timelines. The RBMPs are not due to be finalised until December 2009 and therefore the Programme of Measures which sets out what changes will need to be implemented in order to achieve 'good' status in all water bodies, will not be known until this point. Whilst it is not just water companies which will be affected by the Programme of Measures, it is considered that water companies such as ST will have a key role to play in implementing the measures and helping to achieve 'good' status in time for the 2015 deadline as required by the WFD, or by 2027 as identified by the RBMP.

However, the current PR09 and AMP5 timelines are such that the water companies have already submitted their final BPs, which set out the investment requirements for AMP5 (2010-2015), well before the RBMPs plans are finalised. It is therefore uncertain how much of the investment required to meet with Programme of Measures can be planned for and funded in the next AMP period and that much of the investment required to meet good status may not be forthcoming until AMP6 (2015-2020).

Despite this, studies such as the WCS have a role to play in identifying likely impacts of the WFD and where future investment is most likely to be required in order to move key water bodies towards good status based on the interim risk characterisations. Use of the draft standards and draft risk characterisations is essential such that early decisions can be taken on where investment is most likely to be required in order to meet with the future programme of measures and attainment of 'good' status. In this respect, the Black Country WCS can highlight and provide justification for further investment to be included in ST's future funding submissions to OFWAT.

9.4 Water Quality Summary

- Water quality within the Black Country has been assessed downstream of the eight WwTWs as these watercourses are most likely to be impacted by proposed growth within the study area. The water quality has been assessed against current water quality objectives and future WFD targets;
- In general, water quality within the Black Country area is of fairly poor quality but has complied with current water objectives over the latest Environment Agency reporting periods;
- Four of the eight watercourses are candidate Heavily Modified Water Bodies and one is candidate Artificial and are therefore required to reached 'good ecological potential' by 2015;
- None of the watercourses are currently achieving 'good ecological status' or 'good ecological potential' under the WFD, with biological and Orthophosphate frequently being assessed as poor or bad;
- A detailed water quality assessment will need to be undertaken as part of the Detailed WCS to assess the impacts of proposed growth on downstream water quality.

10 Ecology and Biodiversity

10.1 Introduction

In devising solutions for a WCS it is essential that impacts and effects upon features of biodiversity importance is considered. In particular, WCSs should also be compliant with the requirements of the Conservation (Natural Habitats &c) Regulations 1994 (as amended 2007), which interprets the EU Habitats Directive into English & Welsh law.

Box 10.1 The legislative basis for "appropriate assessment"

Habitats Directive 1992
Article 6 (3) states that:

"Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives."

Conservation (Natural Habitats &c. Regulations) 1994 (amended 2007)
Regulation 48 states that:

"*A competent authority, before deciding to … give any consent for a plan or project which is likely to have a significant effect on a European site … shall make an appropriate assessment of the implications for the site in view of that sites conservation objectives…The authority shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the European site*"

The Regulations require land use plans to take steps through a process known as Habitat Regulations Assessment (HRA) to ensure that a policy framework exists to ensure that their implementation will not result in adverse effects (either alone or in combination with other plans and projects) on internationally designated wildlife sites, specifically Special Protection Areas (SPA), Special Areas of Conservation (SAC) and, as a matter of UK Government policy, sites designated under the Convention on Wetlands of International Importance 1979 ('Ramsar sites').

Since WCSs inform Core Strategies and other DPDs it is essential that the WCS takes account of the thresholds above or below which damage to international wildlife sites will occur when devising abstraction or effluent discharge solutions.

It is understood that ST are undertaking an HRA of their WRMP and this will be a crucial piece of information to draw on for any future study as and when it is complete and made available.

10.2 Methodology

In practice, HRA of projects can be broken down into three discrete stages, each of which effectively culminates in a test. The stages are sequential, and it is only necessary to progress to the following stage if a test is failed. The stages are:

10.2.1 Stage 1 – Likely Significant Effect Test

This is essentially a risk assessment, typically utilising existing data, records and specialist knowledge. The purpose of the test is to decide whether 'full' Appropriate Assessment is required. The essential question is:

"Is the project, either alone or in combination with other relevant projects and plans, likely to result in a significant adverse effect upon European sites?"

If it can be demonstrated that significant effects are unlikely, no further assessment is required.

10.2.2 Stage 2 – Appropriate Assessment

If it cannot be satisfactorily demonstrated that significant effects are unlikely, a full "Appropriate Assessment" will be required. In many ways this is analogous to an Ecological Impact Assessment, but is focussed entirely upon the designated interest features of the European sites in question. Bespoke survey work and original modelling and data collation are usually required. The essential question here is:

"Will the project, either alone or in combination with other relevant projects and plans, actually result in a significant adverse effect upon European sites, without mitigation?"

If it is concluded that significant adverse effects will occur, measures will be required to either avoid the impact in the first place, or to mitigate the ecological effect to such an extent that it is no longer significant. Note that, unlike standard Ecological Impact Assessment (EIA), compensation for significant adverse effects (i.e. creation of alternative habitat) is not permitted at the Appropriate Assessment stage.

10.2.3 Stage 3 – Imperative Reasons of Overriding Public Interest (IROPI) Test

If a project will have a significant adverse effect upon a European site, and this effect cannot be either avoided or mitigated, the project cannot proceed unless it passes the IROPI test. In order to pass the test it must be objectively concluded that no alternative solutions exist. The project must be referred to Secretary of State on the grounds that there are Imperative Reasons of Overriding Public Interest as to why the plan should nonetheless proceed. The case will ultimately be decided by the European Commission.

This report deals with the first stage of HRA – the Likely Significant Effect Test. It also takes the opportunity to consider adverse effects on other statutory sites[55] and non-statutory County Wildlife Sites.

[55] *Statutory site*: Wildlife sites designated under national legislation, specifically the National Parks & Access to the Countryside Act 1949 and Wildlife & Countryside Act 1981 (as amended). These are Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR) and Local Nature Reserves (LNR)

10.3 Issue for Consideration: Treated effluent discharge

The Black Country falls within the Humber (via the River Trent) and Severn River Basin Districts and the Humber and Severn estuaries will therefore be ultimate receiving waters for treated effluent discharged to the Rivers Trent or Severn. The estuaries of both the Humber and Severn are designated for their international wildlife importance (Sections 10.3.1 and 10.3.3, respectively). It is therefore possible that cumulative impacts may result on the receiving estuaries from development in the Black Country considered 'in combination' (as required by legislation) with the additional housing to be delivered across the wider West Midlands, East Midlands, Yorkshire and Humber regions under their respective Regional Spatial Strategies.

Work to inform the Habitat Regulations Assessment of Phase 2 of the West Midlands RSS[56] identified that adverse effects of effluent discharge on the Severn Estuary cSAC, SPA and Ramsar site could not be ruled out and stated that there was a need for a precautionary policy required until the results of the Review of Consents & Water Framework Directive (WFD)/ Restoring Sustainable Abstraction (RSA) Sensitivity Analysis can be made available to the statutory nature conservation bodies. As such, development in the Black Country may contribute cumulatively to adverse effects on the Severn Estuary, if the River Severn is utilised for effluent discharge. This issue would require further investigation and liaison with both the EA and NE. Although the Humber Estuary SAC and associated SPA were not specifically identified within the RSS evaluation work as being of concern, this should also be investigated and confirmed for the WCS.

10.3.1 Humber Estuary SAC

The Humber is the second-largest coastal plain estuary in the UK, and the largest coastal plain estuary on the east coast of Britain. It is a muddy, macro-tidal estuary, fed by the Rivers Ouse, Trent and Hull, Ancholme and Graveney. The concentrations of suspended sediment concentrations are large, being derived from a variety of sources, including marine sediments and eroding Boulder Clay along the Holderness coast. This is the northernmost of the English east coast estuaries whose structure and function is intimately linked with soft eroding shorelines. Upstream from the Humber Bridge, the navigation channel undergoes major shifts from north to south banks, for reasons that have yet to be fully explained. This section of the estuary is also noteworthy for extensive mud and sand bars, which in places form semi-permanent islands.

The site is designated as an SAC for:

- Estuaries;
- Mudflats and sandflats not covered by seawater at low tide;
- Sandbanks which are slightly covered by sea water all the time;
- Coastal lagoons;
- *Salicornia* and other annuals colonising mud and sand;

[56] Treweek Environmental Consultants. 2009. Impact of Housing Growth on Water Supply and Water Quality at European sites – Update to information contained within the West Midlands RSS Phase II Revision HRA

- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*);
- Embryonic shifting dunes;
- Shifting dunes along the shoreline with *Ammophila arenaria* (`white dunes`);
- Fixed dunes with herbaceous vegetation (`grey dunes`);
- Dunes with *Hippophae rhamnoides;*
- Sea lamprey;
- River lamprey; and
- Grey seal.

During the 2007 Condition Assessment Process 94% of the SPA was found to be in favourable condition, with the remainder recovering.

10.3.2 Humber Flats, Marshes and Coast SPA and Ramsar site

The site is designated as an SPA for:

- During the breeding season:
  - Little Tern *Sterna albifrons*, 63 pairs representing at least 2.6% of the breeding population in Great Britain
  - Marsh Harrier *Circus aeruginosus*, 11 pairs representing at least 6.9% of the breeding population in Great Britain (Count as at 1995)
- Over winter:
  - Bar-tailed Godwit *Limosa lapponica*, 1,593 individuals representing at least 3.0% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6)
  - Bittern *Botaurus stellaris*, 2 individuals representing at least 2.0% of the wintering population in Great Britain (5 year mean 91/2-95/6)
  - Golden Plover *Pluvialis apricaria*, 29,235 individuals representing at least 11.7% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6)
  - Hen Harrier *Circus cyaneus*, 20 individuals representing at least 2.7% of the wintering population in Great Britain (5 year peak mean 1984/5-1988/9)
  - Dunlin *Calidris alpina alpina*, 23,605 individuals representing at least 1.7% of the wintering Northern Siberia/Europe/Western Africa population (5 year peak mean 1991/2 - 1995/6)
  - Knot *Calidris canutus*, 33,848 individuals representing at least 9.7% of the wintering Northeastern Canada/Greenland/Iceland/Northwestern Europe population (5 year peak mean 1991/2 - 1995/6)
  - Redshank *Tringa totanus*, 4,452 individuals representing at least 3.0% of the wintering Eastern Atlantic - wintering population (5 year peak mean 1991/2 - 1995/6)

- Shelduck *Tadorna tadorna*, 4,083 individuals representing at least 1.4% of the wintering Northwestern Europe population (5 year peak mean 1991/2 - 1995/6)

- On passage:
  - Redshank *Tringa totanus*, 5,212 individuals representing at least 2.9% of the Eastern Atlantic - wintering population (5 year peak mean 1991/2 - 1995/6)
  - Sanderling *Calidris alba*, 1,767 individuals representing at least 1.8% of the Eastern Atlantic/Western & Southern Africa - wintering population (2 year mean May 1993 - 1994)

The area qualifies under Article 4.2 of the Directive (79/409/EEC) by regularly supporting 187,617 individual waterfowl.

As well as its bird assemblage, the Humber Estuary is designated as a Ramsar site for:

- The site is a representative example of a near-natural estuary with the following component habitats - dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons;
- The Humber Estuary supports a breeding colony of grey seals Halichoerus grypus at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast. The dune slacks at Saltfleetby-Theddlethorpe on the southern extremity of the Ramsar site are the most north-easterly breeding site in Great Britain of the natterjack toad Bufo calamita.
- The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.

10.3.3 Severn Estuary SPA and Ramsar Site

The Severn Estuary is designated as being of European importance due to populations of the following species:

- Over winter:
  - Bewick's Swan Cygnus columbianus bewickii, 280 individuals representing at least 4.0% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6)
  - Curlew Numenius arquata, 3,903 individuals representing at least 1.1% of the wintering Europe - breeding population (5 year peak mean 1991/2 - 1995/6)
  - Dunlin Calidris alpina alpina, 44,624 individuals representing at least 3.2% of the wintering Northern Siberia/Europe/Western Africa population (5 year peak mean 1991/2 - 1995/6)
  - Pintail Anas acuta, 599 individuals representing at least 1.0% of the wintering Northwestern Europe population (5 year peak mean 1991/2 - 1995/6)

- Redshank Tringa totanus, 2,330 individuals representing at least 1.6% of the wintering Eastern Atlantic - wintering population (5 year peak mean 1991/2 - 1995/6)
- Shelduck Tadorna tadorna, 3,330 individuals representing at least 1.1% of the wintering Northwestern Europe population (5 year peak mean 1991/2 - 1995/6)

- On passage (mid-March to early May and from July onwards):
  - Ringed Plover Charadrius hiaticula, 655 individuals representing at least 1.3% of the Europe/Northern Africa - wintering population (5 year peak mean 1991/2 - 1995/6)

The area also qualifies under Article 4.2 of the EC Birds Directive (79/409/EEC) by regularly supporting 93,986 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: Gadwall Anas strepera, Shelduck Tadorna tadorna, Pintail Anas acuta, Dunlin Calidris alpina alpina, Curlew Numenius arquata, Redshank Tringa totanus, Bewick's Swan Cygnus columbianus bewickii, Wigeon Anas penelope, Lapwing Vanellus vanellus, Teal Anas crecca, Mallard Anas platyrhynchos, Shoveler Anas clypeata, Pochard Aythya ferina, Tufted Duck Aythya fuligula, Grey Plover Pluvialis squatarola, White-fronted Goose Anser albifrons albifrons, Whimbrel Numenius phaeopus.

The species-poor invertebrate community includes high densities of ragworms, lugworms and other invertebrates forming an important food source for passage and wintering waders. The site is of importance during the spring and autumn migration periods for waders moving up the west coast of Britain, as well as in winter for large numbers of waterbirds, especially swans, ducks and waders.

The Severn Estuary also qualifies as a Ramsar site on six of the nine Ramsar criteria:

Table 10.1 Criteria under which Severn Estuary qualifies as a Ramsar site

Ramsar Criterion	Description of Criterion	Severn Estuary
1	A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.	Due to immense tidal range (second-largest in world), this affects both the physical environment and biological communities.
3	A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.	Due to unusual estuarine communities, reduced diversity and high productivity.
4	A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.	This site is important for the run of migratory fish between sea and river via estuary. Species include Salmon *Salmo salar*, sea trout *S. trutta*, sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*, allis shad *Alosa alosa*, twaite shad *A. fallax*, and eel *Anguilla anguilla*. It is also of particular importance for

Ramsar Criterion	Description of Criterion	Severn Estuary
		migratory birds during spring and autumn.
5	A wetland should be considered internationally important if it regularly supports assemblages of waterbirds of international importance.	70919 waterfowl (5 year peak mean 1998/99-2002/2003)
6	A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.	The Severn Estuary supports more than 1% of the population of Tundra swan, Greater white-fronted goose, shelduck, Gadwall, Dunlin, Common redshank, Lesser black-backed gull Ringed plover, teal and pintail.
8	A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.	The fish of the whole estuarine and river system is one of the most diverse in Britain, with over 110 species recorded. Numerous scarce species use the Severn Estuary as a key migration route to their spawning grounds in the many tributaries that flow into the estuary. The site is important as a feeding and nursery ground for many fish species, particularly allis shad *Alosa alosa* and twaite shad *A. fallax* which feed on mysid shrimps in the salt wedge.

10.3.4 Severn Estuary Candidate SAC

The Severn Estuary is also designated as a cSAC for supporting significant populations of the following habitats and non-avian species:

- Estuaries
- Mudflats and sandflats not covered by seawater at low tide
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- Sandbanks which are slightly covered by sea water all the time
- Reefs
- Sea lamprey *Petromyzon marinus*
- River lamprey *Lampetra fluviatilis*
- Twaite shad *Alosa fallax*

Glassworts and annual sea-blite colonise the open mud, with beds of all three species of eelgrass Zostera occurring on more sheltered mud and sandbanks. Large expanses of common cord-grass also occur on the outer marshes. Heavily grazed saltmarsh fringes the estuary with a range of saltmarsh types present. The middle marsh sward is dominated by common saltmarsh-grass with typical associated species. In the upper marsh, red fescue and saltmarsh rush become more prominent.

10.4 Issue for Consideration: Abstraction from Local Sources

Work to inform the HRA of Phase Two of the West Midlands RSS[57] identified that adverse effects of abstraction for the Public Water Supply on the Severn Estuary cSAC, SPA and Ramsar site could not be ruled out and stated that there was a need for a precautionary policy required until the results of the Review of Consents and WFD/RSA Sensitivity Analysis can be made available to the statutory nature conservation bodies. As such, development in the Black Country may contribute cumulatively to adverse effects on the Severn Estuary if the River Severn is utilised as a source for water supply. This issue would require further investigation and liaison with both the EA and NE, although any evaluation will need to take account of the availability of the Shropshire Groundwater Scheme (see section 4.4.1.3) to supplement flows in the Severn and compensate for any reduction in levels due to increased abstractions.

In addition to internationally designated wildlife sites, Blithfield Reservoir in Staffordshire (which forms part of the water supply system for the Black Country, see section 4.4.1.2) is a Site of Special Scientific Interest and impacts from any increase in abstraction from, or capacity of, the wildlife interest of the reservoir would need to be accounted for in the WCS. Blithfield Reservoir is Staffordshire's largest area of standing water, situated in the valley of the River Blithe, between Stafford and Burton-upon-Trent. The site is a nationally important for goosander Mergus merganser, regularly supporting more than 1% of the total British wintering population. The peak wintering waterfowl numbers exceed those for all other Staffordshire water bodies and is second only to Rutland Water (Leicestershire) for inland waters in the Midlands region. Furthermore, the reservoir and its woodland and farmland surroundings is an important wintering locality for an outstanding variety of birds.

In addition, any connection between SSSIs and the Sherwood Sandstone Aquifer of the Staffordshire Basin which is a major source of water supply for the Black Country would need to be investigated as part of the WCS. In particular, it would be necessary to ensure that increased abstraction from this aquifer would not lead to damaging drawdown from those SSSIs which are hydrologically linked to the aquifer.

The Review of Consent process (see section 4.5.5) contains details of a number of groundwater sources operated by SSW in South Staffordshire, where reductions in DO may be required. ST also has a number of sites under investigation and they have made a commitment not to include ant new resource options which may impact on those sites under investigation.

10.5 Issue for Investigation: Abstraction from Non-Local Resources

A significant proportion of the public water supply to the West Midlands arises from sources in Wales. There has been considerable debate during the preparation of the WMRSS over adverse impacts of any increase in abstraction from Welsh sources. This mainly concerns water supply for Herefordshire rather than the Black Country, but the matter should be clarified as part of the Detailed WCS.

[57] Treweek Environmental Consultants. 2009. Impact of Housing Growth on Water Supply and Water Quality at European sites – Update to information contained within the West Midlands RSS Phase II Revision HRA

11 Water Cycle - Overview of Constraints

Following the assessment of each of the water cycle and water environment topic areas in proceeding sections, this Section presents an overall summary of impacts and limitations to development up to 2026. The constraints relating to each development area are presented in Table 11.1 to give a visual assessment of issues pertaining to each development area in the Black Country. This is based on a colour coding system. In addition, a summary of main constraints and issues that need to be addressed are discussed.

In general, it can be seen that the main issues relate to potential impact to the water environment, in this case from increases in discharges from WwTWs. However, this needs to be considered against the existing water quality targets and draft RBMP targets. Any opportunity to consider wider Programme of Measures (POMS) in the region to improve the water environment should be considered. Water environment issues in the Black Country are many and varied, and each sector needs to bare a fair share of the burden to achieve proscribed objectives.

Water resources could be a significant issue, mainly in ST's Water Resource Zone (WRZ) 3. The situation for SSW appears to be more straightforward. These issues need to be considered in relation to the findings and assumptions made in Section 4.

The issues surrounding possible constraints of wastewater network need to be considered in conjunction with ST. In particular, many constraints relate to assumptions on WwTW's which have potential to accept additional flow from multiple development areas. When assessed individually, such potential problems are likely to be minimal. Thus, more detailed modelling should be conducted to confirm this preliminary assessment.

Volumetric capacity of WwTW is unlikely to be an issue in the Black Country. Nevertheless, increasing discharges are likely to lead to pressures on some WwTW process capacities and discharge consents. This should be confirmed during any proposed Detailed WCS.

A more detailed description is provided in the following Sections.

Table 11.1 Water Cycle Constraints (2007-2026)

Strategic centres	Houses	WwTW volumetric capacity	Wastewater network	Water resource	Water environment (draft WFD)	Flood risk
SC1: Wolverhampton	2,400					
SC2: Walsall	500					
SC3: Brierley Hill	3,000					
Regeneration corridors						
RC 2 Stafford Road	1,380					
RC 3 South of Wolverhampton City Centre	975					
RC 4 Wolverhampton – Bilston	4,600					
RC 6 Wednesfield/Willenhall/Darlaston	2,550					
RC 7 Bloxwich/Birchills/Bescot	1,800					
RC 8 Hill Top	6,070					
RC 9 Tipton/Dudley Port/Brades Village	6,150					
RC 10 Pensnett/Kingswinford	735					
RC 11 Dudley:Brierley Hill - Stourbridge	5,125					
RC 12 Oldbury/West Bromwich/Smethwick	3,670					
RC 13 Rowley Regis – Jewellery Line	6,800					
RC 14 Coombs Wood – Halesowen	500					
RC 15 Brownhills	640					
RC 16 Coseley – Tipton – Princes End	2,535					

Key

	Spare capacity, minimum investment required, minimal issues.
	Strategic scale mitigation or water cycle infrastructure will be required.
	Major investment required / major limitation

11.1 Water Resources and Supply

ST's draft WRMP indicates a supply/demand shortfall within the Severn WRZ (3) over the entire planning period through to 2035.

As a result, ST is now proposing resources schemes (mainly groundwater) and demand management measures within this WRZ. The precise timing of these schemes will be included in the final WRMP.

The SSW's draft WRMP shows only modest changes to various components of the supply/demand balance. Overall, the Company has sufficient resources to meet the forecast growth in demand plus target headroom for both the annual average and peak week conditions throughout the plan period to 2035. The surplus of resources means that there is no

requirement for either supply-side or demand-side interventions other than those included in their draft WRMP. Demand management measures are therefore all that will be required by SSW.

This healthy situation means that those parts of Black Country supplied by SSW i.e. Walsall, Dudley and Sandwell should all have sufficient resources to meet the planned growth for these areas. However, these assumptions are subject to the risks to water supplies as outlined in Section 4.5.5.

Scott Wilson's initial assessment of the potential benefits from adopting a Water Neutrality position on all future residential development within the Black Country would indicate that it is a realistically achievable target for the Black Country Authorities to aim for in its WCS. In order to achieve this would require the 332,000 currently unmetered households to reduce their water consumption to rates equivalent to just above the level required in order for dwellings to meet the CSH Standard Level 1/2 (i.e. around 120 $lh^{-1}d^{-1}$).

11.2 Flood Risk, SUDS and Surface Water Management

The heavily urbanised nature of the Black Country and its corresponding high level of impermeable surfaces, the extensive network of culverted rivers, and steep sided valleys, result in a high susceptibility to localised surface water flooding during periods of intense rainfall.

As emphasised in the register of historical flood incidents, there are many potential causes for surface water flooding in the Black Country. Furthermore, these flood sources are often interlinked, thus exacerbating surface water runoff.

Flood risk issues in the Black Country are widely dispersed. With no particular flooding "hot spots" identified in the Black Country, perhaps with the exception of the Oxley Brook in Wolverhampton and the M6 culvert in Sandwell, determining the appropriate scale and method of urban pluvial modelling will be a challenge.

- Dudley MBC includes the towns and urban areas of Dudley itself, Stourbridge, Halesowen, Kingswinford, Brierley Hill and Sedgley / Coseley. Generally, Dudley MBC is located on higher grounds, hence fluvial flooding is not a significant issue.
- Sandwell MBC is almost entirely urban. It is centred on West Bromwich and includes the towns of Wednesbury, Tipton and Oldbury. The borough lies at the upstream end of both River Severn and River Tame catchments. Fluvial flooding is therefore not critical in this area.
- Walsall MBC includes the urban areas of Walsall, Brownhills, Aldridge, Bloxwich, Willenhall and Darlaston.
- The City of Wolverhampton (WCC) occupies much of the borough (with the town of Bilston in the south west corner) and is heavily urbanised. It lies on the western side of the Birmingham plateau some 122 metres above sea level. Most of the borough lies in the headwaters of the Stour and Tame catchments (western and eastern parts, respectively), whilst the northern edge of the borough drains into the River Penk.

Dudley, Sandwell and Wolverhampton receive very little drainage from adjacent boroughs, being located at the upper end of their catchments. Therefore these Councils need to be aware of the downstream impact that development will place on the river and drainage systems, as well as the corresponding downstream communities.

The current scoping study has identified that there is significant potential for groundwater flooding within the Black Country area. Anecdotal evidence suggests that historic groundwater flooding has occurred within the WCC administrative area. In addition, concerns regarding the potential for groundwater flooding in the Sandwell MBC and Dudley MBC areas have also been raised.

A full assessment of flooding and surface water management is provided in Sections 6 and 7.

11.3 Wastewater Treatment and Collection

For the purposes of the Outline WCS, ST did not provide information pertaining to the 'process capacity' at the WwTWs. Process capacity refers to the amount of flow that can be treated to the required quality standards as set under the discharge consent. Therefore, it has been agreed that the headroom capacity at the WwTW is calculated from the volumetric capacity (i.e. the difference between the maximum dry weather flow (DWF) that ST are permitted to discharge under the discharge consent and the current DWF that is treated from the existing population). This is based on the assumption that ST would seek the funding required to upgrade the processes in the works (if necessary) to treat the additional flow to the standard required under the existing licence.

Process capacity, discharge consents and potential impacts to the receiving watercourses would need to be assessed in any proposed Detailed WCS.

Eight WwTWs have been identified as being likely to be impacted by growth in the study area.

- Barnhurst WwTW has an estimated volumetric capacity to allow the WwTW to treat flow from around 67,900 new homes before an upgrade or new WwTW will be required.
- Goscote WwTW has an estimated volumetric capacity to treat flow from around 19,000 new homes before an upgrade or new WwTW will be required.
- Lower Gornal WwTW has an estimated volumetric capacity to treat flow from around 7,700 new homes before an upgrade or new WwTW will be required.
- Ray Hall WwTW has an estimated volumetric capacity to treat flow from around 119,300 new homes before an upgrade or new WwTW will be required.
- Roundhill WwTW has an estimated volumetric capacity to treat flow from around 32,860 new homes before an upgrade or new WwTW will be required.
- Walsall Wood WwTW has an estimated volumetric capacity to treat flow from around 2,515 new homes before an upgrade or new WwTW will be required.
- Willenhall WwTW has an estimated volumetric capacity to treat flow from around 18,256 new homes before an upgrade or new WwTW will be required.

- Wombourne WwTW has an estimated volumetric capacity to treat flow from around 8,243 new homes before an upgrade would be required.

Limited information was available on WwTW catchments, and assumptions were made on the areas served by each works, as detailed in Section 8. It has been tentatively concluded that housing targets can be accommodated by the existing volumetric capacity of the relevant WwTW.

A preliminary assessment of process capacity and impacts on watercourses was conducted. WwTW Consents are likely to require tightening to meet the proposed WFD water quality standards under current conditions. Works that are currently treating effluent close to BAT i.e. Barnhurst WwTW have less capacity to treat further effluent flow to a tighter standard and therefore may need to seek alternative treatment options to deal with increased effluent discharges as a result of proposed development in the Black Country.

The urban nature of the Black Country means that there is a good coverage of existing strategic sewers across the study area. However, any upgrades to the existing sewer network are likely to need to pass through already developed areas which can be relatively expensive and the timescales for delivery of this could be relatively long.

Key strategic upgrades are likely to be required to deliver the significant development in RC8, RC9, RC12 and RC16 (as defined in Table 3-4). These will feed into the same sewer network which drains to Ray Hall WwTW and therefore development within these areas will need to be assessed in combination through a detailed modelling exercise to determine existing capacity within the sewer network serving these areas and the potential to accommodate the proposed development.

A significant volume of development is planned for RC11, RC13 and RC14 which will feed into the sewer network that drains to Roundhill WwTW. Key strategic upgrades are likely to be required to deliver development in these areas. The areas which feed into sewer network that drains to Roundhill WwTW will also need to be assessed in similar fashion to that mentioned above.

The Strategic Centre of Brierley Hill is likely to require key strategic upgrades to the sewer network to deliver the proposed development.

11.4 Water Environment

In general, water quality is poor downstream of the WwTWs. The GQA grades confirm that overall chemical quality (for BOD, Ammonia and Dissolved Oxygen (DO)) and biological quality ranges between ‘fairly good’ and ‘poor’. However, all river stretches were compliant with River Quality Objectives during the reporting periods.

Nutrient concentrations are high in all watercourses, which could be attributed to the industrial nature of the catchment, poor quality urban runoff and the number of WwTWs discharging into the catchment.

None of the surface water bodies assessed as part of this catchment currently achieve 'good ecological status' or ‘good ecological potential’ under the WFD. Assessing the impacts of future

growth on river quality is particularly difficult in these circumstances. All future discharges will need to comply with the WFD's aim to meet 'good ecological status' or 'potential' and other measures may be in place within the catchment to address existing water quality problems. It is likely that future growth at WwTWs will require tightened consents to comply with the objectives of the WFD. This will need to be assessed as part of the Detailed WCS.

Due to the scale of the Black Country, it is not possible to give a quantitative assessment of the water quality in each watercourse. In common with previous WCS Studies, Section 9 assessed the potential impacts to water quality from potentially the most significant risk; downstream of WwTWs. In Table 11.1, the water quality status, as assessed by the draft WFD Classification, was ascribed to the development areas by a particular WwTW. It is recognised that this method has limitations, but does allow an impact to water quality to be ascribed to a particular area.

Water Cycle Studies should be compliant with the requirements of the Conservation (Natural Habitats &c) Regulations 1994 (as amended 2007), which interprets the EU Habitats Directive into English & Welsh law. Development may lead to impacts on the Humber SAC and Severn Estuary SPA & RAMSAR site and this should be considered further, in consultation with other stakeholders, during any Detailed WCS.

12 Policy, Developer Guidance and Funding Mechanisms

12.1 Introduction

It is intended that the completed Black Country WCS will produce an overall strategy that each of the key stakeholders can sign up to. This will aid in the process of delivering development in the Black Country and local environs by helping to ensure that objections to proposed development on the grounds of water issues such as flood risk and abstraction are minimised. A completed WCS that is agreed by the Black Country Councils, ST, SSW, NE and the EA will aid developers in understanding the requirements they need to meet in order to comply with the WCS recommendations. It will also set the framework for funding water infrastructure requirements in the future.

In order to achieve this, the Black Country WCS should aim to produce the following:

- Guidance on planning policy with respect to development and the water cycle that the councils can use to input into the LDF, and guidance on incorporating the WCS findings into the Development and Flood Risk SPD;
- Guidance for developers in terms of actions to achieve compliance with the overall WCS. This will be in the form of a Developer Checklist and it is envisaged that this will eventually be a document, which if its criterion are all met for a proposed development, will help to ensure no objection from the EA or LPA on the grounds of water cycle issues. This type of checklist document has been successfully developed for other WCS such as the inaugural WCS completed for Corby. Consideration should also be given to the checklist drawn up in the SFRA;
- Agreement on funding mechanisms, particularly for strategic, development wide infrastructure required i.e. strategic scale and integrated surface water attenuation schemes, maintenance and responsibility;
- Planning timelines for provision of water infrastructure against growth to aid both ST and SSW in planning for future water and wastewater infrastructure within respective BPs;
- To provide justification for ST and SSW in seeking funding through the AMP process for the required infrastructure; and
- Highlight the need for a strategic approach to surface water management e.g. continued development of SWMPs across whole areas rather than from individual developments.

12.2 Developer Checklist

The overall intention is that all developers would be asked to use the Water Cycle Developer Checklist as part of the planning application process and to submit a completed version with their planning applications. The EA is a statutory consultee with regards to flood risk and the

water environment and as such, will need to sign up to the Checklist as will the Councils. The checklist provided in this Stage 1 WCS (See Appendix B) has been developed from examples used in previous WCS as well as the EA's national standard checklist available on their website. It is included in this Outline Study as a starting point to be developed further in the Detailed WCS, once it is known which development scenarios are to be taken forward.

12.3 Funding and Cost Apportionment Mechanisms

In terms of the overall funding mechanism, it is important to consider that the Government has laid down strict rules on how water companies are funded, especially with regard to domestic development, and the industry's economic regulator (OFWAT), regulates this process. Water Companies have the responsibility for providing wastewater treatment and water supply costs to OFWAT (both of these costs in the case of ST and water only costs in the case of SSW) and they are funded through charges to customers within respective operating areas through the Periodic Review process and AMP process. In general, WCS have not considered the apportionment of developer contributions towards strategic water supply and wastewater facilities.

This Stage 1 (Outline) WCS report introduces the various policy, funding and developer requirement elements to the Black Country WCS, but it is envisaged that these will be developed further in any detailed Stage 2 (Detailed) WCS, should such a study be necessary.

The Stage 1 WCS has highlighted that there is a need for expenditure on new infrastructure in the following areas:

- Wastewater treatment and sewerage,
- Large scale surface water management schemes,
- Smaller, site specific surface water management.

Although the options for providing the additional infrastructure will be developed further in any future Detailed Study, it is important to consider funding at a strategic level now to inform the development of the Detailed WCS.

In summary, developers can be included into the financial contribution in two ways:

Stage 1 & 2 - Stakeholder Participation

Sometimes other WCSs have invited property developers to the stakeholder group to provide an input into the direction of the study. It is important to ensure that all developers involved are represented so as to avoid giving any unfair advantage to any one group of developers. In so doing, the developers who are involved would be best placed to undertake the recommendations from Stage 2 of the WCS and ensure that these are incorporated into the design of the developments.

Stage 3 – Infrastructure Funding

Developers may also contribute to the capital works of infrastructure required within the WCS, although in general this would not apply to wastewater or water supply infrastructure as this is

regulated by the Water Companies through OFWAT. It should however be noted that developers can contribute to strategic wastewater mains, which are required to serve a specific development. It could also include contributions for funding large scale flood risk mitigation measures, with particular emphasis on large scale surface water attenuation storage scheme for development in and around the Black Country.

12.3.1 Minimisation of Cost

Despite this, developers can at least contribute to minimising the capital cost of water infrastructure. It can be seen from the assessment of future demands (see Table 4.3 in section 4.5.2.1) existing infrastructure that a key variable is water consumption per capita. To a large extent developers are being encouraged to do this through initiatives such as the Code for Sustainable Homes and the amendments to the Buidling Regulations. Both of these now strongly promote technologies such as grey water recycling, designing developments with less impermeable surfaces, specifying higher quality materials for pipework etc.

Other examples include:

- If the percentage return to sewer can be reduced from 90% to 75%, the number of additional properties that can be accommodated per 1 m^3d^{-1} headroom at an existing WwTW is 0.8; and
- Higher quality pipes could reduce the infiltration of groundwater into drains thereby increasing the number of houses that could potentially be served by a given WwTW.

12.3.2 Water Resource Provision – Manufacturing Sector

From December 2005, non-household customers who are likely to be supplied with at least 50 million litres of water per year at their premises are now able to benefit from a new Water Supply Licensing mechanism. If eligible, they may be able to choose their water supplier from a range of new companies entering the market. The Water Supply Licensing mechanism enables new companies to supply water, once OFWAT has granted them a licence. These companies can compete in two ways:

- By developing their own water source and using the supply networks of appointed water companies (such as ST and SSW) to supply water to customers' premises. This would be carried out under the combined water supply licence; and
- By buying water 'wholesale' from appointed water companies (such as ST and SSW) and selling it on to customers. This is done under a retail water supply licence.

These are potential options for the manufacturing sector to be provided with these services in the Black Country.

12.3.3 Cost Apportionment Mechanism

The Stage 1 WCS has considered that surface water attenuation will be required in order for new development to comply with PPS25. Developers could contribute towards the cost for provision

of this on a strategic level. In addition, there are potential options for developer contribution towards strategic sewerage infrastructure provision. Dependent on the options taken forward in the detailed study, a potential charge could be made to developers through the Section 106 mechanism with the various Black Country Councils setting up a fund to receive Developers' contributions and to use them to fund works.

Research for the Corby WCS has identified that there is a legal requirement for such contributions to be made on the basis of commensurate impact of each development, for instance according to its location in the catchment. This mechanism has already been applied successfully in Corby, whereby contributions have been agreed via Section 106 agreements for two key developments; this is an important precedent.

13 Conclusions and Recommendations

13.1 Overview

The Black Country Outline WCS has identified the existing capacity of the current water environment and water cycle infrastructure and has used this assessment to determine where additional investment is required to supply new infrastructure or protect the water environment. The conclusions of each assessment are presented here.

13.1.1 Wastewater Treatment and Network

- There are six WwTWs located within the study area and a further eight bordering the area. Eight of these works have been identified as potentially being impacted by proposed development within the study area and have therefore been assessed as part of the Outline WCS

- All WwTWs (where information was available to undertake the assessment) have sizeable spare capacity to treat flows from new development in the area. However, no detailed information on trade flow was provided and therefore the assumptions that have been made as part of this assessment will need to be revisited in the Detailed WCS to refine the calculated volumetric capacity at the WwTWs

- The existing sewer network has been used to identify the volume of proposed development that is likely to be served by each of the WwTWs and this has been used to calculate the future wastewater flows to be treated at the works and therefore future capacity

- Based on the proposed housing development in the area, all WwTWs have the capacity to treat the new development without requiring any upgrades to the existing wastewater treatment works (in terms of volumetric capacity).

- WwTW quality consents are likely to require tightening under the WFD and as a result of the proposed growth within the area to comply with WFD standards. Some of the consents, particularly at Barnhurst WwTW is already close to BAT and therefore alternative treatment options may be needed to treat the additional effluent generated from the proposed development in the study area. A Monte Carlo modelling exercise will need to be carried out as part of the Detailed WCS to determine the future consents required under the WFD for future effluent discharges.

- The wastewater network assessment showed that there is a good coverage of existing strategic sewers across the study area which will facilitate new connections to the existing network. However, detailed modelling will need to be undertaken to assess the capacity in the network especially in areas where more than one regeneration corridor will feed into the same sewer i.e. Ray Hill and Roundhill catchments, or the area does not currently have an existing strategic network but significant growth is planned, i.e. Brierley Hill.

13.1.2 Water Resources and Supply

- The proportion of water supplies for the Black Country coming from surface water and groundwater sources is roughly 60:40.
- In general, the CAMS document for the area show the River Severn to either have 'No Water Available' or 'Over-abstracted' (in the Rivers Stour, Worfe and Salwarpe, and associated groundwater bodies).
- The EA assessed the Black Country as lying within an area of moderate water stress.
- The Black Country is served by two water companies, ST and SSW. The parts of the Black Country lying within ST's Severn WRZ (3) are the areas around Wolverhampton and also southwest corner of the Black Country around Stourbridge and Halesowen. SSW provides water only services for the four population centres of Dudley, Sandwell and Walsall.
- ST's draft WRMP indicates a supply/demand shortfall within the Severn WRZ (3) over the entire planning period through to 2035. Their final WRMP to be published shortly (subject to DEFRA's approval) indicates a worsening position in terms of deficits once the latest effects of Climate Change are included. As a result, ST is now proposing resources schemes (mainly groundwater) and demand management measures within WRZ 3.
- In the case of SSW, their position is one of having sufficient resources to meet the forecast growth in demand plus target headroom for both the annual average and peak week conditions throughout the plan period to 2035. Demand management measures are therefore all that is required by SSW.
- ST and SSW have both assumed the growth contained within the WMRSS, JCS growth figures are slightly above those contained with the RSS.
- Under the proposed JCS and based on Water Company consumption figures (Scenario 1), the total residential water demand for the Black Country up to 2026 would be 18 Ml/d. Broken down into the individual population centres, then the demands are highest in Sandwell (6.3 Mld^{-1}) and lowest in Walsall (3.3 Mld^{-1}), although Wolverhampton (3.7 Mld^{-1}) is broadly similar.
- An estimate for the total non-residential demand for the Black Country up to 2026 would be 10.8 Mld^{-1} (Scenario 1, Water Company forecast). The largest growth in the non-residential demand would come from the Sandwell area (4.18 Mld^{-1}), whilst the growth the other three population centres is between 2.1 to 2.3 Mld^{-1}.
- Both ST and SSW recognise the importance of water efficiency in managing the future growth in demand within the Black Country. Leakage control will continue to play an important part, although it has to be recognised that maintaining leakage at existing levels with an increasing network will require a significant commitment from both water companies.
- Scott Wilson's initial assessment of the potential benefits from adopting a Water Neutrality position on all future residential development within the Black Country would indicate that it is a realistically achievable target for the Black Country Authorities to aim for in its WCS. In order to achieve this would require the 332,000 currently unmetered households to reduce

their water consumption to rates equivalent to just above the level required in order for dwellings to meet the CSH Standard Level 1/2 (i.e. around 120 $lh^{-1}d^{-1}$).

- There are currently over thirty Source Protection Zones within the Black Country area. The presence of a Major Aquifer, the Sherwood Sandstone Aquifer of the Staffordshire Basin, will be an important consideration when selecting which types of SUDS techniques are most appropriate for different development areas.
- Other potential risks to water supplies within the Black Country include; Review of Consent process, Climate Change, groundwater quality/WFD issues and water supply resilience issues.

13.1.3 Water Environment

- Water quality within the Black Country has been assessed downstream of eight WwTWs as these watercourses are most likely to be impacted by proposed growth within the study area. The water quality was assessed against current water quality objectives and future WFD targets.
- In general, water quality within the Black Country area is of poor quality, but has complied with current objectives over the latest Environment Agency reporting periods.
- Four of the eight watercourses are candidate Heavily Modified Water Bodies and one is candidate Artificial and are therefore required to reached 'good ecological potential' by 2015.
- None of the watercourses are currently achieving 'good ecological status' or 'good ecological potential' under the WFD, with biological and Orthophosphate frequently being assessed as poor or bad.
- A detailed water quality assessment will need to be undertaken as part of the Detailed WCS to assess the impacts of proposed growth on downstream water quality.
- Water Cycle Studies should be compliant with the requirements of the Conservation (Natural Habitats &c) Regulations 1994 (as amended 2007), which interprets the EU Habitats Directive into English & Welsh law. Development may lead to impacts on the Humber SAC and Severn Estuary SPA & RAMSAR site and this should be considered further, in consultation with other stakeholders, during any Detailed WCS.

13.1.4 Flood Risk and Surface Water Management

- A Scoping Level SWMP was conducted as part of this WCS for the Black Country. High-level flood risk issues were included in this assessment.
- The heavily urbanised nature of the Black Country and its corresponding high level of impermeable surfaces, the extensive network of culverted rivers, and steep sided valleys, result in a high susceptibility to localised surface water flooding during periods of intense rainfall.
- As emphasised in the register of historical flood incidents (Table 6-3), there are many potential causes for surface water flooding in the Black Country. Furthermore, these flood sources are often interlinked, thus exacerbating surface water runoff. A simple analysis of

past flood events using the SPR method is therefore not possible in most cases given the limited data collected by the Councils and the EA during a particular incident.

- During heavy rainfall events, overland flow and surface water runoff is caused by natural topographic gradients, but can also be generated by, or combine with:
    - Highway drainage or sewer design capacity exceedance or unsuitable maintenance regime;
    - Culvert blockage;
    - High levels in the receiving watercourse preventing discharge from the drainage system;
    - Fly-tipping;
    - Canal bank failure / overtopping / maintenance works.

Dudley MBC

Dudley MBC includes the towns and urban areas of Dudley itself, Stourbridge, Halesowen, Kingswinford, Brierley Hill and Sedgley / Coseley. The borough lies on the Severn side of the Severn-Trent catchment. The River Stour runs from east to west through the southern end of the borough and its tributaries drain most of the borough (as well as parts of Sandwell and Wolverhampton), before joining the River Severn at Stourport. Only Coseley in the northeast corner of the borough drains to the Tame catchment. Generally, Dudley MBC is located on higher grounds, hence fluvial flooding is not a significant issue.

Sandwell MBC

Sandwell MBC is almost entirely urban. It is centred on West Bromwich and includes the towns of Wednesbury, Tipton and Oldbury. The borough lies on the east side of the River Severn catchment and is also drained northwards by the headwaters of the River Tame, which then flows from west to east along the border between Sandwell and Walsall. The borough lies at the upstream end of both River Severn and River Tame catchments. Fluvial flooding is therefore not critical in this area (reportedly, an assessment on the summer 2007 floods is available at the Council but could not be consulted for the purpose of this study).

Walsall MBC

Walsall MBC includes the urban areas of Walsall, Brownhills, Aldridge, Bloxwich, Willenhall and Darlaston. The south, west and centre of the borough are heavily urbanised but there are a number of isolated rural pockets in the north and east. The borough almost entirely drains southwards towards the River Tame.

Wolverhampton CC

The City of Wolverhampton occupies much of the borough (with the town of Bilston in the south west corner) and is heavily urbanised. It lies on the western side of the Birmingham plateau some 122 metres above sea level. Most of the borough lies in the headwaters of the Stour and Tame catchments (western and eastern parts, respectively), whilst the northern edge of the borough drains into the River Penk.

Wolverhampton was not significantly affected by floods during summer 2007, for reasons linked with its historical drainage infrastructure development, its natural contours and its location upstream of the country's primary river basins[58]. Although June-July 2007 was very wet (approximately 312 mm, or 267% of 1961-1990 average[59]), the most intense event on 20th July tracked down to the south and west of the Black Country, leaving the Black Country relatively unaffected.

Dudley, Sandwell and Wolverhampton receive very little drainage from adjacent boroughs, being located at the upper end of their catchments. Therefore these Councils need to be aware of the downstream impact that development will place on the river and drainage systems, as well as the corresponding downstream communities. This has been achieved, for instance in Wolverhampton, by providing underground storage tanks in strategic locations or artificial storage reservoirs (e.g. the one at the centre of the racecourse).

Flooding in the Black Country.

Data analyses and site visits out have highlighted the localised, scattered and interlinked nature of flood incidents associated with surface water runoff across the Black Country. It is therefore difficult at this stage to recommend specific areas where investments in significant drainage schemes may be required or best utilised.

Incidents are often due to culvert blockage or drainage capacity exceedance, future investment should rather focus on the following.

- **Enhanced trash screens and gullies maintenance (short-term):** In most parts of the Black Country, maintenance works are undertaken following a risk-based methodology, drawing upon local knowledge. This approach should be formalised and enhanced through the permanent collection of additional information (e.g. residents complaints register, systematic reporting of blocked gullies during clearing works).
- **Creating opportunities through re-development to alleviate Surface Water Flood Risk (short to medium-term):** This could be achieved through close coordination between Developers and the Councils' Drainage Engineers in the shaping of the overall drainage layout (impact of development proposal on maintenance regimes, suitability of proposed drainage techniques, etc.). This would ensure that Local Planning Policies (SPDs and DPDs) regarding surface water runoff management, use of SUDS and the opening up of culverted watercourses are fully considered.
- Improving asset management and ensuring knowledge transfer through the development of a drainage assets database for the four Boroughs (medium-term): There are potentially significant amounts of local knowledge at the Councils that may be lost if not archived, shared and updated.
- **Managing flood risk better and improving the environment by naturalising the river system (medium to long-term):** Opportunities to undertake de-culverting of watercourses should be sought as development proposals come forward. Consideration should be given at this stage to the use of Section 106 agreements.

[58] Wolverhampton City Council, Flood Risk Management - The Pitt Review - Open Executive Decision Item, 30th September 2008.
[59] Met Office rainfall records, available at http://www.metoffice.gov.uk/climate/uk/interesting/july2007/index.html.

- **Undertaking an Outline SWMP (short-term):** Now that the preparation stage is completed, we recommend the commencement of the Risk Assessment stage (Outline SWMP, Stage 2). This is based on level of existing surface water flood risk, the degree of interaction between flood sources and pathways and the proposed level of new development. An identification and selection of areas prone to surface water flood risk, based on detailed topography (LiDAR data) should be carried out using numerical modelling techniques. Please refer to Section 6.8 for more detailed information on modelling requirements for the Black Country.

13.2 Scenario Recommendations

- The timing of the AMP5 Business Planning process has unfortunately meant that the level of engagement from ST and SSW has not been sufficiently detailed enough to enable completion of this aspect of the full Outline Study.
- Rather than speculate on what ST and SSW might find acceptable in terms of future development scenarios, this aspect of the study should be deferred until detailed Stage 2 WCS.

13.3 Scope for Stage 2 Black Country WCS

- To incorporate the findings from both ST and SSW final WRMPs.
- To hold workshops with ST to discuss both water supply and wastewater issues identified above and if possible, to run models to quantify the amount of spare capacity in the existing networks.
- To understand how variations in both occupancy rates and peaks in demands may put added on pressure on the water supply system.
- To investigate further the issue of 'water neutrality', including an estimate of the costs of achieving this.
- To investigate the spare capacity available at each WwTW, taking into account treatment process restrictions.
- To address any hydraulic issues of the receiving watercourses from increasing the discharges from WwTWs.
- To consider the phasing of future development areas within the Black Country.
- To consider the possible funding mechanisms available for making contributions to strategic infrastructure.

14 Progression of the WCS and SWMP

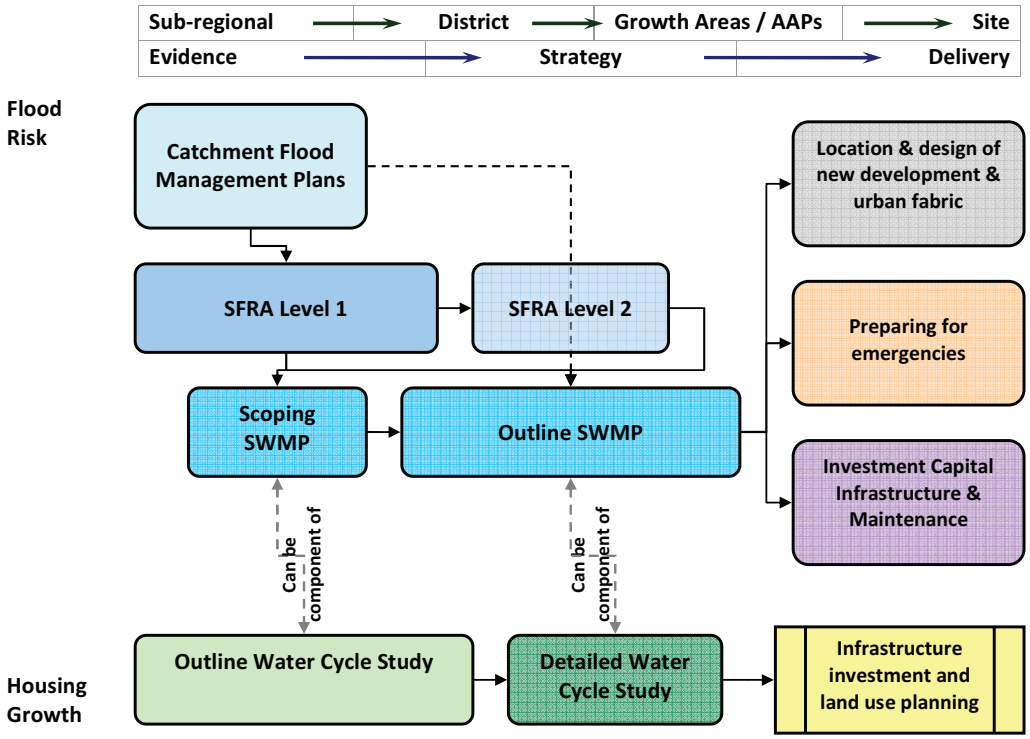
14.1 Introduction

Following the presentation of the final draft report (Black Country Outline Water Cycle Study and Scoping Level Surface Water Management Plan) on 4 August 2009 to Dudley, Walsall and Sandwell Councils, it was requested that the next steps in terms of Detailed WCS and Outline SWMP be listed summarised for programming and discussion purposes.

The lists below are intended to be used as an interim guide to help inform future planning and investment decisions. A more detailed scope of services would need to be produced (by the Black Country Authorities) in order to provide definitive costs.

Figure 14-1 summarises the relationship between the WCS, SWMP and SFRAs at more detailed levels.

Figure 14-1: Relationship between WCSs and SWMPs at all Levels of Detail



14.2 Issues for Consideration in Detailed WCS

- Detailed analysis of wastewater network (WwTWs and sewer network) in conjunction with ST, including modelling where appropriate,
- Assessment of impacts of trade flow,
- Detailed review of discharge consents,
- Detailed consideration of process issues at Barnhurst WwTW in conjunction with Severn Trent,
- Process capacity assessment, including Monte Carlo modelling,
- Analysis of DG5 data from Severn Trent,
- Impacts of capacity of receiving watercourses,
- Clarification on impacts of water supply from Wales and Herefordshire,
- Detailed assessment of impacts of growth on river standards (including water quality and environment),
- Impacts of development on Humber SAC and Severn Estuary SPA and RAMSAR,
- Options and funding for required new infrastructure (including upgrades),
- Enhancement of developer checklist,

14.3 Issues for Consideration in Outline SWMP(s)

- Develop stakeholder engagement and communication strategy,
- Undertake pluvial modelling of the Black Country growth areas and prepare Outline SWMP targeted at growth areas only,
- Detailed SuDS appraisal, decision tree and customised guidance for Black Country developers.
- Detailed assessment of groundwater flooding,
- Establish drainage asset register (per Government requirements),
- Formalise inclusion of British Waterways into Black Country Stakeholder Group for next phase of study and agree terms of reference,
- Development of an Outline River Corridor Improvement Plan,

- Development of guidelines for SuDS maintenance regimes,
- Development of site wide strategic drainage plans,
- Detailed requirements for SuDS (once layouts have been determined),
- Analysis of piezometric maps and borehole groundwater levels,
- Production of maps of areas with shallow groundwater tables, which are typically not suitable for SuDS,
- Production of maps identifying areas of favourable infiltration drainage.

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