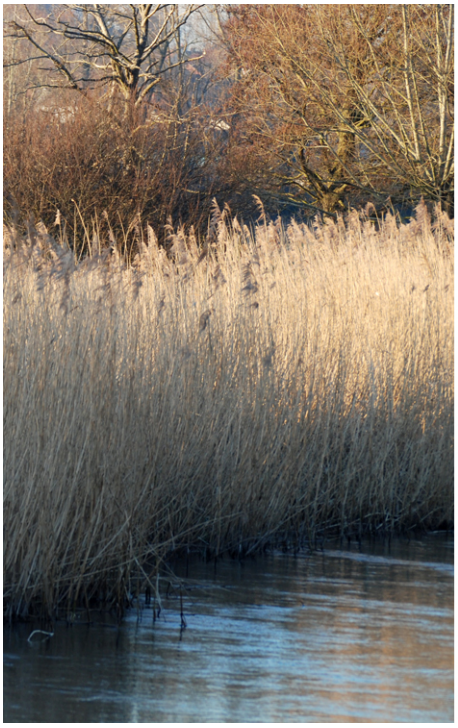
North West Leicestershire District Council

Detailed Water Cycle Study

Final Report



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Detailed Water Cycle Study

Final Report

AMEC Environment & Infrastructure UK Limited

July 2012

Report for

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Executive Summary

North West Leicestershire District Council (NWLDC) is preparing its Core Strategy, which will detail the future planning framework for the District up to 2031. As part of the preparation, the Council must consider what the overall development strategy should be including how much development should take place and where. A key issue for consideration in the District is the water quality of the River Mease, which is designated at a European level as a Special Area of Conservation (SAC) under the Habitats Directive. Currently the Mease is classified as being 'Unfavourable No Change', with reasons for adverse condition related to elevated nutrients found in the river, in particular phosphorus. The river is also failing to meet its objectives under the Water Framework Directive due to the elevated phosphorus levels.

A Water Quality Management Plan for the Mease (Environment Agency, 2011) has been prepared on behalf of the Programme Board, the current members of which are the Environment Agency, Natural England, Severn Trent Water and NW Leicestershire District Council. The Plan identifies a series of mitigation measures across the catchment, actions and parties responsible. The Detailed Water Cycle Study comprises one of the measures identified, and is required to identify solutions to manage the potential for increasing levels of phosphorus as a result of development in the catchment. The Water Cycle Study is therefore one of a series of measures to be undertaken across the catchment to contribute to improving water quality, as no single action on its own is considered sufficient to resolve the current issues facing the River Mease water quality.

This Detailed Stage Water Cycle Study has been prepared to identify long term solutions that will help facilitate development whilst preventing further deterioration of water quality and water resources. Specifically, the aims of this WCS include investigation for sewage treatment at the Packington works to permit development in the Ashby/Packington area; examining the infrastructure constraints for the provision of improved and/or new infrastructure; review of feasible options for achieving level 3/4 of the CSH (water consumption); assessment of the sustainability of preferred options; and development of the water cycle strategy for the district.

At the start of this study it was envisaged that the assessment would be able to identify a solution for development in the immediate term. However, as the assessment has progressed, and with the parallel Water Quality Management Plan assessments, it has been identified that capacity exists within the flow consent of the sewage works to accommodate some development. Although this capacity exists and will not lead to any further deterioration in water quality, in the short term the target level required under the Habitats Directive will still be breached. A Developer Contribution Scheme (DCS) is therefore being prepared to offset any potential impact this short term solution may have on reaching the Habitats Directive target. The WCS therefore concentrates on solutions for when this existing flow capacity is used up, and the DCS focuses on mitigation for development that will use up the existing flow headroom.

Water quality modelling has been undertaken to review a selection of options for wastewater treatment in the catchment of the River Mease. Some of these options are based on theoretical treatment methods which have not

been reliably used in the UK. This is because current phosphorus removal treatments for wastewater in the UK are designed to achieve an annual average of 1mg/l phosphorus, whilst the conservation objective under the Habitat's Directive for phosphorus in the River Mease is 0.06mg/l. This study has not taken account of the different fractions of phosphorus present in wastewater or river quality (there are different fractions of dissolved phosphate and particulate phosphate which further complicate the quality considerations. For simplification this report primarily refers to phosphorus only). By combining the results of the water quality modelling with an assessment of sustainability for each option, preferred solutions for both short term and long term development have been identified.

In the short to medium term, Option 2 'Maintenance of Load' is considered the best solution for facilitating development in the Ashby, Packington and Measham areas. Under this option the sewerage provider, Severn Trent, will ensure that there is no increase over that already consented in phosphorus loading into the River Mease as a result of increased development. This will involve permitting new development to connect to the existing treatment works. When the flow capacity/headroom under the existing permit conditions is reached, a new permit will be applied for with a tighter quality consent, to offset the increase in flow. This is likely to involve increased chemical dosing if necessary at Packington (and possibly Meaesham) sewage treatment works to ensure the loading to the river is not increased above the existing 1mg/l consent. This option was not considered technically viable over 12 months ago. The reasons this was not considered viable are:

- There had been no detailed assessment of the potential water quality impacts;
- It was considered that Packington sewage works was already operating at full capacity; and
- Information available at the time indicated higher levels of phosphorus present in both the river and the effluent quality.

However, due to the following improvements this option is now considered feasible for the short term (in the next 5 to 10 years) without reducing existing consented P loads:

- Improvements in phosphorus removal at Packington works - since this study started, the 1mg/l consent has been introduced at Packington works and actual concentrations discharged from the works have been even lower than 1 mg/l P
- Improved headroom estimations due to a number of factors, one of which includes closure of some industries in Ashby – this means that trade flow to the works has reduced which therefore increases the capacity against the existing volumetric consent, compared to the headroom available before the industries closed;
- A reduced housing projection - previously housing in the order of 2500 was proposed in the Packington sewage treatment works catchment alone. The maximum projection considered for the WCS is now 1600 homes. With improved capacity at the works and the lower housing projection, this means that it is more achievable to accommodate growth at the works in terms of both flow volume and quality: and

- A Developer Contribution Scheme (DCS) is being prepared to offset any potential impact this short term solution may have on reaching the Habitats Directive target.

However, this presents a missed opportunity for improving water quality. In addition to the requirement to bring the River Mease SAC back to favourable conservation status in accordance with the European Habitats Directive and UK Habitats Regulations, the Habitats Directive also encourages that Member States shall endeavour, where they consider it necessary, in their land use planning and development policies and, in particular with a view to improving the ecological coherence of the Natura 2000 network, to encourage the management of features of the landscape which are of major importance to wild flora and fauna. Such features are those which, by virtue of their linear and continuous structure (such as rivers with their banks or the traditional systems marking field boundaries) or their function as stepping stones (such as ponds or small woods) are essential for the migration, dispersal and genetic exchange of wild species. Competent authorities should be seeking opportunities to restore deteriorated habitats where opportunities arise. It is considered therefore that Option 2 must work in conjunction with the medium/longer term solution of additional treatment in some form at one or both of the two main WwTW, in order to work towards the Water Framework Directive target and Habitats Directive SAC Conservation Objective.

In the medium to longer term Option 4(b) should be investigated. This involves improved treatment at Packington Wastewater Treatment works to below the existing 1mg/l permit for phosphorus. The discharge from Packington has been identified as the main contributor (from point sources, i.e. direct inputs) into the river, with the potential for the largest improvements in water quality. None of the options identified were able to reach the target level in the river, and therefore any improvements to wastewater discharges need to be undertaken in parallel with improvements to diffuse sources, i.e. combined sources such as run-off and agriculture.

The Water Quality Management Plan for the Mease (Environment Agency, 2011) identifies a series of mitigation measures across the catchment, actions and parties responsible. This includes the recommendation for a Developer Contribution Scheme, in which developer contributions fund a programme of actions to restore the river, with the primary purpose of mitigating for the phosphate increases as a result of new development in the immediate timescales, whereas the WCS aims are to investigate a long term solution to the River Mease water quality issues. The Developer Contribution Scheme therefore provides an opportunity to secure funding for a series of additional activities contributing to phosphate reduction within the catchment to prevent further deterioration from new development in the immediate/short term, forming part of the actions within the Water Quality Management Plan and improvements at the wastewater treatment works that together seek to restore the river to a robust ecological state with its conservation objectives met.

Network modelling has been carried out by AMEC to assess sewer capacity and improvements required in Ashby, Packington and Coalville. The results show that there are unlikely to be significant constraints affecting the proposed developments and that any issues can be mitigated by minor modifications to the sewer network. Severn Trent is continuing to assess capacity issues in the Coalville network, identified as part of their Drainage Area Programme in 2009. These relate to the input of surface water flows into the network which also use up capacity at the wastewater treatment works (Snarrows) which serves the Coalville area. A solution which addresses both the network capacity and the treatment works capacity is therefore required to meet the proposed growth levels. Initial

feasibility work indicates that a reduction in infiltration to accommodate approximately 3,700 homes (as set out in the Core Strategy Consultation from July 2011) would be feasible. It should be noted that the October 2011 Cabinet Report has now superseded the growth figures in the July 2011 report. Severn Trent Water are proposing more detailed investigations including flow monitoring, but have advised that infiltration reduction work could be completed within 12 to 18 months to align with development phasing. A desk based study of network capacity in the rest of the District, undertaken by Severn Trent Water, indicates that development is unlikely to create any significant capacity or infrastructure issues.

Each potential development site has been reviewed and assessed for the potential to introduce sustainable drainage systems (SuDS) to control surface water run-off. The benefits of using SuDS include reduction of surface water flooding by controlling runoff at source, improving water quality by treating runoff and removing pollutants prior to discharge off site, enhancing the amenity and biodiversity value of a development and, if systems such as rainwater harvesting or greywater recycling are used, reduction in water resources demands. A table for each site is presented in **Appendix D** summarising the most suitable SuDS, based on a high level desk based assessment, as well as indicative sizes and costs based on an assumed percentage coverage of buildings and roads. These should be supported by detailed site specific assessments and will need approval from the SuDS Approval Body prior to construction (Leicestershire County Council is the relevant approval authority).

An assessment of water efficiency in households (new and existing homes) and how builders (and development designers) can achieve the requirements of the Code for Sustainable Homes Level 3/4 for water consumption has been undertaken. Key issues and the feasibility of CSH level 3/4 for water are presented, including guidance and a checklist for both the Council and developers to demonstrate compliance.

Guidance and checklists for both developers and the Council are provided in the appendices to help support sustainable development.

Contents

Glossary

AMP	Asset Management Period	Five year period in which water companies implement planned upgrades and improvements to their asset base. Activities are subject to funding review. The current AMP period, AMP5, runs from 2010 to 2015.
CAMS	Catchment Abstraction Management Strategy	The assessment of how much water can be extracted to meet its many economic uses – agriculture, industry, and drinking water supply – while leaving sufficient water in the environment to meet ecological needs.
CLG	Communities and Local Government	Communities and Local Government sets policy on local government, housing, urban regeneration, planning and fire and rescue.
CSH	Code for Sustainable Homes	Signals a new direction for building standards. Wherever practical DCLG intend to develop and introduce a system of sustainable building standards based on voluntary compliance.
CSO	Combined Sewer Overflow	A system for allowing a certain flow of combined sewerage and stormwater to be discharged into watercourses untreated during storm events to prevent the sewerage system backing up and flooding.
Defra	Department for Environment, Food and Rural Affairs	Department that brings together the interests of farmers and the countryside; the environment and the rural economy; the food we eat, the air we breathe and the water we drink.
DWF	Dry Weather Flow	The measure of the flow influx to a WwTW derived from human activity (both domestic and trade), but excluding any storm-induced flows.
EA	Environment Agency	A government body that aims to prevent or minimise the effects of pollution on the environment and issues permits to monitor and control activities that handle or produce waste. It also provides up-to-date information on waste management matters and deals with other matters such as water issues including flood protection advice.
GIS	Geographical Information System	A system for capturing, storing, analyzing and managing data and associated attributes which are spatially referenced to the earth.
GQA	General Quality Assessment	The Environment Agency's method for classifying the water quality of rivers and canals is known as the General Quality Assessment scheme (GQA). It is designed to provide an accurate and consistent assessment of the state of water quality and changes in this state over time.
HD	Habitats Directive	The Habitats Directive aims to protect the wild plants, animals and habitats that make up our diverse natural environment. The Habitats Directive has been transposed into English law as the Conservation (Natural Habitats &c) Regulations 1994, now known as the Habitats Regulations.
LDF	Local Development Framework	A folder of local development documents that outlines how planning will be managed in the area.
l/h/d	Litres per head per day	A unit for measuring the amount of water consumed and waste flow from households.
LPA	Local Planning Authority	The local authority or council that is empowered by law to exercise planning functions. Often the local borough or district council. National parks and the Broads authority are also considered to be local planning authorities. County councils are the authority for waste and minerals matters.
NWLDC	North West Leicestershire District Council	Local planning authority for the administrative area of the district.
P	Phosphorus	Chemical element that can lead to eutrophication in rivers if present in too much quantities
pcc	Per capita consumption	A phrase referring to the amount of water consumed per head.

PPS25	Planning Policy Statement 25	Set out the Government's national policies on development and flood risk. The policies in these statements apply throughout England and focus on procedural policy and the process of preparing local development documents.
PR	Periodic Review (for water companies' investment plans)	One of Ofwat's main tasks is to set price limits for the water and sewerage companies in England and Wales. Ofwat do this in order to protect consumers from the monopoly providers of these services. However it is also their duty to enable efficient companies to finance their functions. They make sure that consumers receive reliable services and value for money and that each company is able to meet its environmental obligations now and in the future. Price limits are reviewed every five years. Prices were set at the price review in 2004 for the 2005 – 2010. This current price review (PR09) covers the five years from April 2010.
RBMP	River Basin Management Plan	The River Basin Management Plans describe the river basin district, and the pressures that the water environment faces. It shows what this means for the current state of the water environment in the river basin district, and what actions will be taken to address the pressures in line with the requirements of the Water Framework Directive. It sets out what improvements are possible by 2015.
SAC	Special Area of Conservation	A site designated under the European Community Habitats Directive, to protect internationally important natural habitats and species.
SFRA	Strategic Flood Risk Assessment	Document that informs the planning process of flood risk and provides information on future risk over a wide spatial area. It is also used as a planning tool to examine the sustainability of the proposed development allocations.
SPA	Special Protection Area	Sites classified under the European Community Directive on Wild Birds to protect internationally important bird species.
SSSI	Site of Special Scientific Interest	A site identified under the Wildlife and Countryside Act 1981 (as amended by the Countryside and Rights of Way Act 2000) as an area of special interest by reason of any of its flora, fauna, geological or physiographical features (basically, plants, animals, and natural features relating to the Earth's structure).
STW	Severn Trent Water Ltd	Water supply and sewerage company, that provide water supply to the majority of the study area, and sewerage services to the entire study area.
SuDS	Sustainable Drainage Systems	Sustainable drainage systems or sustainable (urban) drainage systems: a sequence of management practices and control structures designed to drain surface water in a more sustainable fashion than some conventional techniques (may also be referred to as SDS).
SWMP	Surface Water Management Plan	A framework through which key local partners with responsibility for surface water and drainage in their area work together to understand the causes of surface water flooding and agree the most cost effective way of managing surface water flood risk.
WCS	Water Cycle Study	A study aimed at ensuring that future development is sustainable in terms of flood risk management, water quality and water supply.
WFD	Water Framework Directive	A European Union directive which commits member states to making all water bodies (surface, estuarine and groundwater) of good qualitative and quantitative status by 2015.
WRMP	Water Resource Management Plan	Plan prepared by water supply undertakers every five years outlining how they aim to meet predicted demand for water over the next 25 years.
WRZ	Water Resource Zone	Defined by the water supply/demand balance in the region such that all customers within it receive the same level of service in terms of reliability of water supply.
WwTW	Wastewater Treatment Works	Separates solids from liquids by physical processes and purifies the liquid by biological processes. Discharge from Wastewater Treatment Works may contain a range of pollutants and need to be carefully monitored.
UWWTD	Urban Wastewater Treatment Directive	The Urban Wastewater Treatment Directive (UWWTD) regulates the collection and treatment of wastewater from residential and industrial developments

1. Introduction

1.1 Context

North West Leicestershire District Council (NWLDC) is preparing its Core Strategy, which will detail the future planning framework for the District up to 2031. As part of the preparation, the Council must consider what the overall development strategy should be including how much development should take place and where. The District is mainly rural by nature, with the main town of Coalville and rural towns of Ashby, Kegworth, Castle Donington, Ibstock and Measham

The impact of new development on existing water infrastructure and the water environment generally will be a key consideration in determining the distribution of new development. Water Cycle Studies provide one of a suite of strategic studies that form the evidence base for Local Development Documents, specifically to ensure that a sustainable balance is struck between growth requirements and the environmental capacity of receiving waters and capacity of water company assets. The WCS is therefore required to help inform the amount of development, where it should be located, and where and how sustainable water infrastructure can be delivered so that growth will not compromise the water environment.

The Environment Agency's WCS guidance sets out three stages through which this is achieved:

- **The Scoping (Stage 1) Study** defines the study area and identifies key stakeholders to form a steering group, agree objectives with the steering group and identifies/collates the available data;
- **The Outline (Stage 2) Study** assesses the capacity of the water environment and water infrastructure and identifies areas of uncertainty where further work is required, to ensure there is sufficient capacity in place to meet the planned growth; and
- **The Detailed (Stage 3) Study** should resolve areas of uncertainty and to support the Core Strategy and provide the information required to implement the final Water Cycle Strategy, a detailed framework for the sustainable provision of infrastructure including a timeline of requirements.

The guidance states that WCSs should be undertaken in areas identified for significant growth, or where environmental constraints to development have already been identified. The Environment Agency and Natural England have identified that future development may significantly impact on the River Mease conservation objectives due to its international designation as a Special Area of Conservation (SAC) under the Habitats Directive, and its 'unfavourable' condition.

The first two stages have already been delivered by Entec UK Ltd (before Entec changed its name to AMEC E&I UK Ltd) through a combined Scoping and Outline Study (March 2010). This current report comprises the Detailed (Stage 3) Water Cycle Study.

1.2 The need for a Detailed Stage WCS

The Scoping and Outline Study identified a number of potential issues that need to be addressed in order to meet the overall aims of the WCS process:

- The need to prevent any further deterioration of water quality in the study area as a result of development, particularly in the River Mease Special Area of Conservation which requires water quality improvements to meet Habitats Directive and Water Framework Directive standards;
- The need to consider infrastructure options to address potential constraints to development as a result of sewage infrastructure capacity in certain locations, working in conjunction with Severn Trent Water;
- The need for site-specific measures to implement and maintain water efficiency in new developments; and
- The need to consider the sustainability and indicative costs of future infrastructure options that may be required to support new development.

The aims of the Detailed Stage WCS are to identify solutions that will help facilitate development whilst preventing further deterioration of water quality and water resources. Specifically, the aims of the Stage 3 WCS can be summarised as follows:

- Drive solutions to be investigated and implemented for sewage treatment at the Packington works to permit development in the Ashby/Packington area;
- Make use of the water quality model being developed for the area to determine impacts of increased sewage discharges on water quality, to support mitigation and design measures for meeting WFD standards;
- Examine the infrastructure constraints for the provision of improved and/or new infrastructure;
- Review feasible options for achieving level 3/4 of the CSH (water consumption);
- Assess the sustainability of preferred options; and
- Develop the water cycle strategy for the district.

In addition the WCS should ensure that the solutions do not undermine the wider work necessary to support the restoration of the River Mease SAC, in accordance with duties under the Habitats Directive and Water Framework Directive. This report focuses on the impact of development on the water cycle, focussing on housing development. It should be noted that there are other sources of pollution and potential causes for the River Mease SAC to fail its Conservation Objectives. These other diffuse sources of pollution are considered in the Environment Agency's Diffuse Water Pollution Plan (Appendix to the River Mease Water Quality (Phosphate) Water Management Plan, Environment Agency 2011).

At the start of this study it was envisaged that the assessment would be able to identify a solution for development in the immediate term. However, as the assessment has progressed, and with the parallel Water Quality

Management Plan assessments, it has been identified that capacity exists within the flow consent of the sewage works to accommodate some development. Although this capacity exists and will not lead to any further deterioration in water quality, in the short term the target level required under the Habitats Directive will still be breached. A Developer Contribution Scheme (DCS) is therefore being prepared to offset any potential impact this short term solution may have on reaching the Habitats Directive target. The WCS therefore concentrates on solutions for when this existing flow capacity is used up, and the DCS focuses on mitigation for development that will use up the existing flow headroom.

1.3 Report Structure

This sections sets out the introduction of the study. The remainder of the report is structured as follows:

- Chapter 2 discusses the key issue of water quality in the River Mease, phosphorus levels and phosphorus removal technologies;
- Chapter 3 sets out the planning context and growth options assumed for this study;
- Chapter 4 presents the assessment of wastewater treatment options for development in the River Mease catchment, including an overview of phosphorous removal technologies, water quality modelling, and a sustainability assessment of the final options considered;
- Chapter 5 presents an overview of wastewater treatment issues in the rest of the District;
- Chapter 6 presents the results of the assessment of the sewerage network capacity across the District;
- Chapter 7 makes recommendations for SuDS on each potential development site and provides guidance on Flood Risk Assessments;
- Chapter 8 presents the recommendations for water efficiency standards and how to reach them; and
- Chapter 9 presents the Development Strategy for the District.

2. Key Issues

2.1 River Mease Designations and Water Quality Objectives

A key issue for consideration in the District is the water quality of the River Mease, which is designated at a European level as a Special Area of Conservation (SAC) under the Habitats Directive (Council Directive 92/43/EEC). The River Mease is a small lowland river which is designated on account of its vegetation and freshwater fish communities. The primary reasons for the Mease being designated an SAC are the presence of spined loach and bullhead fish species. The presence of otter, white clawed crayfish, river water crowfoot and Callitricho-Batrachion vegetation also support the designation. **Appendix A** presents the reasons for designation from Natural England.

The Habitats Directive requires all designated sites to be maintained at, or restored to 'Favourable Conservation Status'. It is the responsibility of Natural England to assess SACs against conservation objectives and classify their conservation status. The river is also designated at a national level as a Site of Special Scientific Interest (SSSI). Currently the Mease is classified as being 'Unfavourable No Change', with reasons for adverse condition related to elevated nutrients, in particular ortho phosphate[1] (River Mease Habitats Directive Review of Consents, Environment Agency, 2009). An increase in levels of nutrients (phosphorus and nitrogen) in rivers and lakes is called **eutrophication** and encourages algal growth, which reduces the conditions needed for fish and invertebrate communities to thrive.

The Water Framework Directive (WFD) is a European Directive that requires all water bodies to be designated as Good Ecological Status by 2015. Ecological Status is defined by a number of components under a scale of Bad, through to Poor, Moderate, Good and then High. One of the supporting elements is 'physico-chemical parameters' which includes phosphorus. Ecological Status is combined with Chemical Status to define the Overall Status of the water body. The river is made up of a number of different WFD 'water bodies' representing different stretches and tributaries of the river.

Prior to the Habitats Directive Review of Consent process, and the Humber River Basin Management Plan produced under the WFD (which includes the River Mease), the River Mease and Gilwiskaw Brook were designated as being a Sensitive Area (Eutrophic), SA(e), under the Urban Wastewater Treatment Directive.

A summary of the designations and targets is presented in **Table 2.1** below.

[1] Ortho phosphate is a soluble fraction of phosphorus

Table 2.1 River Mease Designations and Objectives

Directive*	Water Body designated (WFD ID)	Current Status	Overall Objective	Target for phosphorus	Reason for failure
Urban Wastewater Treatment Directive	Gilwiskaw Brook and River Mease – Sensitve Area Eutrophic			0.1mg/l	
Habitats Directive	River Mease SAC – R Mease downstream of Gilwiskaw Brook confluence to it's confluence with the R Trent, and Gilwiskaw Bbrook downstream of Packington village to it's confluence with the R Mease.**	Unfavourable no change	Favourable Condition	0.06mg/l	Elevated phosphorus
Water Framework Directive	Gilwiskaw Brook from Source to River Mease (GB104028046590)	Poor Ecological Status	Good Ecological Status	0.12mg/l	Poor fish status Moderate status for phosphorus.
Water Framework Directive	River Mease from Source to Gilwiskaw Brook (GB104028046550)	Poor Ecological Status	Good Ecological Status	0.12mg/l	Poor invertebrates Poor phosphorus status
Water Framework Directive	River Mease from Gilwiskaw Bk to Hooborough Brook (GB104028046570)	Moderate Ecological Status	Good Ecological Status	0.12mg/l	Bad status for phosphorus
Water Framework Directive	Hooborough Brook from Source to River Mease (GB104028046580)	Moderate Ecological Status	Good Ecological Status	0.12mg/l	Moderate Invertebrates Poor phosphorus
Water Framework Directive	River Mease from Hooborough Brook to Trent (GB104028046560)	Moderate Ecological Status	Good Ecological Status	0.12mg/l	Moderate Invertebrates Poor phosphorus

*One directive does not have primacy over the others but it is a requirement to meet the most stringent objectives for the site, which in the case of the River Mease is the Habitats Directive

**Therefore the Packington works is not within the SAC stretch of the river but influences the downstream SAC water quality.

New and additional housing in the catchment could exacerbate water quality issues, due to increased discharges from sewage works, one of the main contributors of phosphorus to the environment. The sections below provide more detail on the natural and anthropogenic sources of phosphorus, and considerations for this study.

One of the key issues facing this study is also to balance a solution for wastewater treatment in the River Mease SAC catchment against water resource issues. South Staffordshire Water public water supply abstractions on the River Mease have been subject to sustainability reductions (reduced abstraction to resolve low flow issues in the River Mease). The River Mease catchment is a net importer of public water supply, which means water is supplied from elsewhere but discharged as river flow within the catchment from the wastewater treatment works. Therefore, the transfer of existing effluent or discharges currently into the river into neighbouring works in adjacent river catchments, or reductions in household demand for water might reduce the volume of flow being discharged into the Mease and exacerbate the low flow issues.

2.2 Phosphorus in the Environment

2.2.1 Sources of Phosphorus

Under a natural environment, river phosphorus levels are low. Elevated phosphorus in rivers is a result of human activity and can be due to a number of sources, including point source pollution such as wastewater treatment works and septic tank discharges and diffuse sources such as agricultural and urban runoff. Septic tanks can be used in isolated locations where there is no connection to the sewerage network available. Some developments also use site specific package treatment plants to treat sewage on site. If there is a proliferation of these plants and they are not properly maintained, they can also contribute to diffuse or point source pollution. During heavy rainfall events a combination of rainfall and sewerage can be discharged into the river from sewer overflows, which are used to prevent flooding of the sewerage network. As these discharges take place sporadically and at various points across the catchment they are often classified as diffuse sources.

Phosphorus is added into foods to supplement healthy dietary requirements, and is also used in various detergents and soap products. Laundry detergents containing phosphorus are to be banned in the UK by 2015, but it is still present in dishwasher detergent and soap products. Phosphorus discharges arising from all these products eventually discharge to the river via sewage effluent.

Elevated phosphorus is harmful to the river environment due to the impact on the ecology, specifically fish and invertebrates. As discussed above, eutrophication encourages algal growth, which reduces the conditions needed for fish and invertebrate communities to thrive.

The contribution of phosphorus in the environment from point sources or diffuse sources can vary depending on the river catchment, land use, upstream contributions and population, and also on a seasonal basis. A key uncertainty is quantifying the relative contributions of phosphorus, but in general it is considered to be split relatively equally between sewage point sources and agricultural diffuse sources. Within the Mease catchment, the primary source of phosphate is point source discharges, with agricultural diffuse sources contributing approximately a third of the total phosphate input (Natural England).

In response to the issues in the Mease catchment, the Environment Agency has prepared a River Mease Water Quality Management Plan (Environment Agency, 2011), in which various partners are responsible for delivering actions to help improve water quality and reduce pollution from various sources and sectors. One of the actions is the delivery of this Detailed WCS which focuses on the potential impact of new development in increasing phosphorus contributions to the river via sewage effluent point sources in the Mease catchment. The Plan also includes as an appendix a Diffuse Action Plan (Environment Agency, 2011) to tackle sources of phosphorus from agricultural and urban diffuse run-off in the Mease catchment. Agricultural diffuse pollution is therefore not considered further in this report. The WCS is therefore one of a series of measures to be undertaken across the catchment to contribute to improving water quality, as no single action on its own is considered sufficient to resolve the current issues facing the River Mease water quality.

2.2.2 Environmental Standards

Environmental Quality Standards (EQS) for phosphorus vary between Habitats Directive sites (SACs) and WFD Good Status, with tighter standards required for the sensitive ecosystems in designated SACs. The WFD standards for phosphorus were developed by the UK Technical Advisory Group (UKTAG) to support the first round of River Basin Planning under the WFD. The standards are dependent on the type of river as set in the River Basins District Typology Directions (2010) and are based on the requirements of diatoms, assumed to be the most sensitive part of river ecological species to nutrient pressures. The standards under the Habitats Directive were developed by the Environment Agency as part of the Review of Consents process, and are set for the nutrient conditions relevant to the ranges of conservation interests associated with Favourable Conservation Status (Environment Agency, 2002). Clearly the most stringent requirements need to be met in order to comply with all of the relevant European Directives.

The water quality targets relevant to the Mease are:

- EQS for Habitats Directive = 0.06mg/l phosphorus[2]; and
- EQS for WFD Good Status = 0.12mg/l phosphorus[3].

2.2.3 Phosphorus Levels in the River Mease

As with most UK rivers, the sources of phosphorus in the Mease arise from point source sewage works and diffuse sources such as agricultural and urban run-off. As a result of the introduction of phosphorus removal under the Urban Wastewater Treatment Directive and during AMP4 investment period, phosphorus levels in the Mease have reduced during recent years (more information on the sewage works with P removal is presented in Section 4.1). The average phosphorus level monitored in the River Mease during 2010 was 0.316mg/l (from Environment Agency monitoring data). **Figures 2.1 and 2.2** show the changes in phosphorus levels in the Mease between 2005 and 2010.

[2] Habitats Directive standard is for Total Reactive Phosphorus

[3] WFD standard is for Soluble Reactive Phosphorus

Figure 2.1 Total River Orthophosphate Concentrations, 2005 to 2010 (Source: Environment Agency)

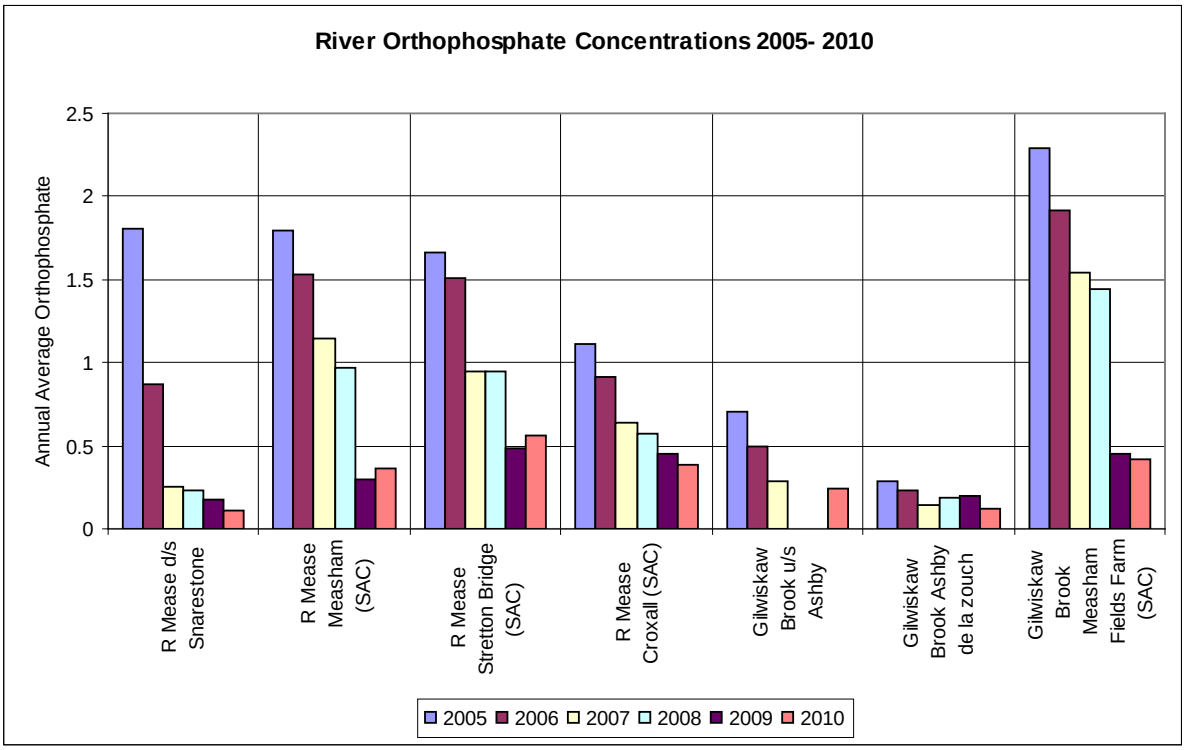
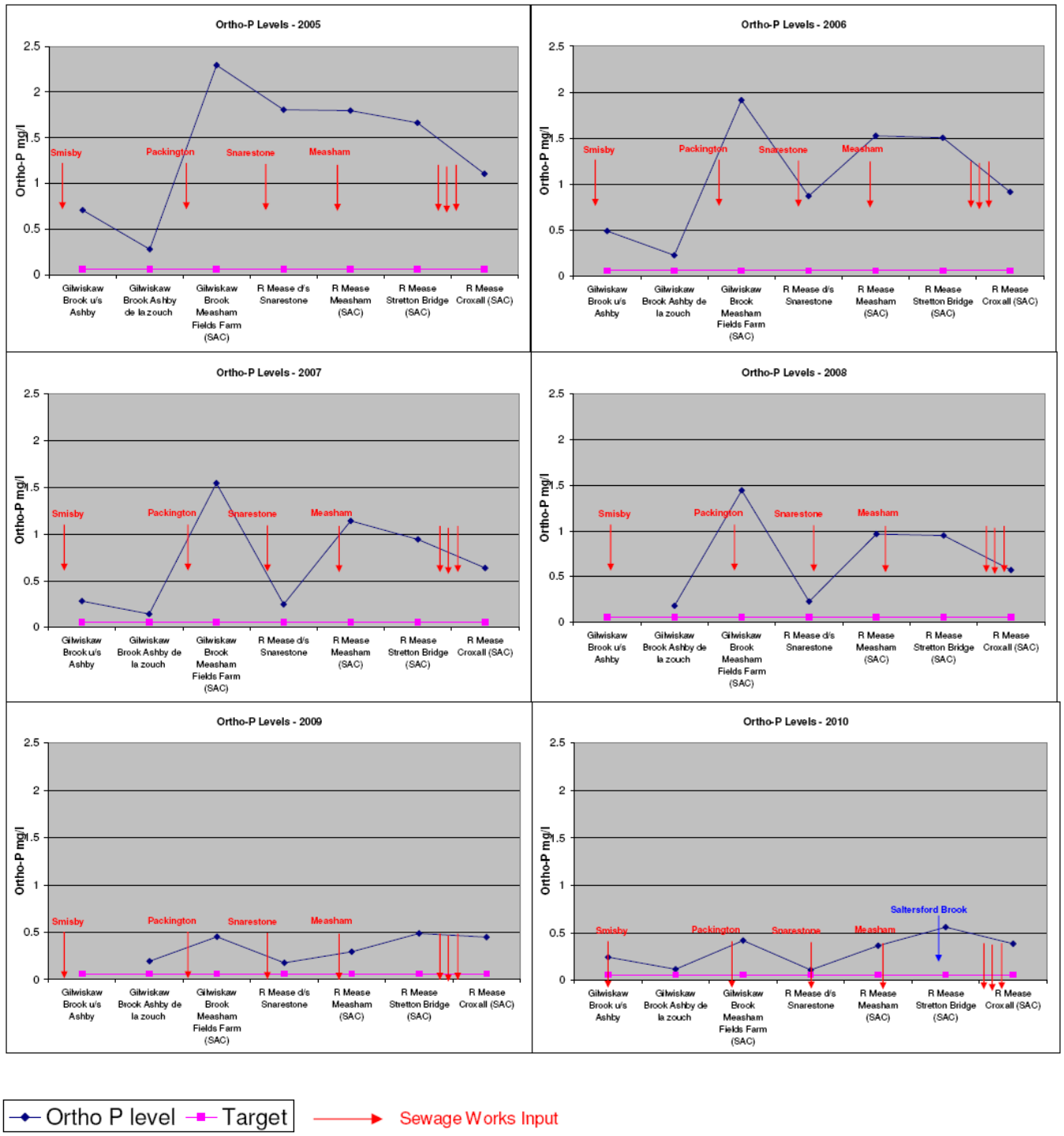


Figure 2.2 River Orthophosphate Concentrations, 2005 to 2010 (Source: Environment Agency)



Despite this improvement in phosphorus levels in recent years, the Habitats Directive Conservation Objective for phosphate and the Water Framework Directive target level for phosphate are still being exceeded. Any future development in the Mease catchment will lead to increased discharges from the contributing sewage works, and risks increasing phosphorus levels again and continued breach of the Directives.

As part of this study the implications of increased sewage discharges from development and the impact of proposed solutions to wastewater treatment on the river quality has been assessed. Chapter 4 presents the assessment on wastewater treatment in the Mease catchment.

3. Planning Context

3.1 Planning Considerations

Housing targets for local authorities have previously been guided by Regional Spatial Strategies (RSS). NWLDC is identified as being within the Leicester and Leicestershire Housing Market Area in the East Midlands Regional Plan, with a proposed target of 10,200 dwellings to be delivered between 2006 and 2026. The focus of development was proposed as being mainly in Coalville, which was identified as a Sub-Regional Centre.

In June 2010 the Coalition Government stated its intention to abolish RSSs through the Localism Bill (later published in December 2010), which aims to encourage local planning authorities to be responsible for determining the right level of housing provision in their area, without the influence of regional housing targets. The Localism Act received Royal Assent in November 2011. Local Development Frameworks (LDF) and Core Strategies are to remain in place under the Localism Act (although the former are now referred to as Local Plans).

In order to progress the preparation of the LDF in response to changes in the planning context, a Cabinet report was submitted in March 2011 which considered some key issues for the Council's Core Strategy preparation. The conclusions of the report in relation to development in the District were:

- The period to be covered by the Core Strategy should be retained as 2006 to 2026;
- No changes should be made to the overall development strategy in view of the proposed revocation of the RSS, although it was recommended that Coalville be referred to a 'Main Town' instead of a 'Sub-Regional Centre';
- A housing target of 8,000 dwellings in the District for the period 2006 to 2026 is recommended as the likely minimum to be required as part of the Core Strategy, to reflect historic rates and new household projections; and
- It is suggested that the development focus is maintained in Coalville, but that the amount of development in Coalville be reduced, distributing approximately 700 dwellings to other Rural Towns in the District.

This information was the latest available when the Detailed WCS was commissioned and the water quality and sewer modelling tasks were commencing. The housing numbers and distribution of housing used for assessments in this Detailed WCS are based on these conclusions and are discussed further in **Section 3.1**.

It should be noted that the results of the consultation on this report were considered and a subsequent cabinet report was submitted in October 2011. This later report also considers the draft National Planning Policy Framework (NPPF), which places greater importance on meeting local needs and so also places more weight on providing the evidence to support growth. The conclusions of the revised report are listed below:

- The period to be covered by the Core Strategy should be extended to 2031, in line with the recommended minimum 15 year period in the emerging NPPF;

- To reflect the increased period to 2031, a revised housing target of 9,700 dwellings is proposed;
- As of 31st March 2011 about 3115 new homes had been built, under construction, with planning permission or granted to be resolved, leaving a residual of about 6,585 dwellings to be delivered across the District; and
- The focus of development should still be located at Coalville, but various evidence base documents, including this WCS, should be considered for the final decision on housing distribution.

The range of proposed housing numbers used in this WCS (**see Section 3.2**) are therefore still valid as they include the proposed revised housing total across the District. The proposed range of housing numbers used to assess water quality and sewerage implications in Ashby, Measham and Coalville are also still within the revised targets.

3.2 Growth Options

In order to assess the impact of development on the water cycle elements (including wastewater treatment, water quality, water resources and drainage), the proposed scale and location of development are usually required. The development plan for the District has not yet been confirmed as it will be informed by the WCS. A range of growth options in terms of housing numbers have therefore been considered and this is set out in more detail in this section.

Prior to the change in government in May 2010, growth targets were driven by the Regional Spatial Strategies (RSS), for which the East Midlands Regional Plan was relevant to the District and required 10,200 homes to be built between 2006 and 2026.

In the Council's Cabinet Report (March 2011), the Government's Localism Bill (December 2010), new household projections and historic completions in the District were taken into account resulting in recommendation for reducing the housing target to 8,000 for the period 2006 to 2026.

Due to some uncertainty around the acceptance of this recommendation at the start of this stage of the WCS, it was agreed with the steering group that both a high growth (10,200 homes) and low growth (8,000 homes) option be considered when investigating solutions for wastewater treatment. Uncertainty also exists around the location of development, therefore for the lower growth option (8,000 homes) three different spatial options were provided. A summary of the options provided is listed below:

- Option 1: High Growth, 10,200 target;
- Option 2: Lower Growth, 8,000 target focussed in Coalville but with high growth in Ashby;
- Option 3: Lower Growth, 8,000 target focussed in Coalville but with additional growth in Ashby and Castle Donington; and
- Option 4: Lower Growth, 8,000 target, growth spread around District.

Between 2006 and March 2010, 2317 homes had either been developed, were under construction or had been granted planning permission. A remaining target of either 7,883 or 5,683 was therefore required, based on the targets of 10,200 and 8,000 respectively.

The indicative distributions of the remaining housing targets across the District under these four options was provided by the Council for the purposes of this study, and are presented in Table 3.1 below.

Table 3.1 Indicative distributions of housing across the District

	Option 1 High Growth	Option 2 Lower growth but high growth in Ashby	Option 3 Lower growth but additional growth in Ashby & Castle Donington	Option 4 Lower growth but additional growth spread around
Ashby	451	936	436	386
Coalville	5725	3623	3623	3623
Ibstock	444	337	337	437
Kegworth	116	49	49	99
Castle Donington	670	455	955	605
Measham	295	208	208	258
Rest of district	182	75	75	275
Total (residual target)	**7883**	**5683**	**5683**	**5683**

In order to undertake the sewer modelling and water quality modelling, the Council provided a range of housing sites and their capacities that might come forward to meet these various spatial housing options within Ashby, Measham and Coalville (where more detailed modelling has been carried out for this study). This also provided a worst case scenario for development sites that might have capacity for more housing than needed to be met for the residual target. **Table 3.2** provides the breakdown of potential sites and the maximum capacity for houses, which has been used in more detailed assessments throughout the study.

Table 3.2 Potential housing sites to meet the spatial option targets

		Ashby	Coalville	Measham
Option 1 High Growth	**Potential sites and total dwellings per site**	A3* Holywell Spring Farm - 500	C23 S Grange Rd – 4500 C19 Stephenson Green – 1800 C40 Standard Hill - 500	M1 Youth Club and M9 Adjacent to A42
	Total	500	6800	350
Option 2 –Lower growth in district but high growth in Ashby	**Potential sites and total dwellings per site**	A5 Money Hill – 1600 OR A7 Packington Nook - 1100	C23 S Grange Rd – 4500 C40 Standard Hill - 500	M8 Bosworth Road– 77 M6 Measham Brick Works – 410
	Total	1100 / 1600	5000	487
Option 3 – Lower growth in district but additional growth Ashby (+200) and Castle Donington	**Potential sites and total dwellings per site**	A3 Holywell Spring Farm - 500	C23 S Grange Rd – 4500 C40 Standard Hill - 500	M6 Measham Brick Works – 410
	Total	500	5000	410
Option 4 – Lower growth in district but with additional growth spread around	**Potential sites and total dwellings per site**	A1 Leics Rd – 259 A9 Moira Rd - 85	C23 S Grange Rd – 4500 C40 Standard Hill - 500	M11 Leicester Road – 300
	Total	344	5000	300

* code references refer to the SHLAA site references

The minimum and maximum potential housing numbers in these three settlements that have been used throughout this assessment are therefore as follows:

- Ashby 344 to 1600 dwellings;
- Coalville 5000 to 6800 dwellings; and
- Measham 300 to 487 dwellings.

4. Wastewater Treatment in the River Mease Catchment

This chapter summarises the assessment of wastewater treatment solutions for development within the River Mease catchment within the District, to overcome existing constraints in relation to river water quality, particularly in terms of phosphorus levels. The main focus of this study is the review of wastewater treatment options for development in the Ashby and Packington areas. The Packington WwTW is considered to be the largest point source contributing to phosphorus in the River Mease (EA, 2011). The Measham WwTW has also been assessed as it is the second largest works discharging into the River Mease. In order to assess the impact of growth (and subsequent changes to sewage discharges) on river water quality, the following steps were taken:

- Review of wastewater treatment technologies for phosphorus removal (**Sections 4.1 and 4.2**);
- Undertake high level screening of options for phosphorus removal to inform the more detailed assessments (**Section 4.3**);
- The EA undertook water quality modelling using their recalibrated model of the River Mease, to quantify the impacts of selected wastewater treatment options on the river phosphorus levels (**Section 4.4**); and
- Carry out sustainability analysis of all options using agreed sustainability criteria (**Section 4.5**).

The results of the water quality modelling and sustainability assessment are presented and used to inform the preferred solution for both short term and long term wastewater treatment in Ashby, Packington and Measham.

Throughout the assessment, regular updates were provided to the steering group, and interim results discussed at steering group meetings to ensure that the assessment took into account the requirements of the Council, EA, Natural England and Severn Trent Water.

4.1 Wastewater Treatment for Phosphorus Removal

The introduction of the EU Urban Wastewater Treatment Directive (UWWTD) in 1991, and the resulting Urban Wastewater Treatment Regulations for England and Wales in 1994, was the first nationwide stimulus for phosphorus removal for UK wastewater treatment works. The driver was the protection of rivers to control nutrient enrichment (eutrophication). Since that time another driver has been the Habitats Directive, which has required tightening of sewage discharges to help achieve Conservation Objectives. Currently where wastewater treatment employs phosphorus removal, the consent limit is either 1 or 2 mg/l according to the volume of the discharge. The consent limits have been set based on the requirements of the UWWTD and are regulated by the Environment Agency by permits (previously known as discharge consents) via the Environmental Permitting Regulations 2011.

4.1.1 Review of UK Treatment Technologies

Currently the following techniques are used for phosphorus removal from wastewater treatment works in the UK:

- **Biological nutrient removal (BNR)** based on the activated sludge process. A specific type of bacteria with a capacity to accumulate a high phosphorus content is used. The bacteria accumulate the phosphorus which is separated from the wastewater flow;

- **Chemical treatment systems** use dosing of a metal solution which causes soluble (dissolved) phosphorus to precipitate, which is then removed as a sludge for further treatment and subsequent disposal or reuse. The metals used are iron or aluminium;

- **Sand filtration** processes are also often used downstream of chemical treatment systems to provide tertiary treatment to help reach the 1 mg/l consent;

- **Reed beds** are constructed wetlands that comprise a certain type of media (e.g. gravel/sand) planted with reeds. P removal can be achieved by accretion, adsorption/desorption, precipitation/dissolution, and plant/microbial uptake. Sewerage providers can use reed beds as a 'polishing' stage at rural works following conventional treatment to give a cleaner effluent. Although they are used to remove phosphorus and can have an uptake of up to 60% (BRE, 2001), there is very little data available on the phosphorus limits discharged from reed beds in the UK. They are typically used as an additional level of treatment to help reach the 1 mg/l consent requirement. They are not used to reliably achieve lower levels than this in the UK;

- **Phosphate recovery** is used to produce phosphate enriched pellets precipitated out of the sewage sludge, this can be used as fertiliser or in other phosphate processing industries. The process costs can be high and depend on high levels of nutrient in the effluent to make it economically viable;

- **Package Treatment Plants** can be used for smaller developments or individual properties. They use a range of treatment processes including: Activated Sludge; Biological Filters; Rotating Biological Contactor; Submerged Aerated Filter; or Sequencing Batch Reactor. However, if low levels of phosphorus are required in the effluent, package plants may require additional sand filtration or reed beds to polish the effluent further before discharge to the environment. There is currently little evidence available as to the concentration of phosphorus that can be produced by small package treatment plants.

Water companies tend to use biological treatment, with chemical dosing and sand filters, or a combination of these processes, to remove phosphorus from sewage to meet the EA requirements. These processes are well tested and are regulated by the Environment Agency. Regular monitoring of the outflow is used to ensure that the processes are compliant with environmental permits. The Environment Agency expects all new properties to be connected to a wastewater treatment works if possible so that good treatment performance can be more reliably controlled and so that there is a robust and properly funded plan in place in case of failure. More information on the Environment Agency's policy for wastewater treatment is summarised in **Appendix B**.

If properties cannot be connected to the sewer network provided by the water company, alternative methods of treatment are required such as package treatment plants and reed beds, which can be used on smaller properties or developments. Although considered to be a sustainable option, there is a limit on the lifetime of the media used to adsorb contaminants. Therefore, regular maintenance is required to replace both the reeds and media typically

every 7 to 10 years (http://www.wte-ltd.co.uk/reed_bed_sewage_treatment.html). Alternative methods of treatment may be subject to applications for environmental permits/abstraction licences. The impact of flooding of reedbeds and of remobilisation of silts and the potential release of phosphorus back into the river will also be considered.

Maintenance is also required to ensure the reeds continue to grow and to prevent blockages in both the inlet and outlet structures. A reed bed used as a polishing plant for a sewage works might only be expected to have a lifespan of 11 to 12 years based on current use of reed beds. This lifetime is based on the requirement to replace the media which can become blocked or clogged with sludge. The temperature can also affect the performance of reed beds. Recent cold winters in the UK in 2009 and 2010 have led to freezing conditions which can reduce the effectiveness of reed bed treatments (www.wte-ltd.co.uk).

4.1.2 Review of Treatment Technologies outside the UK

In 2010, WRc Ltd undertook a review of wastewater treatment removal for phosphorus on behalf of Natural England (Natural England, 2010). A review of technologies and consent limits in other parts of Europe was included. Tighter phosphorus limits of 0.3mg/l as an annual average standard are required in parts of Germany, Sweden, the Netherlands and Southern Ireland. This level tends to be achieved by biological P removal and 2 stage chemical dosing in the activated sludge and secondary settlement tanks. Sand filtration is also used at some works. A final effluent concentration of 0.18mg/l is reported in Germany, and between 0.19 and 0.3mg/l in Sweden. The Dutch Foundation for Applied Water Research (STOWA) reported that a tertiary sand filter fitted to a treatment works which uses chemical dosing upstream, may reach a P concentration of less than 0.15mg/l. In the United States compliance with consents as low as 0.1mg/l have been reached through tertiary filtration supported by chemical dosing. Average effluent concentrations range from 0.007 to 0.2 mg/l through advanced treatment using biological P removal, chemical dosing and filtration.

Whilst high levels of P removal have been demonstrated in some countries, climatic factors should be taken into account as temperature can affect the treatment processes significantly. There are trials ongoing in the UK for processes that may achieve lower than 1 mg/l P, however as these are in early stages there are no published data available on the effluent quality being achieved. It should also be noted that the UK is the only country in Europe that designates Iron as a specific pollutant under the WFD. Reaching the limits quoted in the WRc report from other countries may therefore not be achievable in the UK due to the need to meet iron consent limits (i.e. higher iron dosing to reach P levels may lead to a breach in iron levels and will therefore not be acceptable).

The cost and sustainability of treatment technologies are also considered in the WRc report. Increased greenhouse gas emissions and construction and operating costs are associated with advanced levels of treatment. An example of tightening a consent from 1mg/l to 0.5mg/l for a works serving a population equivalent of 16,000 is presented, which results in a 92% increase in operating costs and 47% increase in operational greenhouse gas emissions.

4.2 Existing Wastewater Treatment in the River Mease catchment

Surveys of the River Mease show that diatoms indicate eutrophic conditions. Macrophytes have also been surveyed and were shown to indicate eutrophic, or at risk of being eutrophic, conditions (Appendix 8 of the SAC

Water Quality Plan, EA, 2011). The River Mease was designated as a sensitive area (eutrophic) under the UWWTD in 2007 and therefore phosphorus removal was required at Packington WwTW. The site at Packington was the only works required to have phosphorus removal/treatment under the UWwTD due to the volume of effluent it treats (the UWWTD requires works with greater than 10,000 population equivalent to have phosphorus removal).

During the Asset Management Period[4] 4 (from 2005 to 2010) Severn Trent Water also invested in phosphorus removal at three other works as a result of compliance with the Habitats Directive in the River Mease catchment: at Donisthorpe, Norton juxta Twycross and Snarestone. The remaining works in the catchment, with the exception of Smisby (due to its small size), also have phosphorus removal planned for the next AMP5 period (2010 to 2015).

The consent limits for the treatment works in the River Mease catchment are summarised in Table **4.1**.

Table 4.1 Wastewater Treatment Works P consent limits in the River Mease catchment

Wastewater Treatment Works	Receiving Watercourse	P consent[5]	Start date for consent
Smisby	Gilwiskaw Brook	N/A	
Packington	Gilwiskaw Brook	1mg/l	2012
Norton Juxta Twycross	River Mease	2mg/l	2008
Snarestone	River Mease	1mg/l	2008
Measham	River Mease	1mg/l	2012
Donisthorpe	Hooborough Brook	1mg/l	2008
Overseal	River Mease	1mg/l	2013
Netherseal	River Mease	2mg/l	2013
Clifton Campville	River Mease	2mg/l	2012
Edingale	River Mease	2mg/l	2012

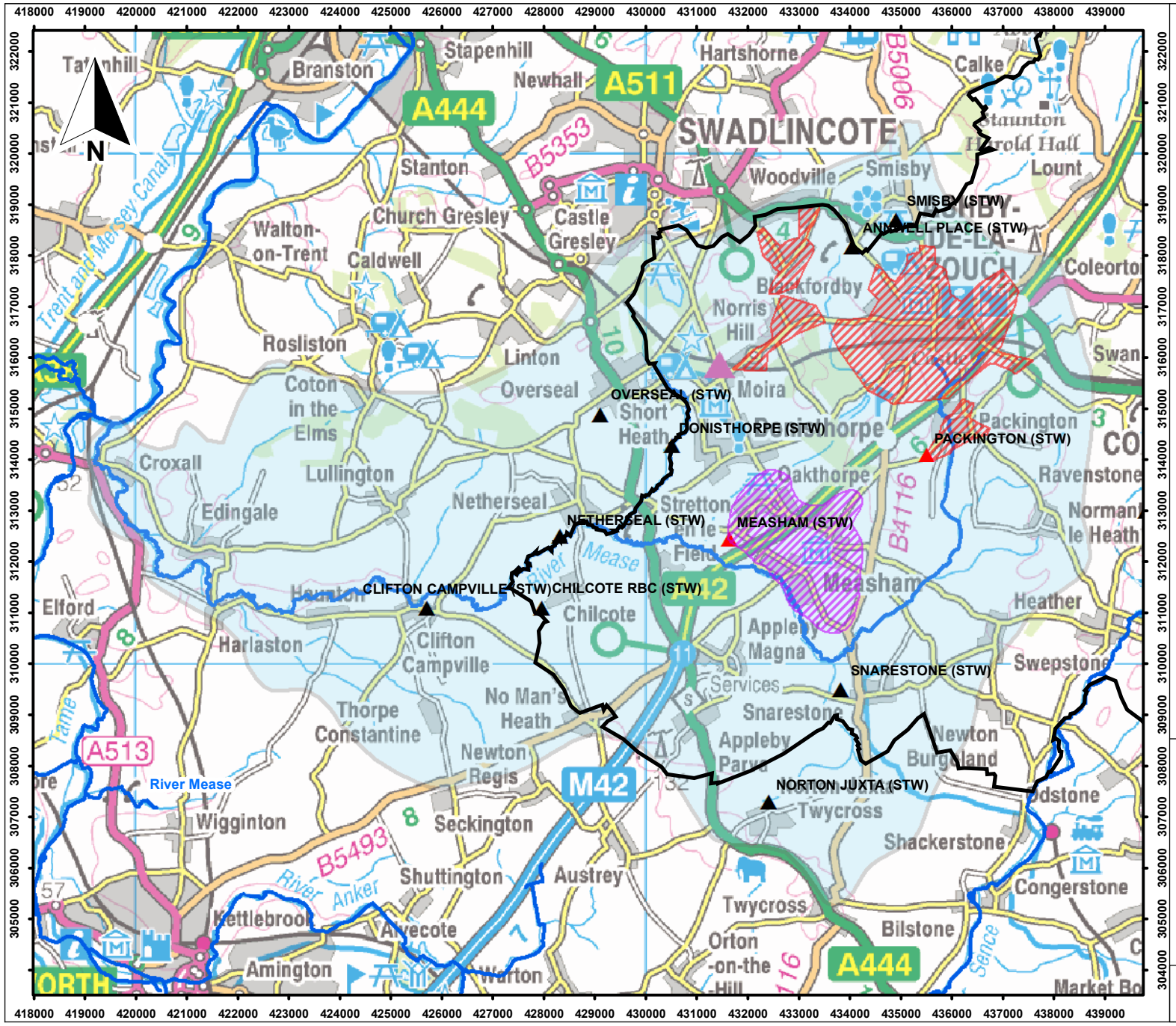
The location of the wastewater treatment works in the catchment of the River Mease are shown in **Figure 4.1**. This figure also shows the different 'catchments' that are referred to in this report. The 'Mease catchment' covers the natural watershed of the River Mease including all of its tributaries. The catchments of Packington and Measham WwTW describe the sewer network areas that drain to either Packington or Measham wastewater treatment works.

[4] Asset Management Planning, in which improvements in infrastructure are planned for, funded and delivered in 5 yearly planning cycles. We are currently in AMP5 period, from 2010 to 2015.

[5] WwTW consents are for Total Phosphorus

Packington WwTW currently uses biological removal and, by March 2012, will be augmented with chemical dosing to achieve the 1mg/l consent. Measham WwTW will use chemical dosing and sand filters for phosphorus removal.

The relative contribution to phosphorus in the river from these sewage works has been assessed by the Environment Agency in the River Mease SAC Water Quality (Phosphate) Management Plan (2011) using the permitted flow and quality limits from each works. It indicates that Packington WwTW contributes the greatest load due to the volume of effluent it treats compared to the other smaller WwTWs. Measham WwTW is the second most significant WwTW discharge. As the majority of development proposed in the River Mease catchment would be in the Packington or Measham sewerage areas, these two works are the focus of this assessment.



Key:

- North West Leics District Boundary
- River Mease catchment
- Approximate River Paths
- ▲ Wastewater Treatment Works
- ▲ WwTW in Detailed Assessment
- Packington WwTW catchment area
- Measham WwTW catchment area

Meters

0 — 5,000

Scale: 1:150,000 @ A4

H:\Projects\HM-255\26271 NW Leics WCS\Drawings\GIS\mxd

North West Leicestershire District Council
Detailed Water Cycle Study

Figure 4.1
Wastewater Treatment Works in the Mease Catchment

January 2012
29438-b001 pitkl

amec

4.3 Screening of preferred WwTW Options

Following the objection to future development in the catchment and the Public Inquiry for the Packington Nook development site, developers have come forward to propose private sewage treatment with the aim of progressing development without further objection. As the Conservation Objective for phosphorus is 0.06mg/l under the Habitats Directive in the River Mease, the developers proposals are for sewage treatment processes that will reach 0.06mg/l P, assuming that this will result in no negative impacts on the river. As discussed already, there is significant uncertainty and therefore risk associated with meeting this level of treatment in the UK, within reasonable economic limits. Nevertheless, developers have proposed wastewater treatment and river treatment options, including reed beds for specific developments, reed beds to treat treated effluent from sewage works, and treating the existing river quality through diverting it through reed beds to reduce phosphorus levels.

In parallel to developers proposing their own treatment options, Severn Trent Water also commissioned a study to review a strategic option to transfer part of the sewerage from Ashby to another sewerage catchment that doesn't discharge to the River Mease. The aim of this option is to permit development in Ashby by transferring the untreated effluent from existing homes out of the catchment, thereby freeing up headroom at Packington WwTW for wastewater flows from new development. In theory this would result in no net change to the flow and quality in the final discharge.

Transferring all of the effluent from sewage works in the River Mease catchment to another works is not considered to be a feasible option as this would result in a reduction in flow in the river. Flow was identified as an issue in the Review of Consents with three actions taken as a direct result: two related to taking flow from existing abstraction licence holders and a third involved setting up an agreement for a group of farmers (spray irrigators) to limit their combined volume.

Although not exhaustive, **Table 4.2** sets out some of the proposed options to deal with wastewater treatment from new development within the Packington WwTW catchment, taken from developers' proposals and from the sewerage provider and regulator. The environmental benefit that these options might bring was considered in order to decide which options should be considered for more detailed assessment in this study. It should be noted that the technical feasibility of these options was not considered in detail at this stage, although comments are included in the table under 'Other Issues'.

It should be noted that this 'screening exercise' did not take into account official screening or sustainability criteria as this was not included in the original scope of the detailed study. This screening assessment is therefore not compliant with the Strategic Environmental Assessment Directive, but rather provides an overview of potential environmental benefit only.

Table 4.2 Screening of Wastewater Treatment Options Proposed for River Mease Catchment

Wastewater Treatment Option	Environmental Benefit	Other Issues	Consider in Detailed Assessment?
1 No change - send flows from new development to Packington WwTW within DWF consent	No environmental benefit. Potential degradation of quality in river.	Technically feasible – no change to existing and planned processes	Yes – use as baseline
2 Maintain load - send flows from new development to Packington WwTW but improve treatment to maintain load This means that to compensate for increased flow rate, treatment process will need to be improved to reduce concentration of phosphorus in the treated sewage discharge	No environmental benefit or disbenefit. Expect to maintain existing P levels but unlikely to deliver improvement.	Technically feasible.	Yes
3 Developers own private treatment, discharged to environment – new developments use private package plants/reed beds that discharge directly to the river (not through Packington WwTW), consented to 0.06mg/l phosphorus in the treated wastewater	Potential environmental benefit but high environmental risk due to uncertainty regarding treatment ability of plants and reed beds to reach required P level.	It is not known if phosphorus limits of less than 1mg/l can be achieved reliably. Similarly most reed beds aim for 1mg/l P. There is no evidence that a consent of 0.06mg/l can be reliably achieved in the UK This option would also require application to the Environment Agency for an environmental permit	Yes
4 Polishing plant – new developments fund and operate a polishing plant for Packington WwTW to provide further treatment of the treated effluent.	Yes, potential benefit resulting in improved quality in the River Mease	Severn Trent would not take responsibility or liability for a plant operated by a third party, therefore the construction and operation would need to be funded by developer contributions. No consents of lower than 1mg/l have yet been set in the UK	Yes
5 Partial Transfer to Stanton WwTW - take flows out of catchment to Stanton WwTW, which serves Swadlincote in the neighbouring South Derbyshire District. The purpose of this option would be to make headroom for new development draining to Packington WwTW, so that there would be no change to the existing baseline. i.e. transfer effluent from 2000 homes to Stanton works, to allow room for development of 2000 homes that would drain to Packington works	No environmental benefit, but expected to maintain existing quality. Potential disbenefit if flows from Packington are reduced (e.g. if the effluent from 2000 homes was diverted from Packington to Stanton works, but only 1000 homes were built in the Packington catchment).	Technically feasible There could be timing issues. The transfer pipeline could take 18 to 24 months to complete, and the completion of new developments could take less than 24 months	Yes

Wastewater Treatment Option	Environmental Benefit	Other Issues	Consider in Detailed Assessment?
6 Transfer to River Trent - take all treated sewage from the outfall at Packington WwTW and discharge to River Trent	Potential environmental disbenefit. Option would lead to significant reduction in flow in the Gilwiskaw Brook, which could affect the ecology of the Brook and the River Mease.	Technically feasible Severn Trent Water would only consider transferring all of flow for cost effectiveness of option. If only a proportion of flow was transferred, they would still incur treatment costs at Packington and would not fund this as well as the transfer. Flow was identified as an issue in the Review of Consent and it is therefore considered that removal of flows may not be favoured by the EA.	No
7 Transfer to other sewage works further downstream on the Mease to benefit from dilution in river - take sewage from new development in the Packington area to other works in catchment	No environmental benefit. The nearest available works is Measham which is already proposing a 1 mg/l consent. Expected that no benefit/change in quality will be detected	Feasibility would depend on capacity of receiving works. As this option is not considered to provide any environmental benefit, it is not considered further	No
8 Developer's own treatment that discharges to sewer – new developments use package treatment plants/reed bed to provide treatment and polishing of effluent to 0.06mg/l phosphorus before discharging to sewer	No environmental benefit. Disbenefit from additional carbon cost of treatment which ultimately is not required: flows would eventually mix with untreated effluent with higher P levels when flows arrive at the works, therefore private treatment would be wasted.	As above there is no certainty that phosphorus limits of less than 1mg/l can be achieved. There is no evidence that a consent of 0.06mg/l can be reliably achieved in the UK	No
9 Divert river – send flows from new development to Packington WwTW but divert river through additional treatment plant	Potential benefit to water quality downstream of treatment, but potential disbenefit to stretch of river that would be diverted. This option would involve abstracting flow to remove phosphorus, which could impact ecology of river and low flows targets.	Technically feasible Uncertainty around who would fund this, and whether abstraction licence would be granted by the Environment Agency, required for taking water out of the river	No
10 Sealed cess pits - new developments use sealed cess pits which are then tankered to Packington WwTW	No environmental benefit	Packington WwTW couldn't accept tankers as it is not licensed to do so, and Stanton WwTW does not have a licensed waste reception licence. The nearest works that could is at Burton-upon-Trent, Claymills WwTW. A development of 1000 homes would need 14 tankers a day, therefore not suitable considering the proposed development numbers. Cess pits are generally not considered suitable as a long term solution for sewage treatment in the wider catchment.	No
11 Combination of private treatment works and using Packington WwTW	Probably unmeasurable impact Private treatment used for some new development will only treat a small proportion of the wastewater entering the river.		No

Based on the potential environmental benefit and a general overview of other factors, as listed in the Other Issues section, options 1 to 5 from the table above were selected and agreed by the steering group to take forward to the next stage and quantify the impacts on river quality. The options are described in more detail in **Section 4.3.1** below.

4.3.1 Options Selected for Water Quality Modelling

Option 1: Do Nothing

This option assumes that new developments within the Packington and Measham WwTW catchments would connect to the sewer network and therefore effluent would be treated at the sewage works, based on the existing processes operating at the works. It is assumed that the 1 mg/l P consent would be maintained, but that flow rates would increase slightly as a result of the new developments. The water quality modelling assesses the impacts of a high and low growth scenario under this 'business as usual' option on the phosphorus levels in the River Mease.

Option 2: Maintenance of Load

Under this treatment option, new developments in the Packington and Measham WwTW catchments would connect to the existing works but treatment processes would be tightened if and when the existing flow consent was exceeded (i.e. when the existing headroom/flow capacity of the discharge permit was reached). A lower concentration of phosphorus would need to be achieved at the treatment works (i.e. lower than the existing 1mg/l consent) in order to offset the impact of the increased flow rate above existing flow consent from new developments. This would be implemented by the issue of a new quality criteria on the sewage works discharge consent/environmental permit, and would maintain the existing phosphorus load[6] entering the river. In reality this is likely to include additional chemical dosing as part of the existing treatment process at the sewage works.

This "Maintenance of Load" option therefore suggests that a new water quality consent is imposed only when the existing headroom (or flow capacity) is used up, rather than imposing a new water quality criteria immediately, and before flow capacity is used up. This is because the imposition of a new quality criteria on the existing volumetric consent conditions would amount to the imposition of an additional quality obligation beyond what has been funded for through the OFWAT periodic review process and Severn Trent would appeal this on principle. It would be considered unfair by Severn Trent to request customers to pay for a quality improvement that has not been subject to OFWAT scrutiny. An appeal process is likely to be lengthy and might not resolve the issue, as there would be a possibility that Severn Trent would win the appeal. Severn Trent are only likely to appeal if a tighter permit limit was imposed on the quality of the discharge within the existing headroom, rather than on the Maintenance of Load approach. If the permit is tightened through the OFWAT periodic review process, this should not cause Severn Trent to appeal.

[6] load in mg/kg = flow rate in l/s x concentration in mg/l

As the proposed growth levels are a small percentage of the existing population served by both Packington and Measham, in reality additional treatment may not be required –a concentration of less than 1 mg/l will already be aimed for at the works to ensure that the consent for 1mg/l over an annual period is achieved. However, if additional treatment was required, it is likely that this would involve additional chemical dosing.

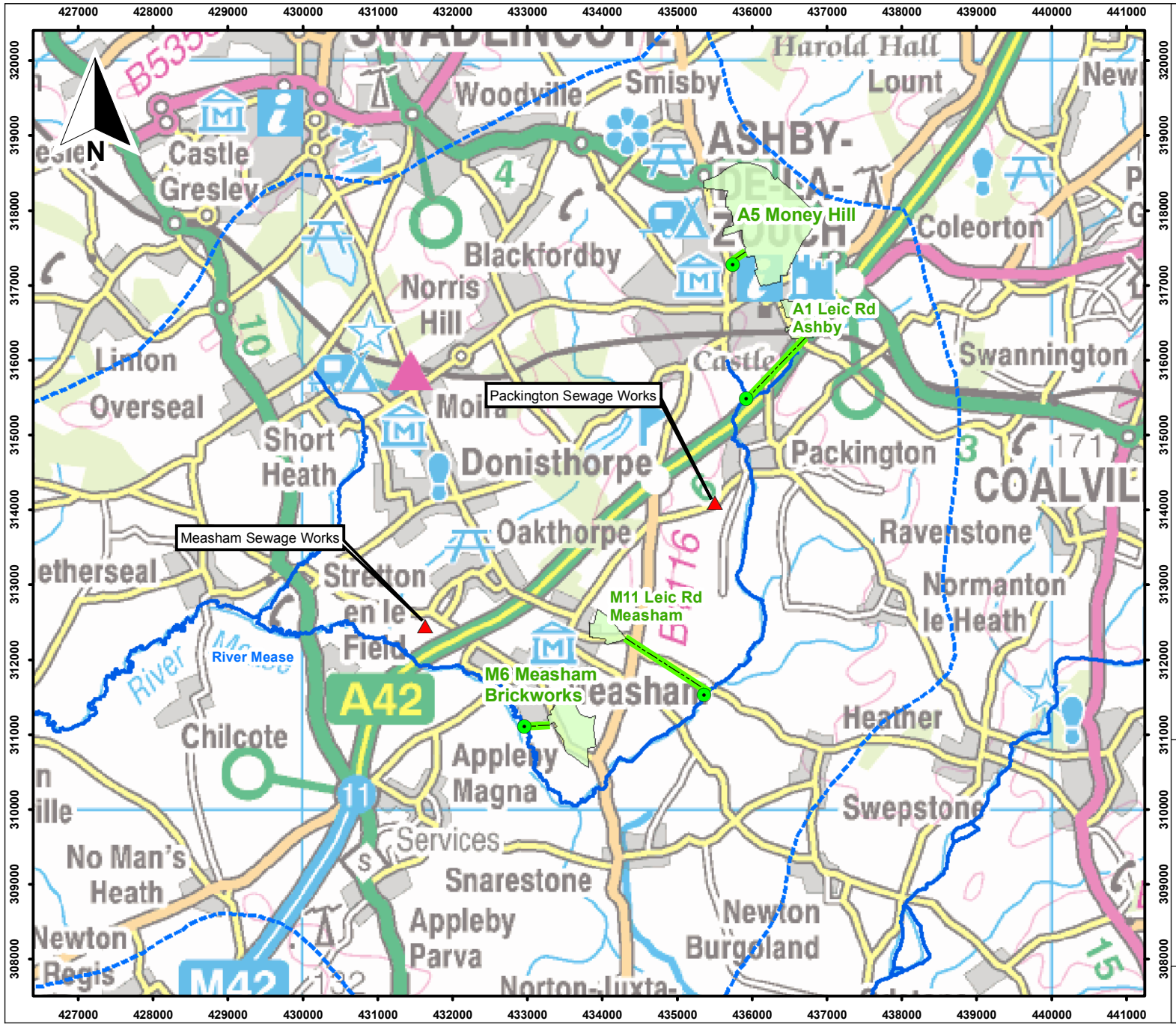
The water quality modelling assesses the impact of this 'maintenance of load' approach under a high and low growth scenario.

Option 3: Private Treatment at New Development Sites

This option involves separate private treatment at each development site. In order to simplify the modelling scenarios and to take account of the uncertainty regarding which sites will come forward, only two sites in Ashby/Packington and two sites in Measham have been considered under different growth scenarios. It has been assumed that new development will not drain to the Packington or Measham WwTW, but will establish a new private treatment plant, funded and operated by the developer, which discharges directly to the River Mease. This could in theory be provided by a package treatment plant and/or reed bed facility etc.

The effluent quality consent put forward by developers in some cases has been to achieve a discharge quality of 0.06mg/l in line with the Habitats Directive standard for the River Mease. The risks associated with this option have been described already in **Section 2.3**, and it is currently unknown and un-proved that this level of treatment can be achieved reliably by either package treatment plants or reed beds. The discharge may also require an application for an environmental permit.

The water quality modelling does not take account of the treatment method used or the risks involved, but assesses the impacts on the river quality if this theoretical option were achieved. However, a slightly more conservative value of 0.25mg/l consented P is also modelled to determine impacts on the river from improved treatment, but considering that 0.06mg/l may not be achievable (i.e. value of 0.25mg/l chosen based on review of technologies and levels achieved in other countries of between 0.15 and 0.3mg/l – see Section 4.1). **Figure 4.2** sets out the proposed locations of discharges and housing numbers assumed to compare the results for high and low growth.



Key:

- North West Leics District Boundary
- River Mease catchment
- Approximate River Paths
- Sites identified as using reedbeds, for modelling purposes
- Indicative locations for discharge (i.e. nearest point in model discharges can enter river)
- Indicative connection between site and discharge into river
- Wastewater Treatment Works

Meters

0 5,000

Scale: 1:150,000 @ A4

H:\Projects\29438 NW Leics WCS\Drawings\GIS\mxd

North West Leicestershire District Council
Detailed Water Cycle Study

Figure 4.2
Potential discharge locations for developers reed bed/private treatment used in water quality modelling

April 2012
29438-b002b pitkl

amec

Option 4: Polishing Plant at Wastewater Treatment Works

Under option 4, further treatment of the final effluent would be achieved by diverting the treated sewage outflow from Packington and/or Measham WwTW through a reed bed / polishing process. The additional treatment would treat all of the flow discharging from the treatment works (i.e. would take the existing flow plus flow arising from new development) with the aim of achieving lower P concentrations than the current discharge consent limit of 1mg/l P. Under normal circumstances, additional treatment beyond the consent level agreed by the sewerage provider would be required to be funded and operated by another party. Further discussion on this issue is included in the more detailed assessment in **Section 4.5** Sustainability Assessment.

If reed beds were to be used, they would need to be designed using a suitable media capable of absorbing phosphorus. Usually reed beds are not designed for P removal and therefore have a different type of media/gravel base.

For the water quality modelling a high and low growth scenario is used to assess the impacts of improved treatment on the river quality against the Habitats Directive target of 0.06mg/l P in the river. The discharge quality from the additional treatment is modelled as being 0.06mg/l P to determine the theoretical affect of reaching this level in further treatment. It should be noted that there is no evidence in the UK of this level of phosphorus being achieved through a reed bed treatment. The impact of providing a polishing treatment / reed bed on either Packington or Measham WwTW is also assessed.

A sensitivity analysis has also been used to model discharges from the additional treatment/polishing plant assuming a level of 0.25mg/l P is achieved. However it should be noted that this level is also idealistic and has not been demonstrated by processes yet in the UK.

Option 5: Transfer to Stanton WwTW

The potential for this option was explored at a very strategic/indicative level by Atkins on behalf Severn Trent Water in 2010. It involves transferring some of the flows from the Packington sewage network directly into Stanton WwTW, serving Swadlincote in the neighbouring South Derbyshire District (transferring flows into the sewer network draining to Stanton WwTW was discounted as this would result in increased sewer flooding).

Two locations in the network were identified in the Atkins report, where flow could be taken out of the system before it reaches Packington works. It was advised by Severn Trent Water that if a transfer was required, then the only viable location to transfer the flow from would be the Willesley Lane Pumping Station. The pumping station serves the sub-catchments of Norris Hill/Blackfordby, Moira Road South and Moira Road North, with a consented pass forward rate of 75l/s. This option would allow the transfer of effluent from this pumping station, which serves approximately 5071 population equivalent[7] directly to Stanton WwTW. A new pipeline would be required,

[7] Assuming an average occupancy rate of 2.26, a population equivalent of 5071 is equal to approximately 2243 homes.

following the route of the freight railway and comprising 5.98km rising main and 3.42km gravity sewer, both of 300mm diameter.

Assuming that the same number of homes are built in the catchment compared to the number that are transferred then it would be expected that no net change in flow or effluent quality would be observed. This option was therefore not included in the water quality modelling exercise. However, mass balance calculations are used to assess the impact on water quality immediately downstream of Packington, in a scenario where fewer homes are built compared to the number transferred to Stanton WwTW.

This option would also require careful consideration to be given to the interim ecological impact on the River Mease catchment and the impact on protected rights and other water users, until such time as new development re-establishes the current flow regime in the River Mease catchment.

Summary of Options and Water Quality Modelling Criteria

The housing numbers and water quality criteria are summarised in **Table 4.3** below.

Table 4.3 Details of options used in water quality modelling

Option Description	Growth Scenario*	Consent Level	Reasoning for Consent
Option 1: Do Nothing	1a High Growth	Packington WwTW = 1mg/l Measham WwTW = 1mg/l	Existing quality consent
	1b Low Growth	Packington WwTW = 1mg/l Measham WwTW = 1mg/l	Existing quality consent
Option 2: Constant Load	2a High Growth	Packington WwTW = 0.913mg/l Measham WwTW = 0.912mg/l	Revision of quality consent based on existing flow
	2b Low Growth	Packington WwTW = 0.980mg/l Measham WwTW = 0.944mg/l	Revision of quality consent based on existing flow
Option 3: Private Treatment at New Development Sites	3a High Growth	Discharge from development sites = 0.06mg/l	Conservation Objective
	3b Low Growth	Discharge from development sites = 0.06mg/l	Conservation Objective
	3c High Growth	Discharge from development sites = 0.25mg/l	Conservative best estimate, based on WRc report from treatment in other countries
	3d Low Growth	Discharge from development sites = 0.25mg/l	
Option 4: Polishing Plant at Wastewater Treatment Works	4a High Growth Polishing at Packington **and** Measham WwTW	Packington WwTW = 0.06mg/l Measham WwTW = 0.06mg/l	Conservation Objective
	4b Low Growth Polishing at Packington **and** Measham WwTW	Packington WwTW = 0.06mg/l Measham WwTW = 0.06mg/l	Conservation Objective

Table 4.3 (continued) **Details of options used in water quality modelling**

Option Description	Growth Scenario*	Consent Level	Reasoning for Consent
	4c High Growth Polishing at Packington WwTW **only**	Packington WwTW = 0.06mg/l Measham WwTW = 1mg/l	Conservation Objective Existing quality consent
	4d High Growth Polishing at Measham WwTW **only**	Packington WwTW = 1mg/l Measham WwTW = 0.06mg/l	Existing quality consent Conservation Objective

*High Growth = 1600 homes in Ashby / Packington, 487 homes in Measham
Low Growth = 344 homes in Ashby / Packington, 300 homes in Measham

4.4 Water Quality Modelling

4.4.1 Methodology

The Environment Agency's SIMCAT model of the River Mease has been used to assess the impacts of Options 1 to 4 on phosphorus levels in the River Mease. The model was re-calibrated by the Environment Agency for the purpose of this study, to ensure that the recent improvements in water quality in the River Mease (between 2005 and 2011) were accounted for. The revised parameters for discharge flow rates and discharge quality were provided to the Agency by AMEC, based on the scenarios listed in **Table 4.3** above. Modelling was undertaken by the Environment Agency and the results provided back to AMEC.

Simple mass balance calculations were undertaken by AMEC to assess the impacts on water quality from Option 5, under the high growth scenario, which would result in effluent from 5071 population equivalent being removed from the sewer network, but effluent from only 3616 population equivalent[8] being introduced to the network from new development. The calculations combine the flow and concentration upstream, with the flow and concentration of the discharge, to calculate the concentration in the river downstream of the discharge.

$$\text{P concentration downstream of discharge in river} = \frac{\text{Flow in river upstream} \times \text{P concentration} + \text{Discharge flow} \times \text{P concentration}}{\text{Flow downstream in river}}$$

[8] The population equivalent can be estimated by multiplying the number of homes by the average occupancy rate of 2.26. Under the high growth scenario for development in the Packington WwTW catchment, 1600 homes corresponds to 3616 PE

4.4.2 Assumptions

The modelling exercise has been used to provide indicative results only, as a number of assumptions have been used to account for uncertainties associated with the proposed wastewater treatment solutions. The assumptions used in the modelling are listed below in **Box 1**.

Box 1 **Assumption used in Water Quality Modelling**
No changes in diffuse pollutant loads
Private treatment from developments discharged at the following grid references (see Figure 4.2 above) - NGR 436054 317194 serving Money Hill development site - NGR 432957 311110 serving Measham Brickworks site - NGR 436550 316087 serving Leicester Rd, Ashby site - NGR 434162 312458 serving Leicester Rd, Measham site
Private treatment and polishing plants can reach 0.06mg/l and 0.25 mg/l (as discussed it is not proved in the UK that these levels can be reliably achieved in a cost effective solution)
Only foul flows from developments accounted for in each option
No increase in surface water run-off

These assumptions should be taken into consideration when viewing the modelling results.

4.4.3 Results and Discussion

The graphs in Fi**gures 4.3 and 4.4** show a summary of all the results for the high growth and low growth scenarios respectively. The existing (baseline) quality in the River Mease and the target for phosphorus are also displayed. The subsequent **Figures 4.5 to 4.9** show each wastewater treatment option compared to the baseline and target, and compares the impacts of high and low growth on the river quality.

Figure 4.3 Summary of results under high growth scenarios

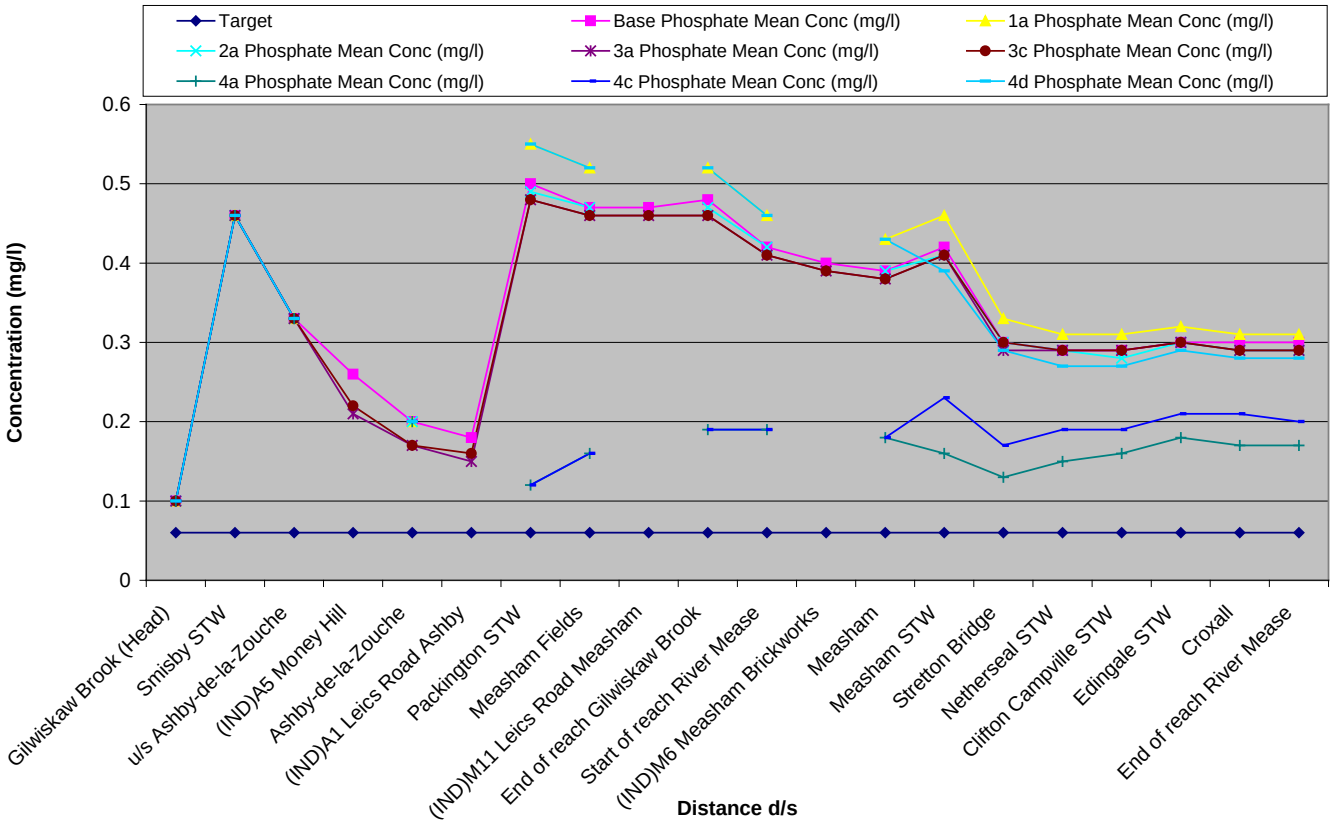
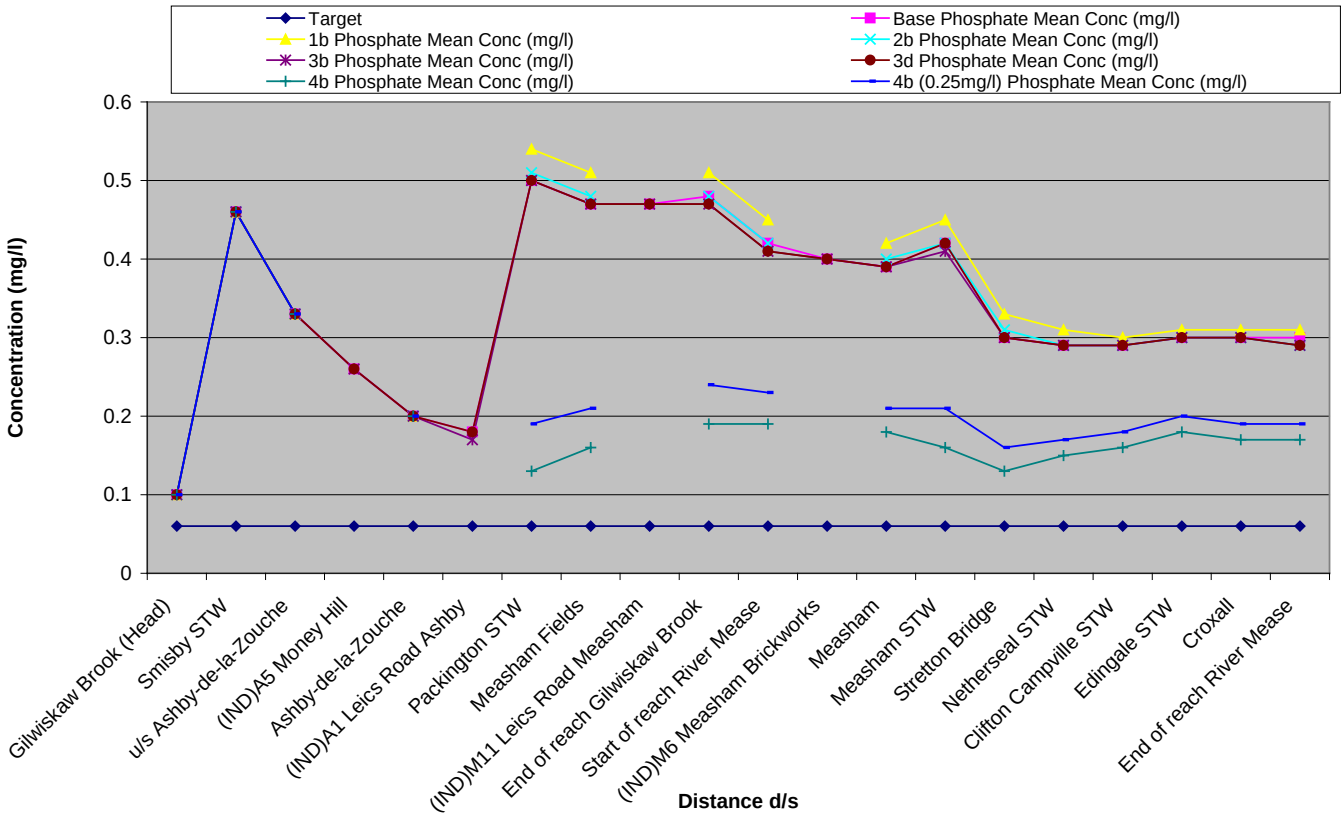


Figure 4.4 Summary of results under low growth scenarios



Figures 4.3 and 4.4 both show that under each option the target level is still exceeded. They also both suggest that Options 4a and 4b, the treatment option that uses polishing plants at both Packington and Measham WwTW with a discharge quality of 0.06mg/l, would see the biggest reduction in phosphorus levels in the river. Whilst this option demonstrated the best results, the modelling does not take account of the technical feasibility and there are still concerns regarding the P level that can be cost effectively achieved in wastewater treatment.

Option 4c, which uses a polishing plant at Packington WwTW only, has the next biggest improvement in river quality. This option achieves the same P levels in the river up until the discharge from Measham WwTW enters the river. The Measham WwTW without polishing increases P levels only from 0.16 to 0.23mg/l immediately downstream of the discharge. This effect is further diluted at the end of the river (the difference at the end of the Mease is 0.03mg/l when comparing Option 4a and 4c). The overall impact on river quality from Option 4d (polishing plant at Measham WwTW only) is not significantly different to the baseline. There is no change upstream of Measham WwTW, and downstream of the works the reduction in P levels is in the order of 0.03mg/l, suggesting that Measham works is not a large contributor of P to the river.

The benefit of using private treatment plants (such as reed beds / package plants) to serve new developments only (Options 3a – 3d) again does not provide significant improvements in phosphorus levels in the river compared to the baseline or compared to Option 2 which maintains the existing loading to the river. Option 3 assumes the theoretical treatment of effluent from new developments to 0.06mg/l, however it does not take account of technical

feasibility and there are still concerns regarding the P level that can be cost effectively achieved in wastewater treatment. A sensitivity option of achieving 0.25mg/l has also been modelled. The results are presented in **Figure 4.7** and demonstrate that even with a slightly higher level of P discharged from new development sites; improvements in the river quality are minimal. This is because the volume of flow being discharged to the river is relatively small compared to the flow within the river; therefore the potential to improve the river quality is limited.

Results from option 1 demonstrate that if no additional treatment or solution is delivered, then phosphorus levels in the river will increase, further widening the gap between the river quality and the Conservation Objective level, and also disregarding the duties placed upon Member States by the Habitats Directive.

The impact on water quality from option 2 which would maintain the existing load into the river demonstrates that there would be no increase in P levels in the river, but that unless the tightened consent included an allowance for some restoration, there would also be no improvement or reduction in P levels towards the target level. It should be noted that the option will need to at least build in a precautionary buffer to be certain that no deterioration will occur.

In all options, **Figures 4.3 and 4.4** show that there is an increase in P loading in the river upstream of Packington WwTW, associated with discharges from Smisby WwTW. This is a much smaller wastewater treatment works operated by Severn Trent Water and serving a population equivalent of approximately 150. The works was recently upgraded in 2006 by Severn Trent Water and therefore they would not be in support of closing it. Improvements at Packington and Measham WwTW would be considered before additional expenditure at Smisby, which contributes relatively little in comparison to the other two works in the catchment.

The following pages show the results in more detail for each option that was modelled.

Figure 4.5 Model results for Option 1 Do Nothing

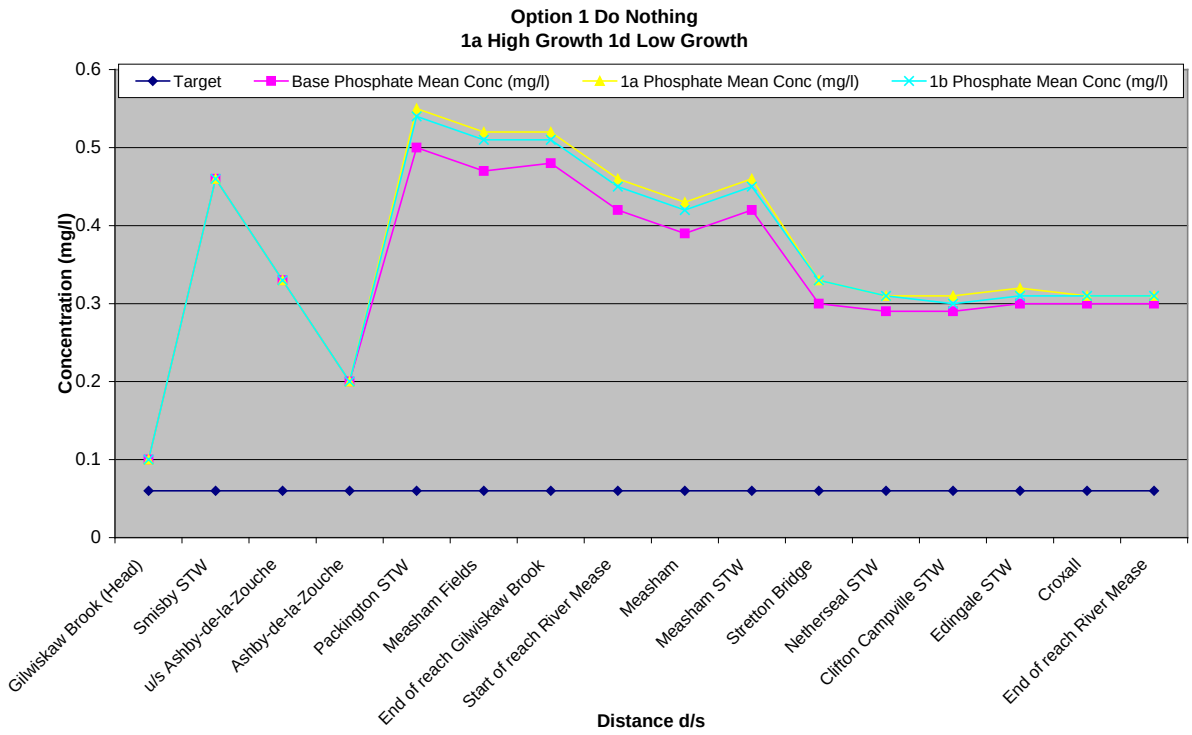


Figure 4.6 Model Results for Option 2 Constant Load

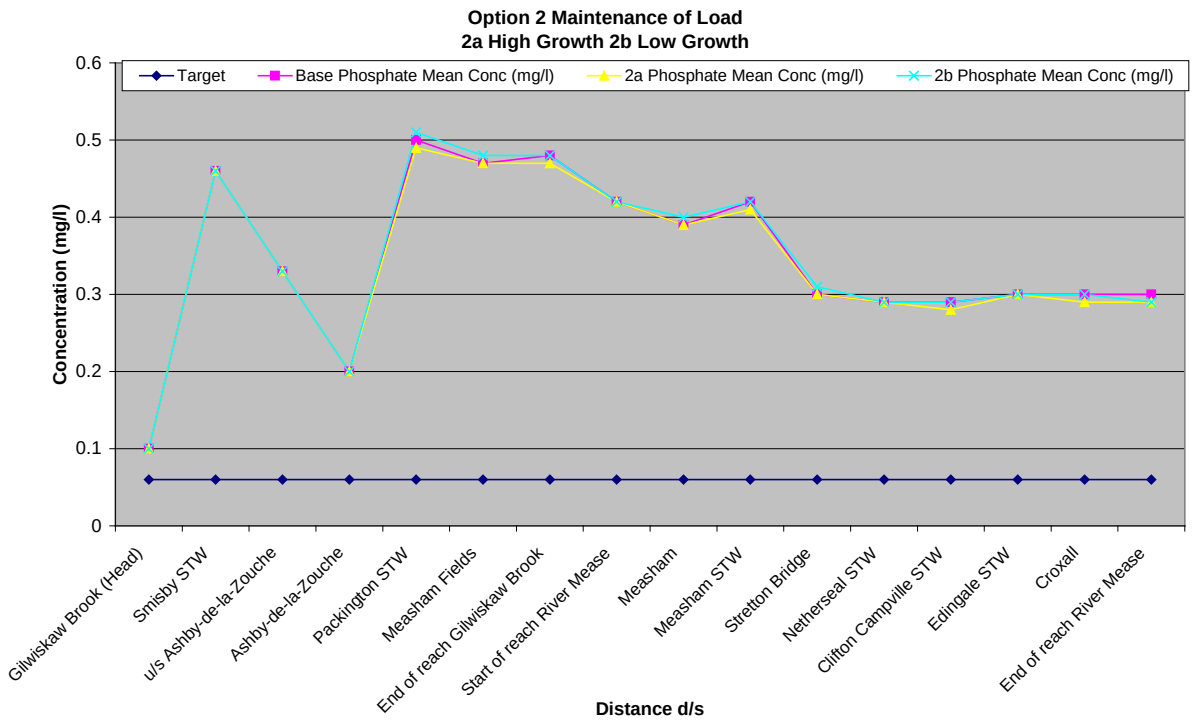


Figure 4.7 Model Results for Option 3 Private Treatment at Development Sites

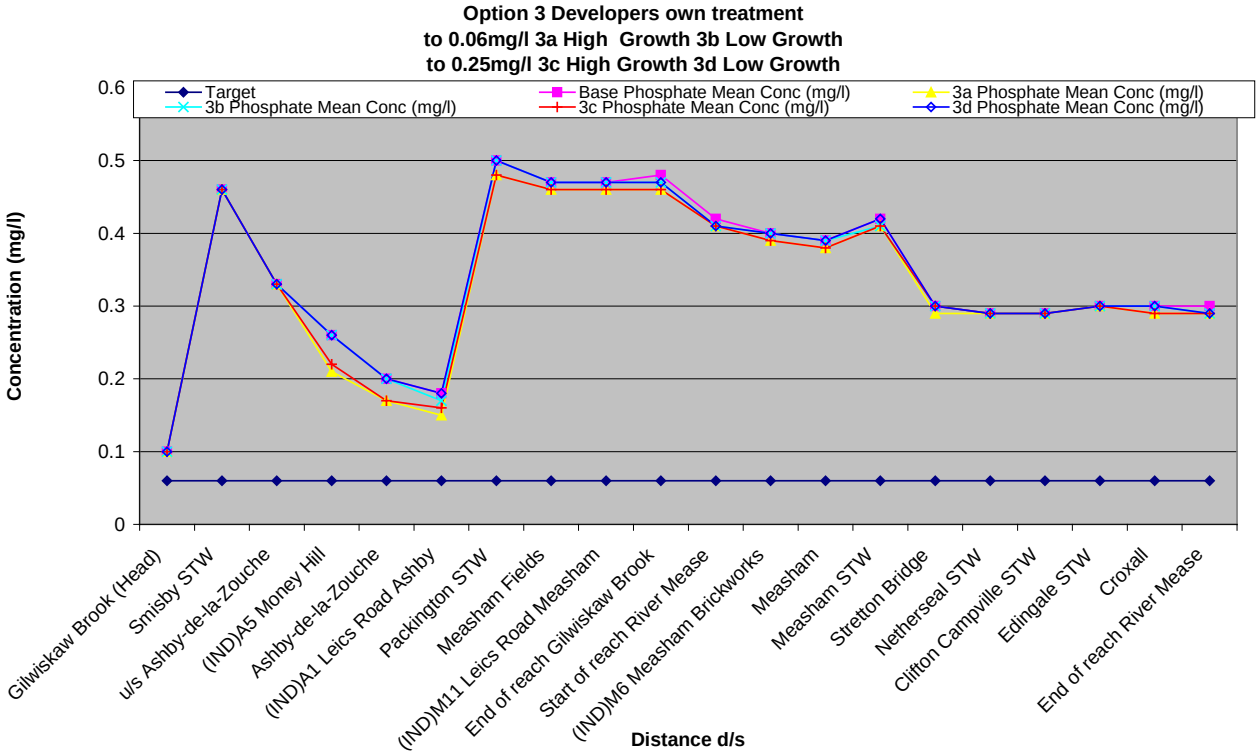


Figure 4.8 Model Results for Option 4 Polishing Plant treatment to 0.06mg/l

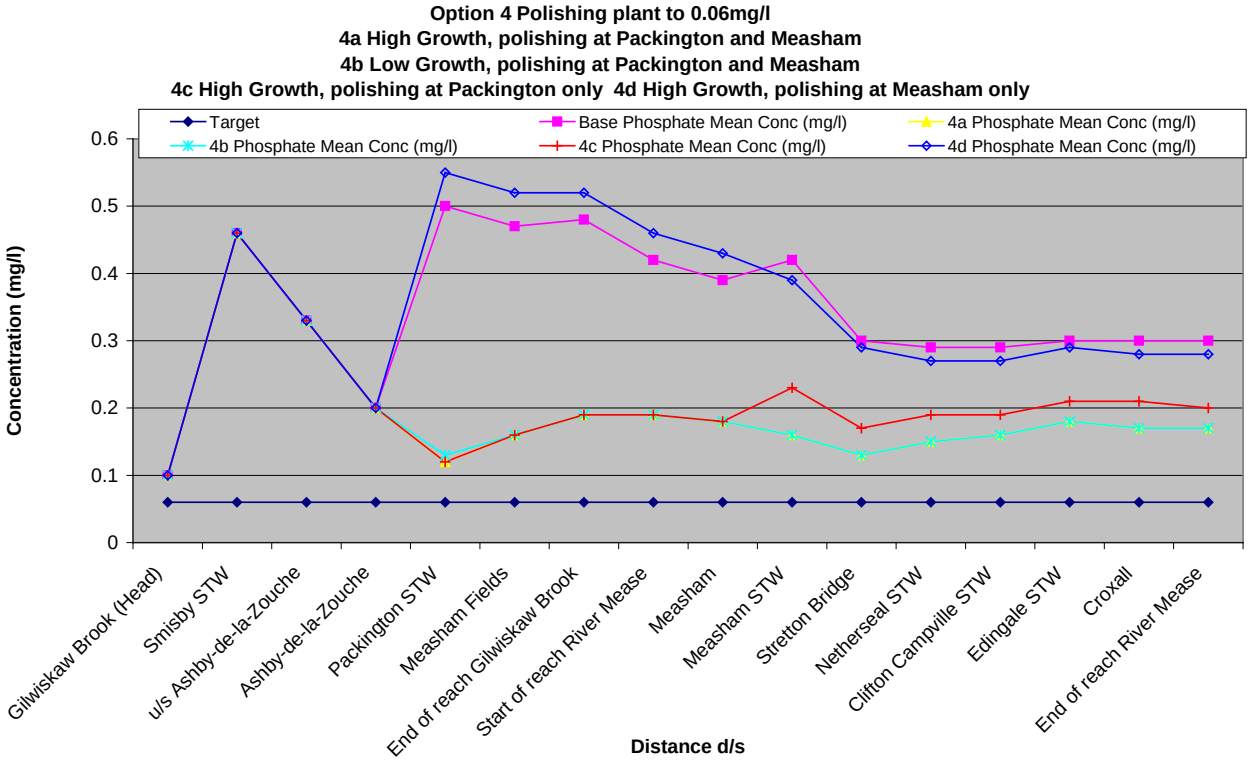
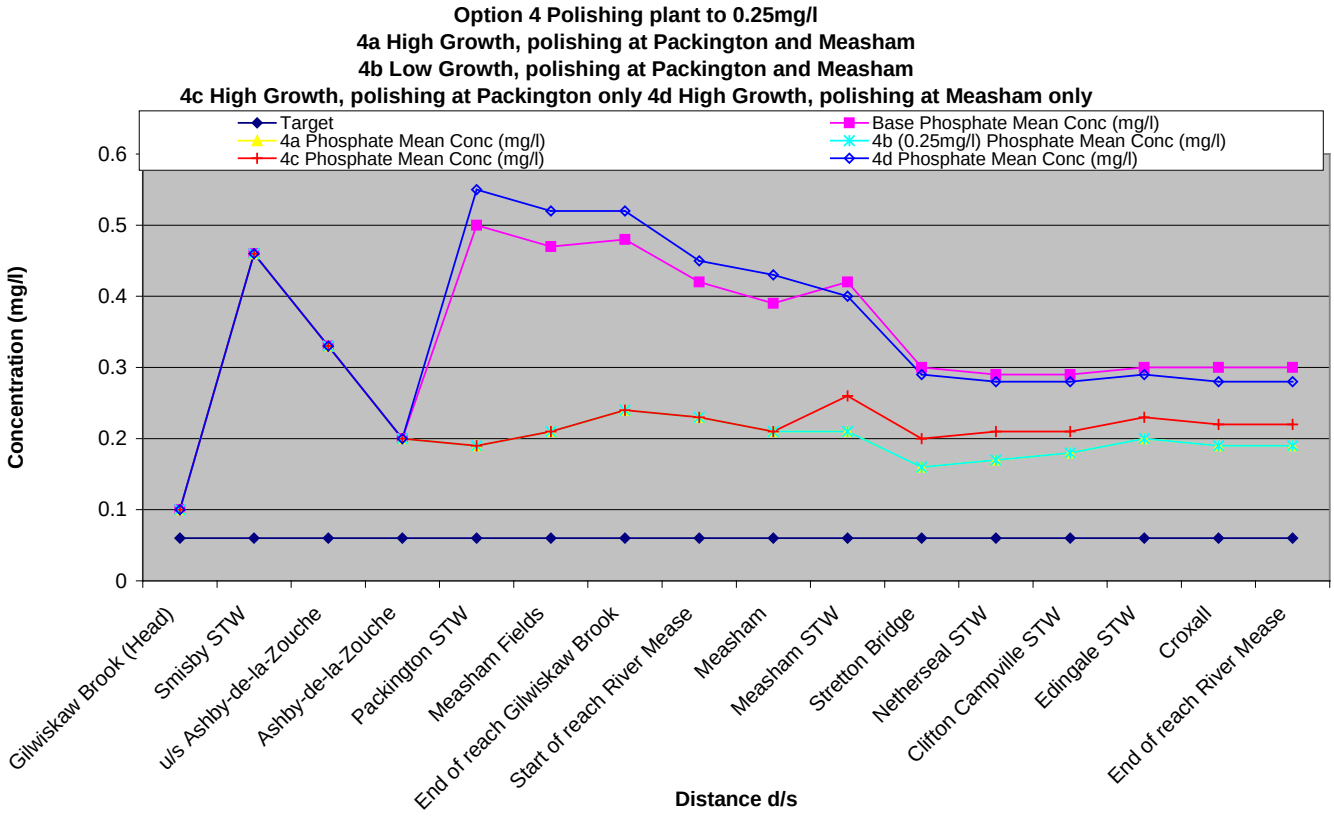


Figure 4.9 Model Results for Option 4 Polishing Plant treatment to 0.25mg/l



Under Option 5, transferring part of the effluent from the sewerage network in Ashby directly to Stanton WwTW in Swadlincote, it is assumed that this option would only be viable if there was no net change in flow or quality. This would have to be achieved by ensuring that the number of homes from which effluent was transferred out of the catchment approximately matched the number of new homes being built (there would need to be some consideration of different occupancy and water efficiency fittings, that would affect wastewater flows from developments).

Under the high growth option used in this study, there is an imbalance with more houses included in the transfer than are being proposed even under the maximum growth scenario for Ashby and Packington. This affects the flow rate to Packington WwTW, as the flow rate is dependent on the number of people living within the network catchment to the treatment works. A simple mass balance calculation has been used to determine the effects on water quality immediately downstream of the treatment works, under the high growth option. The upstream flow rate and phosphorus concentration have been provided from the River Mease SIMCAT model. The results are presented in **Table 4.4** below.

Table 4.4 Water quality Impacts from Option 5, High Growth

STW Final Effluent P mg/l	STW Final Effluent Flow (l/s)	Flow in Mease downstream of STW	P conc (mg/l) if upstream P = 0.183 mg/l
1	68.75 (Baseline)	180.44	0.494
1	66.12 (Transfer Scheme)	177.81	0.487

The results in **Table 4.4** show that if fewer houses are built in Ashby compared to the amount of houses from which effluent is transferred, then there would be a very slight improvement in river quality immediately downstream, but that there would also be a very slight reduction in flow rate. Flow was raised as an issue in the Review of Consents process, and as a result three actions arose to reduce abstractions. It is considered that removal of flows from the catchment may be considered unfavourable.

The decrease in flow could be further exacerbated depending on which development sites come forward, as sites A3 Holywell Spring Farm and A9 Moira Rd would drain to Willesley Road pumping station and would therefore also be taken out of the Packington WwTW flows.

4.4.4 Summary

This section has reviewed the impacts of each option on water quality in the River Mease against baseline and target levels for phosphorus. A number of assumptions have been used in the modelling, and no allowance or consideration of technical feasibility, land take requirements, cost or carbon footprint have been included.

The water quality modelling results alone indicate that additional treatment at Packington WwTW and Measham WwTW, Option 4a, could help to improve the water quality in the River Mease and provides the most significant improvement. A discharge of 0.06mg/l P from both treatment works, although modelled, would not meet the target level and more importantly is not currently considered to be economically feasible. The sensitivity run which models the discharge from both works as 0.25mg/l P also sees a significant improvement in river phosphorus levels.

Even if private treatment plants could reach the target level of 0.06mg/l P to treat effluent from new development, the improvement in the river phosphorus levels is very low. This is because the phosphorus levels are heavily dominated by the existing discharge from Packington WwTW.

The water quality modelling results also indicate that the growth options used (which assume a minimum and maximum growth in Packington and Measham) do not significantly affect the results under each option. Again this is because the levels of growth proposed are a relatively small proportion of the existing population, and therefore will only represent a small increase in wastewater flows compared to the existing baseline.

Section 4.5 below assesses each option against a range of sustainability criteria, including the impact on water quality and also an indicative carbon footprint, to provide a more holistic view of each option. This includes further discussion and recommendations on the preferred solutions.

4.5 Sustainability Assessment of Options

The purpose of the sustainability assessment is to provide a qualitative assessment of the likely *significant* effects on the environment of implementing the WwTW options and, where relevant, to propose measures to avoid, manage or mitigate any significant adverse effects and to enhance any beneficial ones. It provides a relative assessment of the strengths and weaknesses of the options proposed. It will also provide an indication of the option(s) that perform well from a sustainability perspective.

Information on the methodology for defining the scope of the assessment and setting the sustainability assessment framework, including definitions of significance for the assessment criteria are set out in **Appendix C**.

The sustainability assessment considers the five WwTW options, described in **Section 4.3.1**, including the three sub-options under Option 4:

- Option 1 - Do nothing;
- Option 2 - Maintain load;
- Option 3 - Private treatment at new development sites;
- Option 4 - Reedbeds/additional treatment process at sewage works; and
  - Packington and Measham sewage works;
  - Packington sewage works only; and
  - Measham sewage works only.
- Option 5 - Transfer part of Packington sewage catchment to Stanton sewage works.

4.5.1 Assessment Objectives and Guide Questions

The sustainability assessment uses a range of objectives to assess the potential effects of the proposed options. Each WwTW option is assessed against each of the objectives in turn. By completing the assessment of each WwTW option, each option's contribution to sustainability is identified; where it might have either a negative or positive effect, the significance of the effect and any appropriate mitigation or enhancement measures. This approach is consistent with that used in Strategic Environmental Assessment (SEA) and Sustainability Appraisal (SA).

The assessment objectives have been developed from an analysis of other relevant strategic assessments (either Strategic Environmental Assessments (SEAs) or Sustainability Appraisals (SAs)). These have included

assessments by Severn Trent, the EA and Council[9]. The analysis identified the common topics and relevant assessment objectives and criteria pertinent to this sustainability assessment. Consideration was also given to the possible environmental effects of the proposed WwTW options. **Table 4.5** provides a summary of the topics considered and outlines the reasons for their inclusion or exclusion.

Table 4.5 Basis for Scoping Topic Areas

Topic Area	Sub-topic Area	Propose to include in assessment?	Justification for Proposal
Biodiversity Protection and Enhancements	N/a	Yes	Packington WwTW is the main works discharging to River Mease SAC, which is currently failing to meet European standards on ortho-phosphate. Differing WwTW options will affect water quality and therefore ecosystem function and structure in this important site to differing extents. Potential loss of habitat and construction activities for new infrastructure under some of the WwTW options may also impact on biodiversity.
Environmental Sustainability	Water Quality and Resources	Yes	Differing WwTW options will affect water quality and resources to different levels, through changes to phosphorus treatment and potential changes to volumes of flow to the River Mease.
	Soil	Yes	Excavation and the loss of topsoil are likely to be required for a number of options, for example, in order to construct reed beds or for the new pipeline to Stanton WwTW.
	Waste	Yes	The requirement of construction of new infrastructure under several of the WwTW options will result in the need for new materials and generation of waste. There may also be opportunities for recycling and reuse during these options.
Population	Health	No	Impacts on air and noise pollution during construction and operation as well as changes to water quality and odour within the local area during operation are not expected to be of a scale likely to affect human health. No evidence has been found of recreation taking place along the stretch of river considered in this assessment
	Community	No	Given that the proposed WwTW options do not include any changes to housing, open space, land use patterns or community facilities it is not expected that it will impact on this topic.
	Economy	Yes	Although maintenance of all WwTW options is unlikely to result in any full time positions, the construction of new infrastructure may provide jobs of a scale that could impact on this topic. Benefits for the economy will be realised under each option from being able to enable development to take place. As this is the same for each option this particular aspect is not considered further.

[9] SEA Final Environmental Report of Severn Trent Water Ltd Water Resources Management Plan (WRMP) (June 2010); SEA of the Draft River Basin Management Plan for the Humber river basin district (Dec 2008); and Sustainability Appraisal of the North West Leicestershire Local Development Framework – Core Strategy Further Consultation (November 2008)

Table 4.5 (continued) Basis for Scoping Topic Areas

Topic Area	Sub-topic Area	Propose to include in assessment?	Justification for Proposal
Existing Infrastructure/ Landscape	Transport and built environment	No	Infrastructure for the WwTW options are not expected to impact on the transport network or built environment.
	Historical culture	No	Potential sensitive areas include the Conservation Area within Ashby-de-la-Zouch which is within close proximity to some of the proposed developments. However, the infrastructure required for WwTW options (if any) within these areas is considered to be less than that created by the new developments themselves and unlikely to have an impact on this topic.
	Landscape	Yes	The requirement of 9.4km of pipeline to transfer water flows to Stanton WwTW for treatment could have a visual impact on landscape, during the construction period, depending on the route of the pipeline. There is some opportunity for the reed beds once complete to provide a positive visual landscape impact. Once the reedbed is completed this may have a positive visual impact.
Energy Use and Climate Change	Energy Use	Yes	Energy use will be required for construction of any necessary infrastructure and may be required for operation of some WwTW options. This, in addition to the embodied carbon within materials used during construction, could contribute towards greenhouse gas emissions.
	Robustness to climate change	Yes	Changes to river flows as a result of WwTW options may exacerbate the vulnerability of water resources and water quality to the effects of flooding and drought.

The analysis was used to inform draft assessment objectives and guide questions which were sent to the Steering Group for comment and, following receipt of comments, were revised. The revised objectives and associated guide questions are presented in **Table 4.6**.

Table 4.6 Assessment Objectives and Guide Questions for the WwTW options

	Assessment Objective	Guide Questions
Biodiversity Protection and Enhancement		
1	Protection and enhancement of biodiversity, key habitats and species	*Will the WwTW option protect and enhance the status of the River Mease SAC?*
		Will the WwTW option protect and enhance UK Biodiversity Action Plan (BAP) Assets?
		Will the WwTW option increase biodiversity levels across the district?
		Will the WwTW option ensure the requirements of the Habitat Directive are met regarding water quality (i.e. the ortho-phosphate levels for River Mease SAC)?
		Will the WwTW option ensure the requirements of the Water Framework Directive are met regarding ecological status within the River Mease?
		Will disturbance from construction during the WwTW option affect biodiversity?

Table 4.6 (continued) Assessment Objectives and Guide Questions for the WwTW options

	Assessment Objective	Guide Questions
Environmental Sustainability		
2	Protection and enhancement of the water quality and resources	*Will the WwTW option lead to changes in river flows in River Mease and its tributaries?*
		Will the WwTW option affect the sustainability of water abstraction in the local area? (e.g. – by affecting flow rate)
		Will the WwTW option affect surface water quality (e.g. - phosphate levels) and quantity?
		Will the WwTW option ensure the requirements of the Water Framework Directive are met regarding chemical status?
3	Protection and enhancement of soil quality	*Will any excavation associated with the WwTW option have an effect on soil quality, variety, extent and/or compaction levels?*
		Will the WwTW option have an effect on soil function and processes?
4	Promoting the sustainable use of resources and minimising generation of waste	*Will the design and construction for the WwTW option seek to minimise the demand for additional raw materials?*
		Will the WwTW option encourage the reuse and recycling of waste?
		Will the WwTW option encourage sustainable design or use of sustainable materials?
Population		
5	Economy	*Will the construction stages of the WwTW option increase the number of jobs within the local economy?*
Existing Infrastructure/Landscape		
6	Protection and enhancement of landscape character	*Is it likely that the WwTW option will have a visual impact on landscape and townscape character?*
Energy Use and Climate Change		
7	Energy Use & Climate Change	*Is it likely that the WwTW option will result in an increase, directly or indirectly, in greenhouse gas emissions (including embodied carbon within materials in construction)?*
		Will the WwTW option promote the use of renewable energy sources and increase the proportion of the district's energy from renewable/low carbon sources?
		Will the WwTW option be affected by climate change (for example, changes in precipitation affecting flow rate, or flooding of sewage etc)?
		Will the WwTW option affect how climate change may impact on the wider environment?

The five options as described in **Section 4.3.1** have been assessed against each of the sustainability objectives and guide questions presented in **Table 4.5**. For each scenario, a commentary on the likely effects and a 'score' against the objective is provided. A guide to the scoring system used is provided in **Table 4.7**.

Table 4.7 A Guide to the Scoring System used in the Sustainability Appraisal

Score	Description	Symbol
Major Positive Impact	The proposed scenario contributes significantly to the achievement of the objective.	++
Minor Positive Impact	The proposed scenario contributes to the achievement of the objective but not significantly.	+
Neutral	The proposed scenario does not have any effect on the achievement of the objective	0
Minor Negative Impact	The proposed scenario detracts from the achievement of the objective but not significantly.	-
Major Negative Impact	The proposed scenario detracts significantly from the achievement of the objective.	--
Unrelated	The proposed scenario is unrelated to the sustainability objective	~
Uncertain	The proposed scenario has an uncertain relationship to the objective or the relationship is dependent on the way in which the aspect is managed. In addition, insufficient information may be available to enable an assessment to be made.	?

To ensure a consistent approach to interpreting the significance of the effects and to help the reader understand the decisions made by the assessor, a series of quantitative and semi-quantitative 'thresholds' have been defined (shown in **Appendix C**).

For objectives where there is a level of uncertainty where it is not possible to determine between two scores, this is reflected by adding both symbols and both of the appropriate colours within vertical lines.

The scores are only intended to serve as an indication to the types of effects that may occur based on the level of information considered. The findings of the assessment are presented in **Table 4.8**.

4.5.2 Assumptions and Uncertainties

As described in **Box 1** above there are a number of assumptions which will form the basis for all modelled options regarding water quality (i.e.- phosphorus levels). In addition to the assumptions made within the water quality models, a number of assumptions were made in the assessment of the WwTW options. These are presented in **Box 2.**

Box 2	**Assumption used in Sustainability Assessment**
Mean baseline phosphorus levels along the entire stretch of the River Mease are taken from the SIMCAT results as 0.343 mg/l, this is a result of both sewage discharge from Packington and Measham WwTW and discharge from other sources (including non-point discharge from agriculture). Changes to phosphorus levels given are solely as a result of changes in sewage discharge under the options considered. Pollution from other sources is assumed to remain the same as current levels.	
Options 1 and 2 will require no additional infrastructure, apart from small connections from developments to the sewage network. Options 3 and 4 will require construction of reed beds of varying sizes and small amounts of pipework for outlet collection and transfer. An assumed area of reed bed has been estimated, as set out in Table 4.8 below. This does not provide support for the reed bed option or suggest it is technically feasible, but is based on current reed bed design for tertiary treatment in the case of Option 4 (i.e. polishing level **after** treatment at the sewage works) and primary treatment for Option 3 (i.e. used to treat raw sewage and no previous level of treatment used).	
Developers may have also proposed to use other methods of wastewater treatment to achieve the 0.06mg/l P level. In order to limit and simplify the sustainability assessment, it has been assumed that reed beds only are used. If other methods of treatment are proposed, such as combined package treatment plant and reed beds for polishing or in river treatment, then the potential effects on sustainability criteria other than water quality (e.g. landscape, biodiversity, energy use) will be different.	
Option 5 will require the construction of new rising main and sewer pipework of a total length of 9,402 m following the route of the freight railway, under this option the pump at Willesley Road pumping station would also need to be upgraded. This is taken from Option 1 in the Packington Growth report for Severn Trent Water (Atkins, 2010).	
Length of construction will vary across the options.	
Each option assumes the maximum potential development (i.e. high growth option), for the purposes of the sustainability assessment.	
Options 3, 4 and 5 will result in the generation of a number of construction jobs, the total number of these is uncertain but expected to be within the scale of 5-50 jobs. The maintenance of all options is unlikely to generate any full time positions.	
The carbon accounting has assumed the following: • Sewerage needed to connect to the existing network under all options except Option 3 is estimated from the centre of the development site to the nearest manhole. Indicative pipe materials and diameters have been used based on assumed foul flows from the potential sites. • Under Option 5 it has been assumed that the transfer pipeline is constructed from polyethylene, and is mainly constructed in fields adjacent to the existing railway line. The two pumps at Willesley Road pumping station would also require upgrade by 20kW (Atkins, 2010). • Options 3 and 4 above ground assets are based on the assumed reed bed area as set out in **Table 4.8**. • Operational carbon at the WwTW would increase slightly under all options except Option 3 as a result of a slight increase in flow being pumped around the works. This doesn't take account of any potential reductions in flow, for example anticipated form the recent closure of the soap factory in Ashby. • The quantities of CO2 emitted as part of the construction and operation of each of the options is shown in the **Table 4.9** below.	

Table 4.8 Area of Reed Beds for Options 3 and 4[10]

Option 3	Option 4a	Option 4b	Option 4c
Reed bed at Money Hill 13,200m^2 (1.3ha)	Reed bed at Packington WwTW 6,000 m^2 (0.6 ha)	Reed bed at Packington WwTW 6,000 m^2 (0.6 ha)	Reed bed at Packington WwTW n/a
Reed bed at Measham Brickworks 5,850 m^2 (0.6ha)	Reed bed at Measham WwTW 1,728 m^2 (0.2 ha)	Reed bed at Measham WwTW n/a	Reed bed at Measham WwTW 1,728 m^2 (0.2 ha)
Total 19,050 m^2 (1.9ha)	**Total 7,728 m^2 (0.8ha)**	**Total 6,000 m^2 (0.6 ha)**	**Total 1,728 m^2 (0.2 ha)**

Table 4.9 Embedded and Operational CO_2 Emissions for each WwTW Option

	Option 1	Option 2	Option 3	Option 4a	Option 4b	Option 4c	Option 5
Embedded carbon (during construction) (in tonnes CO2)	227	227	1718	924	769	383	2064
Operational carbon (in tonnes CO2/year)	245	245	2	265	261	250	298

There are also a number of uncertainties relating to the high level sustainability assessment of the reed bed options, these are as follows:

- The exact locations and size of future developments and hence also the placement and size of reed beds under option 3 are not certain although assumptions have been made on their location and size;
- The concentration of phosphorus that can be reached in discharged effluent using reed beds for treatment is uncertain. This has been accounted for to some degree in the water quality scenarios with the use of two alternative effluent phosphorus concentration values; one consistent with the achievement of the Habitats Directive target of 0.06mg/l P in the river and one more conservative, 0.25 mg/l P (**see Section 4.4.2**). However, it is possible that in reality phosphorus levels may be greater than that identified and this is considered within the scoring of each of the relevant objectives (namely biodiversity and water objectives);
- As discussed earlier, conventional reed beds cannot yet reliably remove phosphates from receiving waters. Research is ongoing for a suitable filter media. A medium with a high phosphorus binding capacity is an important requirement of treatment wetlands if P removal is to be achieved. It is

[10] Reed bed areas estimated by ARM, based on flows used in water quality modelling. Areas for Option 3 based on reed bed requiring design to treat untreated effluent, reed beds for Option 4 (a-c) based on reed bed designed for tertiary treatment, receiving treated effluent from existing WwTWs. Areas provided are estimated and not detailed design, do not allow for loading of solids of effectiveness of P removal. No assessment is made on available land take. Further studies would be required for appropriate design.

assumed that reed beds used would have an appropriate media for P removal, as opposed to media used in conventional reed beds;

- The concentration of phosphorus in the receiving waters of the River Mease is uncertain and will be dependent on the assumed concentrations of phosphorus in the effluent discharged into the river. This has been subject to modelling, using the two different effluent concentrations of 0.25 mg/l P and 0.06 mg/l P. Within the assessment table (Tables 1.7 and 1.8), the concentrations stated use values calculated from a model using the 0.25 mg l/P value.

4.5.3 Assessment of Effects on WwTW Options

Summary Assessment

Table 4.10 presents a summary of the assessment for the WwTW options. This is followed by a more detailed breakdown of the assessment of effects in **Table 4.11**.

Please note that changes to phosphorus levels given within the assessment table are solely as a result of changes in sewage discharge under the options considered. Pollution from other sources is assumed to remain the same as current levels, unless other measures are taken. Even without discharge from the waste water treatment plants, phosphorus levels would still be significantly greater than WFD target of 0.12 mg/l and the Habitats Directive Conservation Objective of 0.06 mg/l. Therefore, although the WwTW options may result in a significant reduction in phosphorus levels, each option will be unable to reach the target levels (unless combined with a catchment wide initiative to address non-point sources of phosphorus pollution). This has been considered in the scoring for each objective (see **Appendix C** for definitions of significance for more detail)..

Table 4.10 Assessment results of the WwTW options

Options SA Objectives	Option 1 Do Nothing	Option 2 Maintain Load	Option 3 Private treatment at new development sites	Option 4a Reedbeds at Packington & Measham sewage works	Option 4b Reedbeds at Packington sewage works only	Option 4c Reedbeds at Measham sewage works only	Option 5 Transfer part of Packington sewage catchment to Stanton sewage works
Biodiversity Protection and Enhancement							
1. Protection & enhancement of biodiversity, key habitats and species	--	0/-	0/+	+	+	0/-	-
Environmental Sustainability							
2. Protection and enhancement of water quality and resources	--	0/-	0/+	+	+	0/-	0/-
3. Protection and enhancement of soil quality	0	0	-	-	-	-	-
4. Promoting the sustainable use of resources and minimising generation of waste	0	0	-	-	-	-	-
Population							
5. Economy	0	0	+	+	+	+	+
Existing Infrastructure/Landscape							
6. Protection and enhancement of landscape character	0	0	0	+	+	+	-
Energy Use and Climate Change							
7. Energy Use and Climate Change	-	-	-	-	-	-	-

Detailed Assessment of Effects

Full assessments of the potential effects of the WwTW options are presented in **Table 4.11 and 4.12**.

Table 4.11 Full Assessment matrices of WwTW options 1-3

SA Objectives	Option 1 Do Nothing	Option 2 Maintain Load	Option 3 Private treatment at new development sites
Biodiversity Protection & Enhancement			
1. Protection and enhancement of biodiversity, key habitats and species	-- Current mean phosphorus levels along the River Mease are 0.34mg/l and these significantly exceed the SAC conservation objective limit for the river of 0.06mg/l. This option will lead to a further increase of approximately 8% in mean phosphorus concentrations along the river which is likely to exacerbate existing adverse effects on biodiversity from eutrophication. The resulting reduced dissolved oxygen levels will be detrimental to species with important conservation value, such as bullhead and spined loach.	0/- Existing water quality will be maintained under this option. In consequence, the phosphorus concentrations will remain significantly greater than the 0.06 mg/l target within the conservation objective for the River Mease SAC. As a result, whilst the option will not exacerbate the existing effects on biodiversity from eutrophication, such impacts will still occur and will not be lessened. In addition to the negative effects arising, it represents a missed opportunity to improve water quality to be more in line with conservation targets.	0/+ The use of reed beds to treat the wastewater arising from the new developments may slightly improve water quality by reducing phosphorus concentrations by some 3% compared to current baseline conditions (assuming 0.25mg/l P can be reached). However, given that it is uncertain which level of phosphorus the reed beds can realistically achieve in the long term, changes to water quality may be even more slight and may do little to address current exceedances of the 0.06 mg/l P conservation objectives and 0.12 mg/l WFD target. The construction of reed beds at two development sites (Money Hill and Measham Brick Works) covering a total area of approximately 1.9ha will require considerable excavation and land take. However, it is expected that these sites will have low biodiversity value and therefore disturbance during construction and land take is only expected to have a minimal effect. Once the reed beds are completed this is likely to have a positive effect on biodiversity through habitat creation for a number of species, including reed warblers, newts and water voles.

SA Objectives	Option 1 Do Nothing	Option 2 Maintain Load	Option 3 Private treatment at new development sites
Environmental Sustainability			
2. Protection and enhancement of water quality and resources	-- Under this option the increase in sewage effluent generated from new developments sent to Packington and Measham sewage works with no additional treatment will result in a mean increase in phosphorus levels along the stretch of the river to 0.37mg/l compared to current levels of 0.34mg/l (an 8% increase). Both levels significantly exceed the WFD target and SAC conservation objective of 0.12mg/l and 0.06mg/l respectively. The levels will further affect eutrophication and levels of dissolved oxygen available to biota in the river. The greatest increases in phosphorus levels will be at and just downstream of the sewage treatment works where increases in phosphorus concentrations of up to 11% are expected, however these changes in phosphorus levels will decrease over distance from the discharge with levels elevated by an estimated 3% at the end of rivers reach within the sewage catchment. Although it is expected that the river flow will increase under this option (assuming no change to existing flows to the works) this is expected to be very slight compared to the total flow and therefore is not expected to have an impact on river flow or abstraction objectives.	0/- This option will maintain the existing water quality. This will be achieved through improving treatment of the additional sewage effluent from the new developments where necessary. In consequence, at 0.34mg/l, the phosphorus concentrations will remain significantly greater than the 0.12 mg/l target within the WFD for the River Mease. As a result, whilst the option will not exacerbate the existing negative effects on water quality, they will do nothing to address the current exceedances. Although it is expected that the river flow will increase under this option (assuming no change to existing flows to the works) this is expected to be very slight compared to the total flow and therefore is not expected to have an impact on river flow or abstraction objectives.	0/+ The use of reed beds at Money Hill to treat sewage effluent for 1600 homes may decrease phosphorus levels at and immediately downstream of the discharge point from reed bed by some 11-15% (based on P treatment levels of 0.25 mg/l being reached). However, these effects are localised and along the majority of the river the change is not significant, giving a mean reduction in phosphorus levels across the stretch of river Mease within the sewage catchment to 0.333 mg/l, roughly a 3% decrease from current levels. At 0.33mg/l, the phosphorus concentrations will remain significantly greater than the 0.12 mg/l target within the WFD for the River Mease. As a result, whilst the option may contribute to a very minor reduction, they will do little to address the current exceedances. Furthermore, accounting for uncertainty surrounding whether P treatment levels of 0.25 mg/l could be realistic met, it is possible that these small changes to phosphorus levels could be reduced further, resulting in even smaller changes to phosphorus levels, if any. Although it is expected that the river flow will increase under this option (assuming no change to existing flows to the works) this is expected to be very slight compared to the total flow and therefore is not expected to have an impact on river flow or abstraction objectives.

SA Objectives	Option 1 Do Nothing	Option 2 Maintain Load	Option 3 Private treatment at new development sites
3. Protection and enhancement of soil quality	0 As there will be no additional infrastructure required under this option (apart from small connection from developments to the sewage network) and therefore no subsequent need for excavation or removal of topsoil, this option will not impact on this objective.	0 As there will be no additional infrastructure required under this option (apart from small connection from developments to the sewage network) and therefore no subsequent need for excavation or removal of topsoil, this option will not impact on this objective. It is assumed that maintaining the load can be achieved within the current treatment operation	- Under this option a level of land excavation will be necessary to construct reed beds with a total area of approximately 1.9 ha across the 2 locations. However, it is expected reed beds will be designed such that the minimum cut volume is created, minimising total excavation needed and topsoil excavated from the site will be used to mix into the medium layer of the reed bed reducing any negative impact on this objective.
4. Promoting the sustainable use of resources and minimising generation of waste	0 This option will not result in additional use of resources or generation of waste.	0 It is assumed that maintaining the load can be achieved within the current treatment operation. Therefore, it will not impact on this objective.	- Many of the materials required within the reed bed media such as limestone, steel slag, soil will be easily obtainable from local sources. However, other materials, such as iron rich media may require to be imported from abroad. This would increase the need for fuel for transport, which would score badly against this objective. Furthermore, it is expected that reed bed media will become saturated with phosphorus within 7-10 years. This will result in the need to replace reed bed media with new materials every 7-10 years during the lifetime of the reed bed. The saturated media would then be treated as sludge and undergo waste water treatment. However, the re-use of excavated topsoil to mix into the medium layer of the reed bed will reduce the need for new materials in the first instance.

SA Objectives	Option 1 Do Nothing	Option 2 Maintain Load	Option 3 Private treatment at new development sites
Population			
5. Economy	There will be no additional jobs created under this option. 0	There will be no additional jobs created under this option. 0	There will be some generation of a small number of jobs during the construction of the reed beds but this will not be significant. + Once the reed beds are completed it is expected that there will be minimal maintenance work required, including horticultural care and monitoring, however, this will not result in a full time position.
Existing Infrastructure/Landscape			
6. Protection and enhancement of landscape character	As this option does not require the introduction of any infrastructure or change to activities it will have no impact on this objective. 0	As this option does not require the introduction of any infrastructure it will have no impact on this objective. 0	The construction of reed beds may require some temporary use of large scale equipment (such as diggers etc) which may cause very localised and transient visual intrusion. The extent to which this could be a detrimental effect will depend on the site and the extent to which it is visible from neighbouring sensitive receptors. 0 Once the reedbed is completed this may have a positive visual impact, however, given the small size of reed bed expected under this option, this impact is expected to be very minor.

SA Objectives	Option 1 Do Nothing	Option 2 Maintain Load	Option 3 Private treatment at new development sites
Energy Use and Climate Change			
7. Energy Use & Climate Change	Additional energy will be required to pump the increased sewage effluent expected from new developments around the network. This will increase emissions of operational carbon each year by roughly 245 tonnes but this is not considered significant. - Although it is expected that the river flow will increase under this option this is expected to be very slight compared to the total flow and therefore is not expected to affect the resilience of the river to flooding events given increasing frequency and severity of high rainfall events expected under climate change.	Additional energy will be required to pump the increased sewage effluent expected from new developments around the network. This will increase emissions of operational carbon each year by roughly 245 tonnes but this is not considered significant. - Although it is expected that the river flow will increase under this option this is expected to be very slight compared to the total flow and therefore is not expected to affect the resilience of the river to flooding events given increasing frequency and severity of high rainfall events expected under climate change.	Energy will be required during the construction of the reed bed (including the embedded energy in some of the construction materials used, the diesel used to transport the materials and the diesel used to excavate the reed bed). This is estimated to be approximately 1,700 tonnes of CO^2. - During operation there will be minimal energy required for pumping flow within the reed bed however this will be very small (roughly 2 tonnes of carbon a year). Reed bed system is designed to minimise any risks of flooding from River Mease so should not affect vulnerability to increasing flood risks under climate change.

Table 4.12 Full Assessment matrices of WwTW options 4-5

SA Objectives	Option 4 - Polishing plant at sewage works			Option 5
	4a Reedbeds at Packington & Measham sewage works	4b Reedbeds at Packington sewage works only	4c Reedbed at Measham sewage works only	Transfer part of Packington sewage catchment to Stanton sewage works
Biodiversity Protection & Enhancement				
1. Protection and enhancement of biodiversity, key habitats and species	+ Assuming that reed beds can treat sewage effluent to phosphorus levels of 0.25mg/l this option would significantly improve water quality by reducing mean phosphorus concentrations along the stretch of the river by some 37% compared to current baseline conditions. However, given that it is uncertain whether the reed beds can realistically achieve phosphorus levels of 0.25mg/l in the long term, changes to phosphorus levels in the river Mease may be substantially lower than this. Therefore, although this option is expected to make progress towards addressing current exceedances of the 0.06 mg/l P conservation objectives and 0.12 mg/l WFD targets it can not be said with any certainty that this would have a significant impact on species and ecological systems within the river (including species with important conservation status such as bullhead and spined loach). During construction of the reed beds considerable excavation, top soil removal and direct loss of the land will occur to construct 2 reed beds with a total land area of roughly 5.4 ha. However, it is expected that the land used and land within close proximity will be of a low biodiversity value and therefore minor.	+ Assuming that reed beds can treat sewage effluent to phosphorus levels of 0.25mg/l this option would significantly improve water quality by reducing mean phosphorus concentrations along the stretch of the river by some 32% compared to current baseline conditions. However, given that it is uncertain whether the reed beds can realistically achieve phosphorus levels of 0.25mg/l in the long term, changes to phosphorus levels in the river Mease may be substantially lower than this. Therefore, although this option is expected to make progress towards addressing current exceedances of the 0.06 mg/l P conservation objectives and 0.12 mg/l WFD targets it can not be said with any certainty that this would have a significant impact on species and ecological systems within the river (including species with important conservation status such as bullhead and spined loach). During construction of the reed beds considerable excavation, top soil removal and direct loss of the land will occur to construct 2 reed beds with a total land area of roughly 4.2 ha. However, it is expected that the land used and land within close proximity will be of a low biodiversity value and therefore minor.	0/- The introduction of reed beds at Measham WwTW along with no additional treatment for Packington WwTW will result in the mean of phosphorus concentration along the river Mease increasing slightly to 0.354 mg/l (approximately a 3% increase). The changes to water quality and its subsequent effects on biodiversity will, however, be more location specific depending on proximity to the WwTW point discharge. The additional sewage effluent from the development of some 1600 homes discharging to Packington WwTW without any additional treatment will have a localised negative effect on water quality. Phosphorus levels could increase by some 10% immediately downstream of the WwTW point discharge. Within these areas there will be negative effects on biodiversity, through eutrophication which is likely to alter the community structure. Given the designation of the river as a SAC, this could have negative impacts on species with important conservation value, such as bullhead and spined loach. The introduction of reed beds at Measham WwTW will decrease phosphorus levels by some 3-7% immediately downstream of the STW. This will decrease the negative biodiversity impact but is still	- Under this Option there will be considerable land-take, excavation and construction required in order to introduce 9,402m of pipeline to transfer to Stanton. There is the potential for this to have negative effects including through removal of habitat or noise/dust disturbance to biodiversity within close proximity during construction. However, given that the pipeline is to follow the route of the freight railway line the land is not expected to have a high biodiversity value and the proposed route is not within close proximity to important conservation sites this is not expected to be significant. Under this option it is expected that there will be a 1.42% decrease in phosphorus levels at the river at the point of discharge by the Packington WwTW. Therefore it is expected that the changes to water quality along the River Mease will be negligible. In consequence, the phosphorus concentrations will remain significantly greater than the 0.06 mg/l target within the conservation objective for the River Mease SAC. As a result, whilst the option will not exacerbate the existing effects on biodiversity from eutrophication, such impacts will still occur and will not be lessened.

SA Objectives	Option 4 - Polishing plant at sewage works			Option 5
	4a Reedbeds at Packington & Measham sewage works	4b Reedbeds at Packington sewage works only	4c Reedbed at Measham sewage works only	Transfer part of Packington sewage catchment to Stanton sewage works
	The generation of noise, dust and vibration may have negative effects on biodiversity during periods of construction. However, these effects will be minor and temporary. Once the reed beds are constructed it is likely that they will have a positive effect on biodiversity through the creation of habitat for species such as reed warblers and water voles.	The generation of noise, dust and vibration may have negative effects on biodiversity during periods of construction. However, it is expected that the land used and land within close proximity will be of a low biodiversity value and therefore any negative effects will be minor and temporary. However, given the smaller scale of reed beds constructed and the need for construction on only one site the potential for temporary negative impact is less than under Option 4a. Once the reed beds are constructed it is likely that they will have a positive effect on biodiversity through the creation of habitat for species such as reed warblers and water voles. However, given that the total area of reed beds created under this option will be smaller the potential for positive impact is less than under Option 4a.	significantly greater than targets set in WFD (0.12 mg/l) and Habitats Directive (0.06mg/l). Given that it is uncertain whether the reed beds can realistically achieve phosphorus levels of 0.25mg/l in the long term, changes to phosphorus levels in the river Mease may be less than this. During construction of the reed beds considerable excavation, top soil removal and direct loss of the land will occur to construct 2 reed beds with a total land area of roughly 4.2 ha. However, it is expected that the land used and land within close proximity will be of a low biodiversity value and therefore minor. The generation of noise, dust and vibration may have negative effects on biodiversity during periods of construction. However, it is expected that the land used and land within close proximity will be of a low biodiversity value and therefore any negative effects will be minor and temporary. However, given the smaller scale of reed beds constructed the potential for negative impact is less than under Option 4b. Once the reed beds are constructed it is likely that they will have a positive effect on biodiversity through the creation of habitat for species such as reed warblers and water voles. However, given the smaller scale of reed beds constructed the potential for positive impact is less than under Option 4b.	
Environmental Sustainability				

SA Objectives	Option 4 - Polishing plant at sewage works			Option 5
	4a Reedbeds at Packington & Measham sewage works	4b Reedbeds at Packington sewage works only	4c Reedbed at Measham sewage works only	Transfer part of Packington sewage catchment to Stanton sewage works
2. Protection and enhancement of water quality and resources	+ Assuming that reed beds can treat sewage effluent to phosphorus levels of 0.25mg/l the introduction of reed beds at both Packington and Measham sewage works would substantially improve water quality by reducing mean phosphorus concentrations along the stretch of the river to 0.217 mg/l P (a 37% reduction compared to current baseline conditions). However, given that it is uncertain whether the reed beds can realistically achieve phosphorus levels of 0.25mg/l in the long term, changes to phosphorus levels in the River Mease may be substantially lower than this. Therefore, although this option is expected to make progress towards addressing current exceedances of 0.12 mg/l WFD targets it can not be said with any certainty that this would have a significant impact. Although it is expected that the river flow will increase under this Option this is expected to be very slight compared to the total flow and therefore is not expected to have an impact on river flow or abstraction objectives.	+ Introducing reed beds at only Packington sewage works (of a capacity to treat for 1600 homes expected in the new development) will lead to significant reduction in phosphorus levels along the River Mease. However, given that there will be no reedbeds at Measham sewage works to treat the increase in sewage effluent from new developments, the decrease in phosphorus concentrations downstream of Measham sewage works will not be as great as under Option 4a.. Despite this, the decrease in phosphorus levels will be substantial across the whole river section giving a mean phosphorus concentration of 0.233 mg/l P (a 32% reduction compared to current levels, assuming that reed beds treat sewage effluent to 0.25mg/l). However, given that it is uncertain whether the reed beds can realistically achieve phosphorus levels of 0.25mg/l in the long term, changes to phosphorus levels in the river Mease may be substantially lower than this. Therefore, although this option is expected to make progress towards addressing current exceedances of 0.12 mg/l WFD targets it can not be said with certainty that this would have a significant impact on this objective. Although it is expected that the river flow will increase under this Option this is expected to be very slight compared to the total flow and therefore is not expected to have an impact on river flow or abstraction objectives.	0/- The additional sewage effluent from development of some 1600 homes discharging to Packington sewage works without any additional treatment will have a localised negative effect on water quality with phosphorus levels increasing by some 10% in the vicinity of these discharges. However, the introduction of reed beds at Measham sewage works will result in localised decreases in phosphorus levels downstream despite an increase in sewage effluent from the increased population living in new developments (of up to 490 new homes) in Measham. However, these decreases will be less than under Option 4b, as the reedbed will be smaller (as it will be a relevant size to treat for 490 homes expected in new developments in Measham). Overall, accounting for these spatial differences along the river, the mean concentration of phosphorus along river sites will be 0.354 mg/l P (which is approximately a 3% increase compared to current levels). However, given that it is uncertain whether the reed beds can realistically achieve phosphorus levels of 0.25mg/l in the long term, changes to phosphorus levels in the river Mease may in reality alter from this (i.e. – decreases in phosphorus levels would be less and increases would be greater if levels reached during reedbed treatment were greater than 0.25mg/l). Therefore, changes to water quality are expected to have a potentially minor negative impact. Although it is expected that the river	0/- Under this option it is expected that there will be a 1.42% decrease in phosphorus levels at the river at the point of discharge by the Packington WwTW. Therefore it is expected that the changes to water quality along the river Mease will be negligible. In consequence, the phosphorus concentrations will remain significantly greater than the 0.06 mg/l target within the conservation objective for the River Mease SAC. As a result, whilst the option will not exacerbate the existing effects on water quality, such impacts will still occur and will not be lessened. Decreases in water flow are expected under this option as a result of transferring a greater flow out of the sewage network than will be generated from the increased population in the development. However this will be minimal (a decrease from current levels by some 1.5%). Although minor this could potentially contribute towards current constraints on water resources during periods of low flow.

SA Objectives	Option 4 - Polishing plant at sewage works			Option 5
	4a Reedbeds at Packington & Measham sewage works	**4b Reedbeds at Packington sewage works only**	**4c Reedbed at Measham sewage works only**	**Transfer part of Packington sewage catchment to Stanton sewage works**
			flow will increase under this Option this is expected to be very slight compared to the total flow and therefore is not expected to have an impact on river flow or abstraction objectives.	
3. Protection and enhancement of soil quality	- Under this option approximately 0.8 ha of land will be lost to reedbed construction which would have a negative impact on this objective. However, it is not considered to be significant given that the soil is not expected to be of a high quality based on high level soil mapping and it is expected reed beds will be designed such that the minimum cut volume is created, minimising total excavation needed. Furthermore, topsoil excavated from the site will be used to mix into the medium layer of the reed bed.	- Under this option approximately 0.6 ha of land will be lost to reedbed construction would may have a negative impact on this objective. However, it is not considered to be significant given that the soil is not expected to be of a high quality and it is expected reed beds will be designed such that the minimum cut volume is created, minimising total excavation needed. Furthermore, topsoil excavated from the site will be used to mix into the medium layer of the reed bed.	- Under this option approximately 0.2 ha of land will be lost to reedbed construction, which may have a negative impact on this objective. However, it is not considered to be significant given that the soil is not expected to be of a high quality and it is expected reed beds will be designed such that the minimum cut volume is created, minimising total excavation needed. Furthermore, topsoil excavated from the site will be used to mix into the medium layer of the reed bed.	- Under this Option there will be considerable land excavation and removal of soil required in order to introduce 9,402m of pipeline at 1.5 m depth underground to transfer sewage from Willesley Road pumping station to Stanton WwTW. However, given that the pipeline is to follow the route of the freight railway line the soil quality is not expected to be high this is not expected to be significant.
4. Promoting the sustainable use of resources and minimising generation of waste	- Many of the materials required within the reed bed media such as limestone, steel slag, soil will be easily obtainable from local sources. However, other materials, such as iron rich media may require to be imported from abroad. This would increase the need for fuel for transport, which would score badly against this objective. Furthermore, it is expected that reed bed media will become saturated with phosphorus within 7-10 years. This will result in the need to replace reed bed media with new materials every 7-10 years during the lifetime of the reed bed. The saturated media would then be treated as sludge and undergo waste water treatment. However, the re-use of excavated topsoil to mix into the medium layer of	- Many of the materials required within the reed bed media such as limestone, steel slag, soil will be easily obtainable from local sources. However, other materials, such as iron rich media may require to be imported from abroad. This would increase the need for fuel for transport, which would score badly against this objective. Furthermore, it is expected that reed bed media will become saturated with phosphorus within 7-10 years. This will result in the need to replace reed bed media with new materials every 7-10 years during the lifetime of the reed bed. The saturated media would then be treated as sludge and undergo waste water treatment. However, the re-use of excavated topsoil to mix into the medium layer of	- Many of the materials required within the reed bed media such as limestone, steel slag, soil will be easily obtainable from local sources. However, other materials, such as iron rich media may require to be imported from abroad. This would increase the need for fuel for transport, which would score badly against this objective. Furthermore, it is expected that reed bed media will become saturated with phosphorus within 7-10 years. This will result in the need to replace reed bed media with new materials every 7-10 years during the lifetime of the reed bed. The saturated media would then be treated as sludge and undergo waste water treatment. However, the re-use of excavated topsoil to mix into the medium layer of	- The construction of a pipeline of 9,402m length from Willseley Road pumping station to Stanton sewage works will require considerable quantities of material (such as steel) and considerable removal of topsoil to introduce the pipes. However, no materials will be required during the operation of this option.

SA Objectives	Option 4 - Polishing plant at sewage works			Option 5
	4a Reedbeds at Packington & Measham sewage works	4b Reedbeds at Packington sewage works only	4c Reedbed at Measham sewage works only	Transfer part of Packington sewage catchment to Stanton sewage works
	the reed bed will reduce the need for new materials in the first instance.	the reed bed will reduce the need for new materials in the first instance. Furthermore, the construction of reedbeds only at Packington WwTW rather than both Packington and Measham WwTW will result in less material use and waste generation than under Option 4a.	the reed bed will reduce the need for new materials in the first instance. Furthermore, the smaller scale of reedbed required will result in less material use than under Option 4b.	
Population				
5. Economy	Construction of the reed beds will generate jobs. However, given the scale of construction required and the temporary nature of the jobs generated, this is not expected to be significant. + During the operation of the reed beds it is envisaged that there will be minimal maintenance required and although some horticultural care and monitoring work may be required, especially in the first years, it is not expected to result in any full time positions.	Construction of the reed beds will generate jobs. However, given the scale of construction required and the temporary nature of the jobs generated, this is not expected to be significant. + During the operation of the reed beds it is envisaged that there will be minimal maintenance required and although some horticultural care and monitoring work may be required, especially in the first years, it is not expected to result in any full time positions.	Construction of the reed beds will generate jobs). However, given the scale of construction required and the temporary nature of the jobs generated, this is not expected to be significant. + During the operation of the reed beds it is envisaged that there will be minimal maintenance required and although some horticultural care and monitoring work may be required, especially in the first years, it is not expected to result in any full time positions.	The construction of 9,402 m length of pipeline and pumping station required under this Option over 18-24 month timeframe will generate jobs. + Minimal maintenance work will be required throughout the lifetime of this Option but is not expected to result in any full time positions.
Existing Infrastructure/Landscape				
6. Protection and enhancement of landscape character	The construction of reed beds may require some temporary use of large scale equipment (such as diggers etc) which may cause very localised and transient visual intrusion. The extent to which this could be a detrimental effect will depend on the site and the extent to which it is visible from neighbouring sensitive receptors. + The banking for reed beds will be designed so that it is as sympathetic to the existing landscape as possible. There is some opportunity for the reed beds once complete to provide a positive visual landscape impact.	The construction of reed beds may require some temporary use of large scale equipment (such as diggers etc) which may cause very localised and transient visual intrusion. The extent to which this could be a detrimental effect will depend on the site and the extent to which it is visible from neighbouring sensitive receptors. + Given that the reedbed will be smaller in size and the construction period is expected to be for less time than under scenario 4a the potential for negative effect is also considered to be less.	The construction of reed beds may require some temporary use of large scale equipment (such as diggers etc) which may cause very localised and transient visual intrusion. The extent to which this could be a detrimental effect will depend on the site and the extent to which it is visible from neighbouring sensitive receptors. + Given that the reedbed will be smaller in size and the construction period is expected to be for less time than under scenario 4b the potential for negative effect is also considered to be less.	The introduction of 9402m length of pipeline from Willsley Road pumping station to Stanton STW is likely to require the use of some large scale equipment such as diggers to dig to 1.5m depth required. This may cause a visual intrusion to the landscape during the construction period (within the order of 18-24 months). However, given this effect will be temporary and that the route of the pipeline is expected to follow the freight railway this is not expected to be significant. -

SA Objectives	Option 4 - Polishing plant at sewage works			Option 5
	4a Reedbeds at Packington & Measham sewage works	4b Reedbeds at Packington sewage works only	4c Reedbed at Measham sewage works only	Transfer part of Packington sewage catchment to Stanton sewage works
	Once the reedbed is completed this may have a positive visual impact.	The banking for reed beds will be designed so that it is as sympathetic to the existing landscape as possible. There is some opportunity for the reed beds once complete to provide a positive visual landscape impact. Once the reedbed is completed this may have a positive visual impact.	The banking for reed beds will be designed so that it is as sympathetic to the existing landscape as possible. There is some opportunity for the reed beds once complete to provide a positive visual landscape impact. Once the reedbed is completed this may have a positive visual impact.	
Energy Use and Climate Change				
7. Energy Use & Climate Change	Energy will be required during the construction of the reed bed (including the embedded energy in some of the construction materials used, the diesel used to transport the materials and the diesel used to excavate the reed bed), this is estimated to cause emissions of approximately 925 tonnes of carbon. - Additional energy will be required to pump the increased sewage effluent expected from new developments around the network and within the reed beds themselves. This will increase emissions of operational carbon each year by roughly 265 tonnes but is not considered significant. Reed bed system is designed to minimise any risks of flooding from River Mease so should not affect vulnerability to increasing flood risks under climate change.	Energy will be required during the construction of the reed bed (including the embedded energy in some of the construction materials used, the diesel used to transport the materials and the diesel used to excavate the reed bed), this is estimated to cause emissions of approximately 770 tonnes of carbon. - Additional energy will be required to pump the increased sewage effluent expected from new developments around the network and within the reed bed itself. This will increase emissions of operational carbon each year by roughly 260 tonnes but is not considered significant. Reed bed system is designed to minimise any risks of flooding from River Mease so should not affect vulnerability to increasing flood risks under climate change.	Energy will be required during the construction of the reed bed (including the embedded energy in some of the construction materials used, the diesel used to transport the materials and the diesel used to excavate the reed bed), this is estimated to cause emissions of more than 380 tonnes of carbon. - Additional energy will be required to pump the increased sewage effluent expected from new developments around the network and within the reed beds itself. This will increase emissions of operational carbon each year by roughly 250 tonnes but is not considered significant. Reed bed system is designed to minimise any risks of flooding from River Mease so should not affect vulnerability to increasing flood risks under climate change.	The embedded carbon during the construction of the reed beds is expected to be approximately 2,065 tonnes of CO_2. - The operation of this option is expected to result in carbon emissions of almost 300 tonnes of CO_2 a year. The carbon emitted during construction and operation is not expected to be significant on a district level and is considered to be minimal compared to other carbon emissions, for example, the construction and operation of the new developments themselves. Decreases in water flow expected under this option as a result of transferring a greater flow out of the sewage network than will be generated from the increased population in the development will be minimal (a decrease from current levels by some 1.5%). Although minor this could potentially impact on low flow issues in the river.

4.5.4 Summary of Sustainability Assessment

The following section gives a summary of the assessment presented in **Table 4.10** and described in detail in **Tables 4.11 and 4.12.**

Across all of the options other than option 5, it is expected that river flow will increase as a result of the effluent discharge from the development. However, this increase is expected to be very slight compared to the total flow and therefore is not expected to impact on abstraction, river flow, or resilience to flooding under climate change. However, as the impact of option 5 is a slight decrease in river flow, this has been included in the summary of the effects of that option.

Option 1 –- Do Nothing

Given that under this option the sewage effluent generated from new developments and sent to Packington and Measham sewage works will not receive any additional treatment compared to current levels, it is expected that mean phosphorus levels along the river will increase by some 8%. This is likely to exacerbate the existing issue of eutrophication and poor water quality which will worsen adverse impacts on biodiversity, including on species with important conservation value such as bullhead and spined loach, resulting in a significantly negative effect on both water quality and biodiversity. The option will make no contribution towards achieving the phosphorus concentration values of either the WFD target or the River Mease SAC conservation objectives and will allow further deterioration of the river in terms of its water quality.

The additional sewage effluent generated from new developments will increase energy required to pump around the system, which will cause increases to operational carbon emissions.

However, given that apart from small connections linking the developments to the sewage network there will be no additional infrastructure required and no subsequent land take, it is expected that this option will not impact on objectives related to soil quality, resource use or landscape, resulting in these objectives receiving a neutral score. The lack of infrastructure required plus the fact that no additional operational jobs will be required for this option result in a neutral score for the economy objective.

Option 2 - Maintain Load

Improving treatment of the additional sewage effluent from the new developments will ensure no increase in the phosphorus levels in effluent discharge. As a result, the existing negative impacts on water quality from elevated phosphorus levels will continue and the option will make no progress against the phosphorus concentration values of either the WFD target or the River Mease SAC conservation objectives.

Similar to option 1, additional energy will be required to pump additional sewage effluent around the system, and therefore this option has a negative effect on energy use and climate change objectives.

This option would not require any additional infrastructure, aside from small connections linking the developments to the sewage network and as a consequence will have minimal effect on soil quality, resource use, landscape or economy objectives.

Option 3 - Private Treatment at New Development Sites

Under this option there is potential for slight reductions in phosphorus along the River Mease. However, given the uncertainty surrounding whether the reed beds will realistically be able to remove phosphorus from effluent to these levels, such reductions may be unrealised. Therefore, although this option may contribute to a very minor reduction, there is a low likelihood of it making a substantive contribution to improving water quality or meeting the WFD target and conservation objectives.

If the reed bed is constructed on land with previously low biodiversity value, it is likely to have a positive effect, due to the creation of a new habitat for a number of species including reed warblers, newts and water voles.

The construction of the reed beds will require land excavation and the use of resources (including soil, limestone and steel slag). It is assumed that the design of the reed bed will ensure a minimal cut volume reducing total excavation and loss of soil. There is also the opportunity to re-use excavated topsoil to mix into the medium layer of the reed bed. However, there is potential need to source certain materials (such as iron rich media) from abroad and a requirement to replace the reed bed media possibly every 7-10 years (the estimated time taken for the reed bed media to saturate). If these occur, this may result in a potentially significant negative score for resource use objective.

Given that reed beds under this option will be treating raw sewage from the development sites (as opposed to option 4 where the reed beds will be used treat sewage following a level of pre-treatment within the WwTWs) the total area required for the reed beds will be greater. Therefore this option will have the greatest land take and a greater use of resources (including soil, limestone and steel slag) when compared to any other option

The operational energy and associated emitted carbon from this option will be lower than that associated with additional pumping at a WwTW, given that the additional effluent will be treated within reed beds at the developments themselves. However, energy will be required during the construction of the reed bed, and the materials used for the reed bed will contain embodied carbon.

Option 4 - Reed Beds at Wastewater Treatment Works (WwTWs)

4a) Packington and Measham WwTWs

Given that under this option reed beds will be used treat sewage with a lower phosphate content than option 3 (following some level of treatment within the WwTWs) it is expected to lead to larger reductions in phosphorus along the River Mease. However, as is the case for all reed bed options, the uncertainty surrounding whether the reed beds will be able to treat to this level, means that changes to phosphorus levels in the River Mease may be substantially lower than this. Therefore, although this option is expected to make the greatest progress between options towards addressing current exceedances of the 0.12mg/l P WFD target and 0.06 mg/l P conservation

objectives it cannot be said with any certainty that this would have a significant positive impact on water quality, levels of eutrophication or impact on biodiversity.

Furthermore, treating sewage with some level of previous treatment will result in reed beds with a smaller total area than under option 3. This will decrease the total land take[11] and use of resources (including soil, limestone and steel slag). On the other hand, the smaller area of land will result in less reed bed habitat creation which will decrease associated positive effects on biodiversity. However, overall it is considered that the greater potential improvements to water quality will result in this option having a greater positive impact on biodiversity than option 3, although it is still not considered significant.

A number of construction jobs will be created which will result in a positive effect on the local economy, however, it is not expected to be of a scale that is considered significant.

Energy will be required to pump the sewage effluent to the reed beds. Furthermore, energy will also be required during the construction of the reed bed (including the embedded energy in some of the construction materials used, the diesel used to transport the materials and excavate the reed bed), resulting in a negative impact on energy use and climate change objectives.

4b) Packington WwTW Only

This option requires only one reed bed to be located at the Packington WwTW. The area proposed will be smaller that that for option 4a and in consequence, whilst it will have similar effects to option 4a, the scale of the effects (regarding land take, soil quality, resource use, energy use, employment and economy) will be smaller.

The reed bed at Packington WwTW will reduce phosphorus levels along the River Mease, albeit to a lower extent than option 4a. Due to the uncertainty surrounding the effluent phosphorus levels that can be achieved by reed beds, whilst there will be some progress towards meeting WFD target and SAC conservation objectives, this effect is unlikely to be significant. The habitat created by the reed bed, whilst beneficial to biodiversity will not be of the same scale as option 4a.

4c) Measham WwTW Only

This option requires the construction of a reed bed at Measham WwTW which will be smaller in area than that proposed for option 4b. In consequence, its effects will be similar, although proportionally less than for options 4a and 4b (in line with the reduced footprint of the reed bed).

This option is expected to have a mixed effect on water quality along the River Mease. The additional sewage effluent discharged from Packington WwTW from the development will be expected to cause a localised decrease in water quality downstream to the discharge point at Packington WwTW. However, the introduction of reed beds at Measham WwTW to treat sewage effluent will result in a corresponding localised decrease in phosphorus levels downstream of the discharge from the Measham WwTW. Overall, accounting for spatial differences along the

[11] No assessment or survey has been undertaken to determine if land is available for a reed bed tertiary treatment / polishing plant.

river, the mean phosphorus concentration along the River Mease is expected to increase (by some 3% assuming the reed beds could treat the wastewater to 0.25mg/l P, which would increase further if the reed beds were unable to treat to this level). Therefore, this option is expected to increase current negative effects on water quality and eutrophication and its subsequent negative impact on biodiversity.

Option 5 - Transfer Part of Packington Sewage Catchment to Stanton WwTW

The removal of flow to another network is expected to reduce water flow in the River Mease by some 1.5% based on a transfer of 5071 population equivalent and the introduction of 3616 population equivalent (**see Table 4.4**). This could contribute towards negative effects on water resources and biodiversity during periods of low flow. The changes to water quality expected under this option are expected to be negligible; at the point of discharge by Packington WwTW phosphorus levels are expected to decrease by 1.42%. As a result, similarly to option 2, phosphorus levels will remain significantly above WFD target and conservation objectives and the negative impacts on water quality.

The continuation of high phosphorus levels will result in the persistence of the existing problem of eutrophication and its adverse effect on biodiversity. This, alongside with the land-take and construction disturbance generated from the construction of 9.4km of pipeline to transfer to Stanton is expected to have a negative effect on biodiversity. However, given the low biodiversity value of land along and within close proximity to the pipeline route, this is not expected to be significant.

The construction of the pipeline will require excavation, removal of topsoil and use of resources. However, given that the pipeline is to follow the route of the freight railway line, disturbance and loss of valuable soil resources is expected to be kept to a minimum. The operational life of the pipeline will be considerably in excess of that anticipated for the reed bed (which may need to replace reed bed media every 7-10 years) reducing the overall need for resources.

A limited number of temporary construction jobs will be generated during the construction of the pipeline (expected to last up to two years).

Energy will be required during the construction of the pipeline (including the embedded energy in some of the construction materials used), as well as for the pumping of effluent along the pipeline, resulting in a negative impact on energy use and climate change objectives. However, although the operational carbon expected under this option is slightly greater than for options 4a and 4b, the carbon emissions linked to construction of the pipeline is considerably less than for the construction of reed beds under these two options.

4.5.5 Key Conclusions Emerging from the Appraisal

Five WwTW options, as well as three sub-options, have been assessed in order that the key sustainability strengths and weaknesses can be reviewed and evaluated. In reviewing the scenarios, AMEC has drawn the following conclusions and recommendations:

- Given that phosphorus levels are currently already significantly above WFD targets and conservation objectives, and that under option 1 an increase in sewage effluent from development will cause a significant increase in phosphorus levels which will worsen both water quality and impact on biodiversity within an internationally designated site (SAC), it is not acceptable to do nothing.

Therefore, it is necessary to compare how the operation of the remaining options impact will impact on water quality (and subsequently on biodiversity) whilst also considering the negative or positive impacts the construction of infrastructure will have on the remaining objectives.

- Option 2 will treat the additional effluent arising from the development to ensure that existing phosphorus levels within the effluent discharged from the WwTW remain at the current levels. Although this represents a missed opportunity to improve water quality to be more in line with WFD targets and conservation objectives, the lack of additional infrastructure will minimise any negative effects on soil quality, resource use, waste and landscape and energy;

- Options 3-5 all require the construction of infrastructure (either reed beds in the case of options 3 and 4 or transfer pipeline in the case of option 5). The construction of the required infrastructure for each option has a positive impact on employment through the generation of construction jobs and on biodiversity through the creation of reed bed habitat. However infrastructure construction will have negative impacts on soil quality, resource and energy use and waste. Reed beds may have an overall positive impact on landscape, whereas a pipeline is more likely to have a negative impact. The scale of these negative or positive impacts will depend partly on the size of infrastructure required and its location (i.e. - option 3 will have greater impacts than options 4a, 4b and 4c given its greater size and the need to construct at two locations);

- WwTW options which consider treating wastewater with reed beds (namely options 3 and 4) offer the greatest potential for decreasing phosphorus levels along the river Mease to be more in line with WFD target of 0.12mg/l P and conservation objectives of 0.06 mg/l P. However, given the uncertainty surrounding the reduction in phosphorus levels that can be achieved from treatment by reed beds, the potential for such reductions could be overstated;

- Option 3 is considered as unfavourable compared to other reed bed options as it requires the greatest total area and therefore has the greatest negative impacts on soil quality, resource and energy use and waste. Furthermore, as the reed beds are used to treat raw sewage from development as opposed to 'treated sewage' from WwTWs the impact on water quality is less than for options 4a and 4b;

- Option 4c (the introduction of reed beds at Measham WwTW only) is the least favourable sub-option for option 4 as, despite decreases in phosphorus levels in localised sections of the river downstream of Measham WwTW, overall the mean phosphorus level in the River Mease is expected to increase, resulting in a potentially negative impact on water quality and biodiversity. This is a result of the discharge from Packington WwTW upstream, which is assumed to continue to discharge at the 1mg/l P consent value. At the same time the construction of the reed bed will have negative impacts on soil quality, resource and energy use and waste;

- Option 5 is considered the least favourable of the options as the change to water quality is negligible compared to current levels and the construction of the pipe and the resulting land take, construction disturbance, potential visual intrusion, energy and resource use will have negative effects on nearly all of the objectives (with the exception of economy as jobs will be provided).

4.5.6 Summary and Recommendations

- Option 1 is not considered as an acceptable option given the significant expected increases in phosphate levels, increasing current exceedances of WFD target and conservation objectives and thereby worsening water quality and levels of eutrophication and its subsequent impacts on biodiversity further;

- It is recommended that options 4c and 5 are not considered further as the changes to water quality compared to current levels will be negligible (although it is recognised that compared to do nothing the water quality would be favourable under these options) and the construction of infrastructure will have a negative impact on most of the other objectives (with the exception of economy). Option 3 should also be disregarded given the requirement for a larger reed bed area which will have a more negative impact on most of the objectives whilst providing smaller improvements to water quality.

Option 4a of those options including reed beds will be the most favourable if reductions in phosphorus levels are the most important of the objectives to affect; however, such reductions may not be as great as modelling suggests. It will have positive effects on biodiversity, economy and landscape. However, the construction of the reed bed will have a more negative impact on soil quality, resource and energy use.

Although option 2, will have a minimal impact on water quality compared to current levels and represents a missed opportunity to reduce phosphorus levels in effluent discharges, it is not associated with the negative effects of the other options where additional infrastructure (whether reed beds or pipelines) is required. Given the uncertainty over the performance of the reed beds it may be more beneficial to adopt option 2 until certainty in reed bed technology or other phosphorous removal technology and its effectiveness is achieved. If this approach is taken, it is clear that option 2 must work in conjunction with the medium/longer term solution of additional treatment in some form at one or both of the two main WwTW, in order to work towards the Water Framework Directive target and Habitats Directive SAC Conservation Objective.

Any proposed WwTW options should also be considered in conjunction with the catchment wide initiatives to address non-point sources of phosphorus pollution, as set out in the River Mease SAC Water Quality (Phosphate) Water Management Plan (EA, 2011) to collectively effect a significant reduction in phosphorus levels in line with the River Mease WFD target and SAC conservation objective.

5. Wastewater Treatment in the Rest of the District

The proposed growth options outside the catchment of the River Mease in the District would primarily involve new housing developments in Coalville and Castle Donington. The Outline WCS identified that Snarrows WwTW that serves Coalville and discharges into a tributary of the River Soar would potentially be a constraint to growth post 2015. Potential constraints were also identified in the works serving Castle Donington from 2023 onwards. The WwTW serving Ibstock and Kegworth were identified in the Outline WCS as having Dry Weather Flow capacity for new development.

This section provides a strategic review of these potential constraints and confirms the existing headroom available at these four works, based on discussions held with Severn Trent Water Ltd. **Figure 5.1** shows the wastewater treatment catchment areas for these remaining parts of the District (i.e. outside the River Mease area).

5.1 Wastewater Treatment Capacity for Coalville

In response to the potential constraints to growth at Snarrows WwTW, identified in the Outline WCS (Entec, 2010), Severn Trent Water have been investigating capacity in the sewerage network and wastewater treatment works serving Coalville. The investigation by Severn Trent Water has also been in response to objections to development raised by the Environment Agency, regarding potential adverse impacts on the Grace Dieu Brook water quality due to the interaction of combined sewer overflow and sewage treatment discharges that could be increased due to development.

As part of Severn Trent Water's Drainage Area Programme in 2009, capacity constraints within the sewer network were identified as being caused by a combination of infiltration from groundwater into the network, watercourse inflow, misconnections and surface water run-off entering the system. The infiltration of non-foul flows into the sewer network will not only affect the pipe capacity but will also have subsequent effects on the flow and storage capacity of Snarrows WwTW. Severn Trent Water has assessed that there is headroom/capacity for about 2,500 new homes based on existing measured flows at Snarrows WwTW. A solution which addresses both the network capacity and the treatment works capacity is therefore required to meet the proposed growth levels (housing targets for Coalville used in this study range from 4500 to 6800 new homes).

The first option that is being investigated is to reduce existing surface water flows into the network to release capacity to accommodate additional foul flows from new development. Surface water/infiltration reduction options are being assessed by Severn Trent Water, and a CCTV survey of the network along the Grace Dieu Valley was also undertaken in July 2011 as part of their assessment. The initial feasibility work indicates that a reduction infiltration to accommodate approximately 3,700 homes (as set out in the Core Strategy Consultation from July 2011, although this figure has since been changed in the October 2011 Cabinet Report) would be feasible.

Severn Trent Water are proposing more detailed investigations including flow monitoring (which commenced in October 2011 and is ongoing until Spring 2012), but have advised that infiltration reduction work could be completed within 12 to 18 months to align with development phasing. They are continuing to monitor and

investigate the issues, and if additional improvements are required to meet the development targets and phasing, conventional capacity upsizing or additional storage will be considered. The revised residual target of approximately 4,000 between 2011 and 2031 will also be considered as part of their assessment.

It should be noted also that the implementation of water efficiency measures in new homes in line with the Code for Sustainable Homes Level 3 could also help to reduce the resulting foul flows from new homes compared to existing homes with higher water consumption. Retrofitting water efficiency measures and schemes including the water metering trials can help to reduce foul flows from existing properties. The combination of these measures can help to increase capacity in the network and potentially facilitate more development. Further information and guidance on how to meet these water efficiency levels are provided in Chapter 8 of this report.

Additional localised capacity improvements are also expected to be required in the sewer network in addition to removal of infiltration/surface water ingress and to prevent local flooding capacity issues. Further detailed modelling will be required and carried out by Severn Trent Water on receipt of planning application or more detailed information on development sites. Information required from the developers in order to undertake these assessments include preferred connection points, flow rates and development phasing, otherwise modelling can only be based on speculative development assumptions. Chapter 6 of this report summarises the results of network modelling for proposed development sites. The modelling is based on the existing network and flows, but makes an allowance for improvements in capacity that are currently being investigated by Severn Trent Water, as described above. This is because the existing slow response in the model was vastly overestimating flood volumes for design storms.

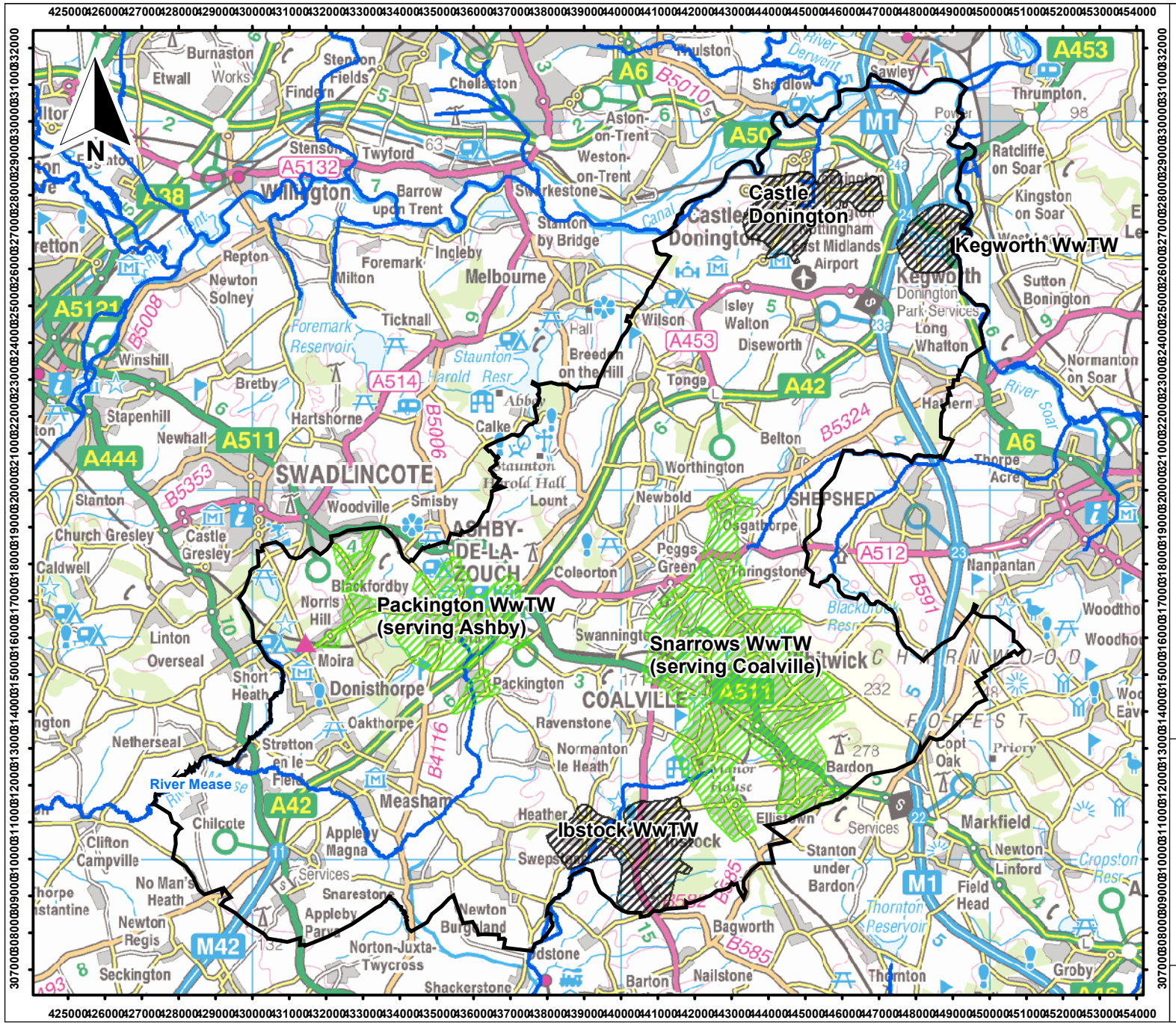
The Environment Agency's River Basin Management Plan for the River Humber, which includes North West Leicestershire's administrative area, summarises the WFD objectives for the River Soar and its tributaries. For the tributary that receives discharges from Snarrows WwTW, the target for achieving good status for phosphorus has been delayed until 2027, as it has been assessed as 'disproportionately expensive' to meet good status for P by 2015 or 2021 (in line with river basin planning cycles). It is expected that Severn Trent Water and the EA will therefore be assessing potential reductions in sources of phosphorus within the next river basin planning cycle (2015 to 2021).

5.2 Wastewater Treatment Capacity for Castle Donington

The development in Castle Donington is expected to be between 605 and 955 homes between 2010 and 2031, depending on which growth option is confirmed for the District. Since the submission of the Outline WCS, improvements to the capacity of Castle Donington WwTW are being proposed during the AMP5 period, driven by capital maintenance requirements. Furthermore the Outline WCS considered a growth option with a higher number of proposed homes which led to the conclusion of potential flow capacity constraints at the works. As the proposed housing numbers in Castle Donington have now reduced, together with the plans to expand the works, there are no longer capacity issues for wastewater treatment with regard to flows.

The Humber River Basin Management Plan for the River Humber states that the target for achieving good status for phosphorus in the receiving watercourse for Castle Donington WwTW has been delayed until 2027, as it has been assessed as 'disproportionately expensive' to meet good status for P by 2015 or 2021 (in line with river basin

planning cycles). As for the Snarrows works, it is expected that Severn Trent Water and the EA will be assessing potential reductions in sources of phosphorus at Castle Donington within the next river basin planning cycle (2015 to 2021).



Key:

- North West Leics District Boundary
- Approximate River Paths
- Sewage network catchment, high level assessment by Severn Trent Water
- Sewerage network catchment modelled for study

0 5,000 Meters

Scale: 1:150,000 @ A4

H:\Projects\HM-255\26271 NW Leics WCS\Drawings\GIS\mxd

North West Leicestershire District Council
Detailed Water Cycle Study

Figure 5.1
Wastewater Treatment Works / sewerage network catchments assessed in the Rest of the District

January 2012
29438-b001 pitkl

amec

6. Sewerage Requirements

6.1 Introduction

In order to assess localised sewerage capacity issues and required improvements needed to serve new developments, Severn Trent Water provided AMEC with the sewer network models for Ashby and Coalville. These were used to assess the potential impact of future development sites on the existing drainage systems. The models provided were part of the AMP4 Drainage Area Plan studies. In each case the most up to date model was provided, and modelled by AMEC using Infoworks CS Version:10.5.1.19012.

The existing models were reviewed against AMEC's in house model build checks and Severn Trent Water's own modelling specifications. Any errors or deviations from modelling best practice that would have a detrimental impact on this study were rectified. A summary of other changes that were made to the models to make them fit for purpose for this study are listed in **Table 6.1** below.

Table 6.1 Summary of changes to Ashby and Coalville network models

Ashby-de-la-Zouch model	Coalville model
*In order to ensure that the model predicted flooding from all areas where water could be retained on the surface, all of the nodes (modelled manholes) with no floodable area were adjusted to have 0.1 hectares floodable area.	*Where some values had been interpolated incorrectly, the values were recalculated & re-interpolated
Nodes with default flood cone parameters were adjusted to Severn Trent Water's standards thereby providing a better representation of flooding behaviour	*Data in the model to represent future options which did not go ahead were removed
*Data in the model to represent future options which did not go ahead were removed	*The existing model contained several orifices which were used to represent safety chains that had "ragged up" and partially blocked the sewer. These were removed from the model and the network assumed "clean".
It was assumed that the scheme at Vicarage Lane PS to increase the storage volume within the tanks would go ahead and this was included in the model (although a comparison was made with this removed from the model for preferred options). **Based on previous STW options report and model, assumed this scheme would go ahead**	The network was modelled both with and without slow response runoff. After initial testing it was decided to proceed without slow response runoff as this tended to vastly over estimate flood volumes for design storms. It has therefore been assumed that slow response runoff / infiltration will have been removed from the network by Severn Trent Water prior to construction of any of the specified growth options. **Previous DAP study states model should be used with caution for design storms due to slow response, since our proposed solution does not involve a storage solution this should not be an issue. It should be noted that the model was calibrated by using the addition of thie slow response**
Estimations were made as to the populations of the future developments based on the number of dwellings and using the average occupancy rate of 2.26.	Estimations were made as to the populations of the future developments based on the number of dwellings and using the average occupancy rate of 2.26.

Table 6.1 (continued) Summary of changes to Ashby and Coalville network models

Ashby-de-la-Zouch model	Coalville model
This model has not allowed for un-modelled storage included in the drainage network of the new developments.	The pump capacity of Kelham Bridge pumping station was increased from 80 l/s to 130 l/s based on the recommendations listed in the Severn Trent Water's Drainage Area report dated .2009. **Based on recommendations listed in the STW's Drainage Area Report, 2009**
It has been assumed that no surface water drainage will join the sewer network	It has been assumed that no surface water drainage will join the sewer network

*This is a standard model amendment in line with Severn Trent Water's modelling specification

All significant developments (10 properties or more) that have been constructed since the last model update were added to the model for each area. The base models were updated with previous model updates which were preformed by Severn Trent Water in the form of model maintenance.

Simulated design storms were developed in InfoWorks using the Wallingford rainfall maps to enable the networks to be modelled under various conditions. Time series rainfall (TSR) events were also used to assess the effect of the proposed developments on the combined sewer overflows (CSOs) in the catchment. These simulate realistic rainfall over an extended period. For this study TSR data covering a one year period was used.

The latest available Drainage Area Plans (DAP) from AMP4 indicate that a number of the CSOs within catchment were deemed to be deficient at the time of the DAP studies, namely -937-02m06 Ashby-De-La-Zouch DAP and Q-937-01m06 Coalville DAP, which were conducted in 2008 and 2009 respectively. The models used in this study are based on the existing DAP models with the addition of any model maintenance (later additions to the model to reflect changes within the catchment) performed by or on behalf of Severn Trent. However this does not include amendments to the CSOs. In practice, the CSOs are operating within their consents and it is considered that additional foul only development flows will have a negligible impact on CSO spill performance.

In both cases the same design storm simulations were run for the updated base model, the model containing the proposed development sites and the model with the reinforcement options. Results for the proposed development sites and the reinforcement options were compared with those of the base model to assess impact.

Sewerage network requirements for the rest of the District area have not been modelled. High level comments have been provided by Severn Trent Water on each potential development site in Castle Donington, Measham, Ibstock and Kegworth, based on readily available information.

6.2 Ashby and Coalville Network Modelling Results

6.2.1 Ashby-de-la Zouch and Packington

In order to provide the Council with an introductory assessment of the potential development sites on network capacity, AMEC has conducted a high level assessment based on a desktop study using readily available information, and existing hydraulic models.

The network catchment of the hydraulic model serving Ashby and Packington drains to the Packington WwTW. The catchment is at its highest in the north and generally slopes to the south. There are two corridors of low ground where small tributaries flow. One runs from Blackfordby in the north west to Willesley Lane Pumping Station (PS) in the south. The other runs from the centre of Ashby to Packington in the south east.

The growth options and potential development sites that have been included in the model are listed below in **Table 6.2** below.

Table 6.2 Growth Options and sites modelled in Ashby

Growth Option	Potential Development Sites	Number of dwellings*
Option 1: High Growth	A3 Holywell Spring Farm	500
Option 2a: Lower growth in district but high growth in Ashby	A5 Money Hill	1600
Option 2b: Lower growth in district but high growth in Ashby	A7 Packington Nook	1100
Option 3: Lower growth in district but additional growth Ashby and Castle Donington	Same as Option 1	Same as Option 1
Option 4: Lower growth in district but with additional growth spread around	A1 Leics Rd – 259 dwellings A9 Moira Rd – 85 dwellings	Total = 344

* Number of dwellings used and multiplied by average occupancy rate of 2.26 (average over growth period) and flow rate of 135 litres per head per day to calculate foul flows from new developments

It should be noted that in a previous Drainage Area Plan (DAP) for Ashby-De-La-Zouch it was recommended that off-line storage tanks should be installed at Vicarage Lane Pumping Station which was predicted to suffer from significant flooding[12]. This study has been conducted with the assumption that this storage will be in place. Should the off-line storage tanks recommended in the previous DAP from 2008 not be installed at Vicarage Lane PS, then additional storage would need to be installed to accommodate the future developments in the order of

[12] DAPs often include notional solutions based on predicted problems but in reality unless there were known problems these problems are often due to modelling issues.

around 425m^3 for Option 1 and 500m^3 for Option 2a to keep the volume of predicted flooding at Vicarage Lane PS at a level comparable to the present situation.

The results of the network capacity assessment for Ashby and Packington are presented in **Table 6.3** below. These are notional solutions based on modelling assumptions. Ultimately Severn Trent Water has a statutory obligation to accommodate new development and will need to undertake more detailed modelling to determine what capacity improvements are required (if any). This table is based on AMEC interpretation and not that of Severn Trent Water.

Table 6.3 Potential Constraints and Reinforcement in the Ashby and Packington network

Option	Sites	Sewerage issue	Required Reinforcement
Option 1	A3 Hollywell Spring Farm – 500 dwellings (1130 additional population)	For the purpose of this exercise the proposed development was modelled as a foul subcatchment draining to manhole SK34178101. Following the assessment it was apparent that the predicted flooding increase was negligible across the catchment during a 30 year storm event. The model predicts a relatively small increase in the predicted volume of flooding at the junction of Abby Drive and Moira Road (manhole SK34166601) a short distance downstream of the connection point where there was an increase in the volume of flooding of approximately 10m^3. Following the inclusion of the proposed development and the required reinforcement (off-line tank at the junction of Abby Drive and Moira Road) the model predicted a minor increase in the spill duration and spill volume from the Combined Sewer Overflow (CSO) at Willesley Lane PS during the course of a year, the percentage increases are between 1 and 2% respectively. The affect of the proposed development on the CSOs and the increases in model predicted flooding following the reinforcement are shown on Figure 6.1.	Off line tank with pumped return at the junction of Abby Drive and Moira Road (manhole SK34166601).
Option 2a	A5 Money Hill – 1,600 dwellings (3,616 additional population)	For the purpose of this exercise the proposed development was modelled as a foul subcatchment draining to manhole SK35177201 near Gilwiskaw Brook. After the inclusion of the development the increase in predicted flooding was negligible during a 30 year storm across the catchment, however, there was a cluster of increased flooding downstream of the connection point with a maximum increase at manhole SK35167804 outside the health centre on North Street where there was a predicted increase of 15.7m^3 of flooding. The model suggests that there is only negligible effect on the CSOs as a result of this option. The affect of the proposed development on the CSOs and the increases in model predicted flooding following the reinforcement are shown on Figure 6.2.	Upsizing 21m of sewer from 375mm to 450mm between manhole SK35166602 on Derby Road and manhole SK35166604 on Kilwardby Street.
Option 2b	A7 Packington Nook – 1,100 dwellings (2,486 additional population)	The proposed development was modelled as a foul subcatchment draining to manhole SK35156302 in the field just south of Nook Farm. It was found that predicted flooding increase was negligible during a 30 year storm event. The model suggests that there is only negligible effect on the CSOs as a result this option. The affect of the proposed development on the CSOs is shown on Figure 6.3	None

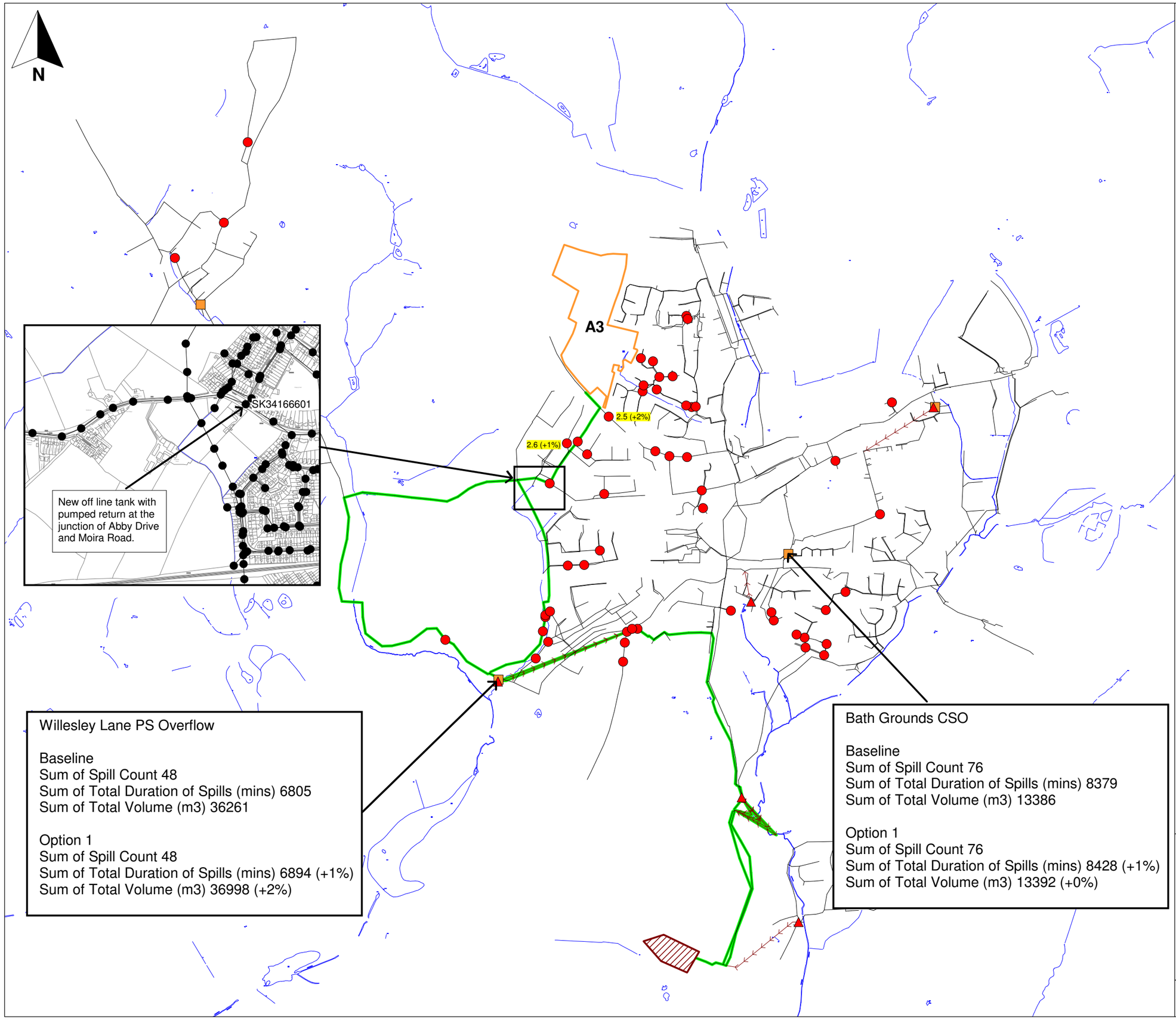
Table 6.3 (continued) Potential Constraints and Reinforcement in the Ashby and Packington network

Option	Sites	Sewerage issue	Required Reinforcement
Option 3	As Option 1	Option 3 is the same as Option 1.	See option 1
Option 4	A1 Leics Road – 259 dwellings (586 additional population) A9 Moira Road – 85 dwellings (193 additional population)	For the purpose of this exercise the proposed developments were initially modelled as foul subcatchments with A1 draining to manhole SK36167304 and A9 draining to manhole SK34167601. The predicted flooding increase was negligible across the catchment as a result of adding properties at A1 but there was a local increase as a result of adding A9 during a 30 year storm. By including A9 there was a cluster of increased flooding with a maximum increase at node SK34167601 where there was an increase of 4.4m^3. It was found that connecting the subcatchment A9 to manhole SK34165501 in the field rather than manhole SK34167601 in Moira Road reduced the volume of predicted flooding to a comparable level with the present situation. The model suggests that there is only negligible effect on the CSOs as a result this option. The affect of the proposed development on the CSOs and the increases in model predicted flooding following the reinforcement are shown on Figure 6.4.	None

Based on a desktop study using readily available information and existing hydraulic models.

The results show that there are unlikely to be significant constraints affecting the proposed developments in Ashby-De-La-Zouch and Packington. Where significant increases in predicted flooding are apparent, the model predicts they could be mitigated by minor modifications to the sewer network. These are potentially large sites with several hundred housing units per site and care must be taken when designing the drainage on site.

As discussed in the introduction section above, the number of spills from CSOs in the existing base models seems to be incorrect, as the number of spills per year seems too high. This is an issue that require additional updates in the model, rather than on site investigation into the performance of the CSOs. Nevertheless the models have assessed the impact on CSOs spill frequency, duration and volume from new development. As only foul flows are modelled from new developments, and CSOs tend to spill in response to heavy rainfall events, the developments do not significantly impact the existing modelled situation. It is unlikely that new development will significantly affect actual CSO spills either for the same reason (only foul flows are expected to connect to the network, with SuDS used to manage surface water from new developments).



Key

Proposed Development Site

Site With Site Reference

Modelled Sewer Key

Foul/Combined Sewer

Foul/Combined Rising Main

Proposed Sites Drainage Path To WwTW

1.3 Future Predicted Flooding Increase (Increases over 2.5m3 labelled)

Ancillaries Key

Foul/Combined Pumping Station

Combined Sewer Overflow

Sewage Treatment Works (STW)

0 km — 1 km

Scale 1km @ A3

Ashby-De-La-Zouch
Proposed Development Sites
Option 1

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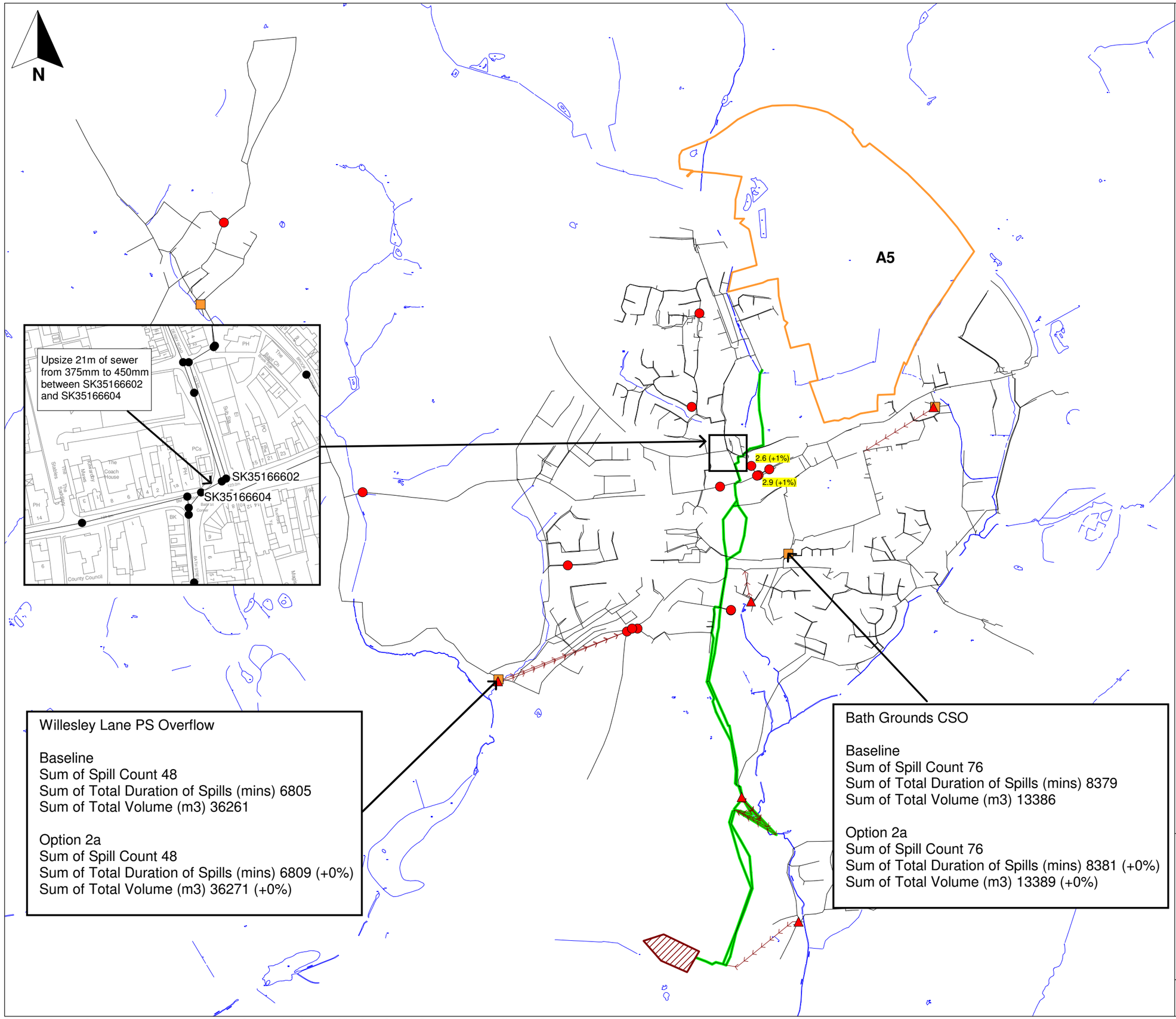

Key

Proposed Development Site

Site With Site Reference

Modelled Sewer Key

Foul/Combined Sewer

Foul/Combined Rising Main

Proposed Sites Drainage Path To WwTW

1.3 Future Predicted Flooding Increase (Increases over 2.5m3 labelled)

Ancillaries Key

Foul/Combined Pumping Station

Combined Sewer Overflow

Sewage Treatment Works (STW)

0 km — 1 km

Scale 1km @ A3

Ashby-De-La-Zouch
Proposed Development Sites
Option 2a

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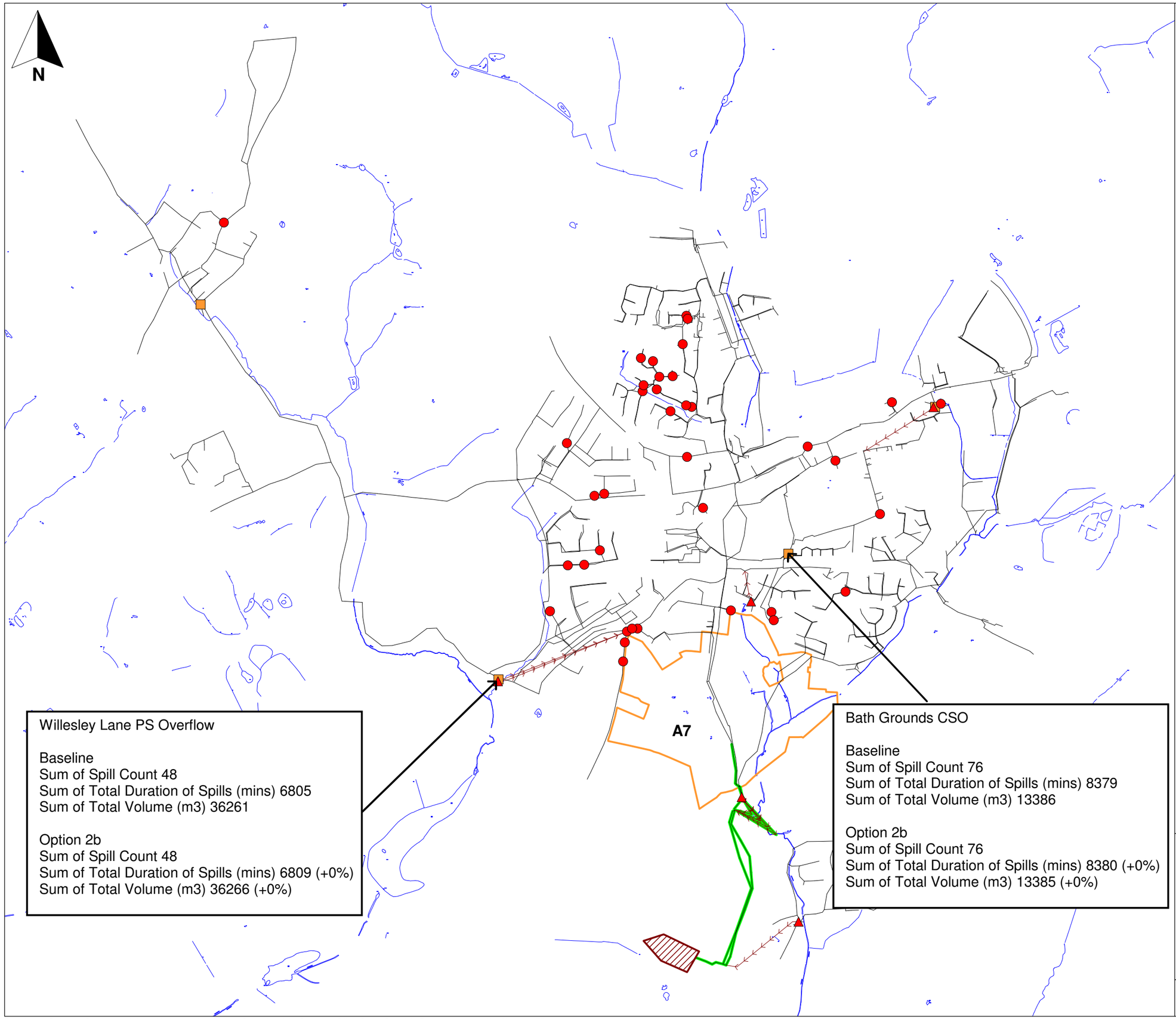

Key

Proposed Development Site

Site With Site Reference

Modelled Sewer Key

Foul/Combined Sewer

Foul/Combined Rising Main

Proposed Sites Drainage Path To WwTW

1.3 Future Predicted Flooding Increase (Increases over 2.5m3 labelled)

Ancillaries Key

Foul/Combined Pumping Station

Combined Sewer Overflow

Sewage Treatment Works (STW)

0 km — 1 km

Scale 1km @ A3

Ashby-De-La-Zouch
Proposed Development Sites
Option 2b

Aug 2011
29438-S005 CAMPP

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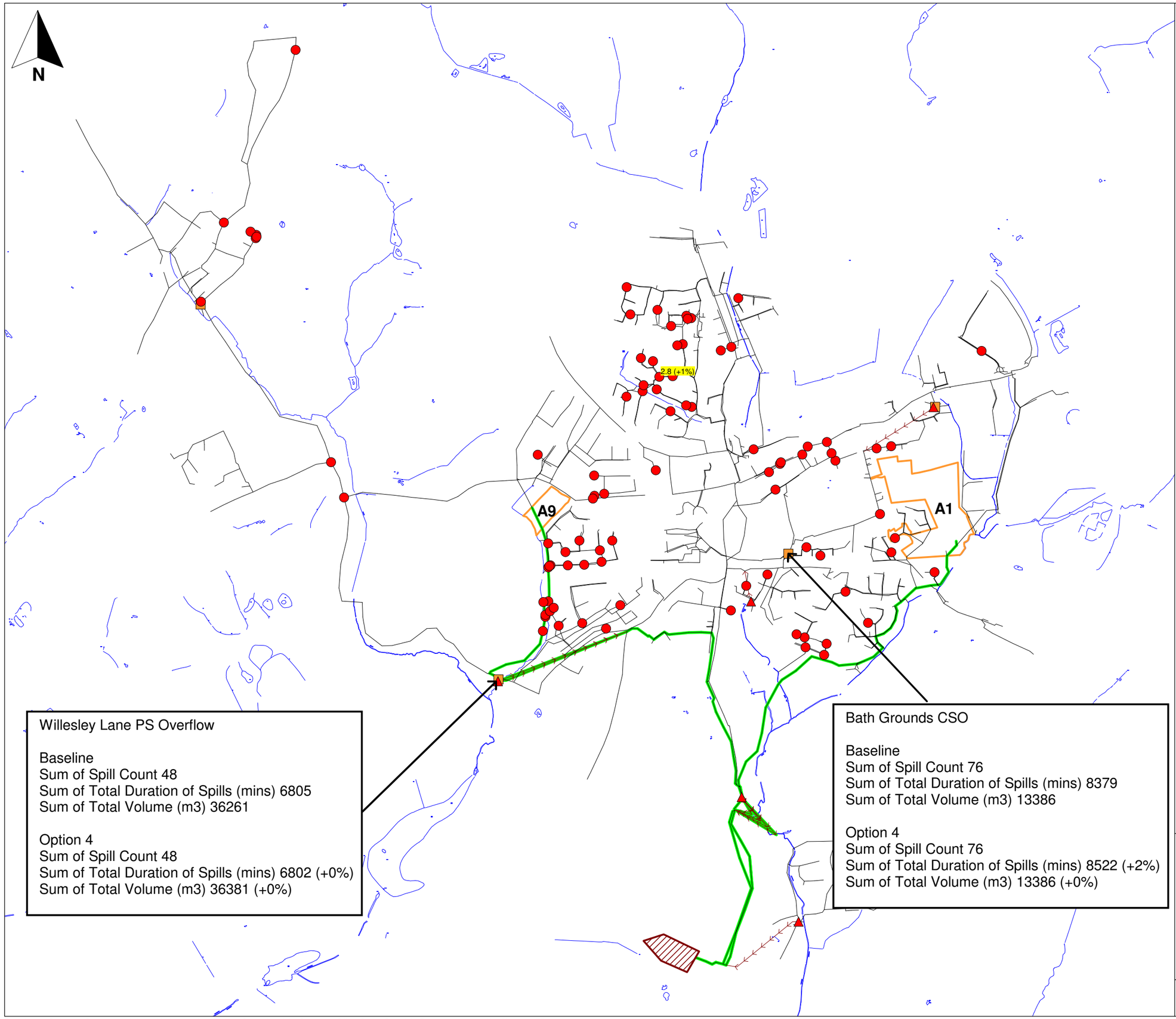

Willesley Lane PS Overflow

Baseline
Sum of Spill Count 48
Sum of Total Duration of Spills (mins) 6805
Sum of Total Volume (m3) 36261

Option 4
Sum of Spill Count 48
Sum of Total Duration of Spills (mins) 6802 (+0%)
Sum of Total Volume (m3) 36381 (+0%)

Bath Grounds CSO

Baseline
Sum of Spill Count 76
Sum of Total Duration of Spills (mins) 8379
Sum of Total Volume (m3) 13386

Option 4
Sum of Spill Count 76
Sum of Total Duration of Spills (mins) 8522 (+2%)
Sum of Total Volume (m3) 13386 (+0%)

Key

Proposed Development Site

Site With Site Reference

Modelled Sewer Key

Foul/Combined Sewer

Foul/Combined Rising Main

Proposed Sites Drainage Path To WwTW

1.3 Future Predicted Flooding Increase (Increases over 2.5m3 labelled)

Ancillaries Key

Foul/Combined Pumping Station

Combined Sewer Overflow

Sewage Treatment Works (STW)

0 km — 1 km

Scale 1km @ A3

Ashby-De-La-Zouch
Proposed Development Sites
Option 4

Aug 2011
29438-S006 CAMPP

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6.2.2 Coalville

The Coalville catchment covers the town of Coalville, including Whitwick, Thringstone and Hugglescote, and the drainage network drains to Snarrows WwTW, north of the town. The general catchment topography of Coalville is that the land slopes downwards from the south to the northern tip of the catchment where Snarrows WwTW is located. The land also slopes to the southwest corner where Kelham Bridge Pumping Station (PS) is located.

One major assumption in the network modelling is that the infiltration reduction works, currently being investigated by Severn Trent Water, will have been implemented, thus reducing infiltration into the network. This is because during the initial review of the model, which was modelled both with and without slow response runoff from the infiltration, flood volumes for design storms were vastly over estimated. It has therefore been assumed that slow response runoff / infiltration will have been removed from the network by Severn Trent Water prior to construction of any of the specified growth options.

The growth options and potential development sites that have been included in the model are listed below in **Table 6.4** below.

Table 6.4 Growth Options and sites modelled in Coalville

Growth Option	Potential Development Sites	Number of dwellings*
Option 1: High Growth	C23 Bardon = 4500 dwellings C19 Stephenson Green = 1800 dwellings C40 Standard Hill = 500 dwellings	Total = 6800
Option 2: Lower growth in district but high growth in Ashby	C 23 Bardon = 4500 dwellings C40 Standard Hill = 500 dwellings	Total = 5000
Option 3: Lower growth in district but additional growth Ashby and Castle Donington	Same as Option 2	Same as Option 2
Option 4: Lower growth in district but with additional growth spread around	Same as Option 2	Same as Option 2

* Number of dwellings used and multiplied by average occupancy rate of 2.26 (average over growth period) and flow rate of 135 litres per head per day to calculate foul flows from new developments

In order to provide the Council with an introductory assessment of the potential development sites, AMEC has conducted a high level assessment based on a desktop study using readily available information, and existing hydraulic models. The results are presented in Table 6.5 below. These are notional solutions based on modelling assumptions. Ultimately Severn Trent Water has a statutory obligation to accommodate new development and will need to undertake more detailed modelling to determine what capacity improvements are required (if any). This table is based on Amec interpretation and not that of Severn Trent Water.

Table 6.5 Potential Constraints and Reinforcement in the Coalville network

Option	Sites	Sewerage issue	Required Reinforcement
Option 1	C23 Bardon – 4500 dwellings (10,170 additional population) C19 Stephenson Green – 1800 dwellings (4,068 additional population) C40 Standard Hill – 500 dwellings (1,130 additional population)	Due to the local topography, the foul drainage on the Bardon site (C23) would likely have to be split between the north and the south of the site, with flows from the north half being pumped into the main sewer network on the south side of the site. The most appropriate connection point for foul flows from the whole site is located towards the south west of the site. For the purpose of this exercise the proposed development was modelled as two foul subcatchments draining to manhole SK42115801, one by gravity and one pumped. The most appropriate connection point for foul flows from the Stephenson Green site (C19) is either SK42148903 on Stephenson Way, SK43154302 on Green Lane or SK44150203 on Hall Lane. For the purpose of this exercise it was determined the sewer on Hall Lane could not accept the additional flow, consequently it was assumed that the flow from C19 will drain to manholes SK42148903 and SK43154302. Finally, the most appropriate connection point for foul flows from the Standard Hill site (C40) was SK41138301. For the purpose of this exercise the site was modelled as a foul subcatchment with a pumped inflow into manhole SK41138301. It was found that the volume of predicted flooding increased marginally in several areas across the catchment during a 30 year storm. In addition the model predicted some flooding downstream from C19, the volume of model predicted flooding was considered to be significant but this could be reduced to levels only marginally higher than the present situation by reinforcing the system. Following the inclusion of the proposed developments and the required reinforcement the model suggested that three Combined Sewer Overflows (CSOs) could be affected by Option 1. The model predicted a minor increase in both the spill duration and spill volume from the CSO at St Marys Lane, the percentage increases during the course of a year are 1 and 3% respectively. In addition to increases in the spill duration and spill volume, the model also suggested that the number of spills from Kelham Bridge CSO and Station Road/Hugglescote CSO may increase. The percentage increases for the number of spills, the spill duration and the spill volume at Kelham Bridge CSO during the course of a year are 10%, 13% and 8% respectively. Similarly, the percentage increases at Station Road/Hugglescote CSO are 8%, 13% and 17% respectively. Due to capacity issues at Snarrows WwTW the pumping rate at Kelham Bridge SPS is currently throttled back. As part of the infiltration removal strategy it is envisaged that it will release capacity at Snarrows WwTW and therefore allow the pumping rate at Kelham Bridge SPS to be reinstated to avoid the issues with increased spills resulting from development. The affect of the proposed development on the CSOs and the increases in model predicted flooding following the reinforcement are shown on **Figure 6.5**.	For C19, upsize approximately 74m of sewer from 1050mm to 1200mm between manhole SK43163401 and manhole SK43163405 in open ground.
Option 2	C23 Bardon – 4500 dwellings (10,170 additional population) C40 Standard Hill – 500 dwellings (1,130 additional population)	With the exception of C19, which has been removed, Option 2 is the same as Option 1. It was found that the predicted flooding increase was negligible during a 30 year storm across the catchment. The impact on CSOs at St Marys Lane, Kelham Bridge and Station Road/Hugglescote Lane is the same as Option 1. The affect of the proposed development on the CSOs and the model predicted flooding following the reinforcement are shown on Drawing **Figure 6.6**.	None

Table 6.5 (continued) Potential Constraints and Reinforcement in the Coalville network

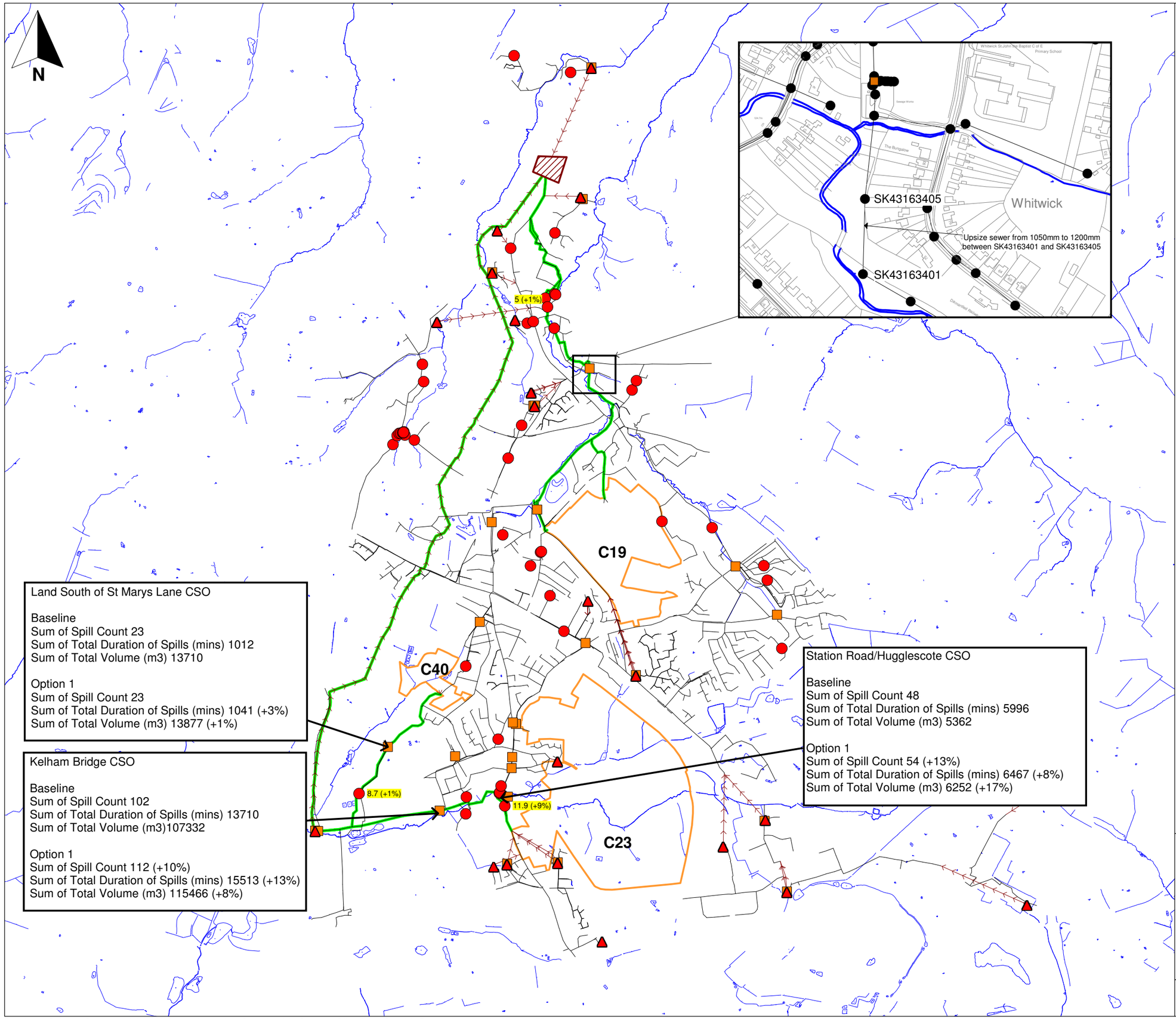
Option	Sites	Sewerage issue	Required Reinforcement
Option 3	As Option 2	With regard to Coalville option 3 is the same as Option 2. As such it was not modelled.	See option 2
Option 4	As Option 2	With regard to Coalville Option 3 is the same as Option 2. As such it was not modelled.	See option 2

Based on a desktop study using readily available information, and existing hydraulic models.

The results show that there are unlikely to be significant constraints affecting the proposed developments in Coalville and predicted increases in flooding could be largely mitigated by minor works, assuming that the infiltration works is implemented. However these are large sites with several thousand housing units on some sites and care must be taken when designing the drainage and pumping arrangements at each site to help minimise their impact on the existing network.

As discussed in the introduction section above, the number of spills from CSOs in the existing base models seems to be incorrect, as the number of spills per year seems too high. In particular the issue at Kelham Bridge Pumping Station overflow is a known problem to Severn Trent Water and is currently being investigated as part of the infiltration reduction measures. Nevertheless the models have assessed the impact on CSOs spill frequency, duration and volume from new development. As only foul flows are modelled from new developments, and CSOs tend to spill in response to heavy rainfall events, the developments do not significantly impact the existing modelled situation. It is unlikely that new development will significantly affect actual CSO spills either for the same reason (only foul flows are expected to connect to the network, with SuDS used to manage surface water from new developments).

In addition to the sites modelled above, Severn Trent Water also provided initial comments on potential development sites in Ibstock, some of which may affect the sewerage network in Coalville due to their location close to the sewer catchment to Snarrows WwTW (serving the Coalville area). Particularly Leicester Road/Ravenstone Road would drain toward Kelham Bridge pumping station. Whilst this in itself is not expected to be a problem it has already been noted that there might be capacity issues associated with the pumping station as a result of development in the south of Coalville (see **Table 6.6** for assessment of sites in the Rest of the District). As part of the infiltration removal strategy it is envisaged that capacity at Snarrows WwTW will be released and therefore allow the pumping rate at Kelham Bridge PS to be reinstated to avoid the issues with increased spills resulting from development.



Key

Proposed Development Site

Site With Site Reference

Modelled Sewer Key

- Foul/Combined Sewer
- Foul/Combined Rising Main
- Proposed Sites Drainage Path To WwTW
- 1.3 Future Predicted Flooding Increase (Increases over 5m3 labelled)

Ancillaries Key

- Foul/Combined Pumping Station
- Combined Sewer Overflow
- Sewage Treatment Works (STW)

0 km — 2 km

Scale 2km @ A3

Coalville
Proposed Development Sites
Option 1

Aug 2011
29438-S001 CAMPP

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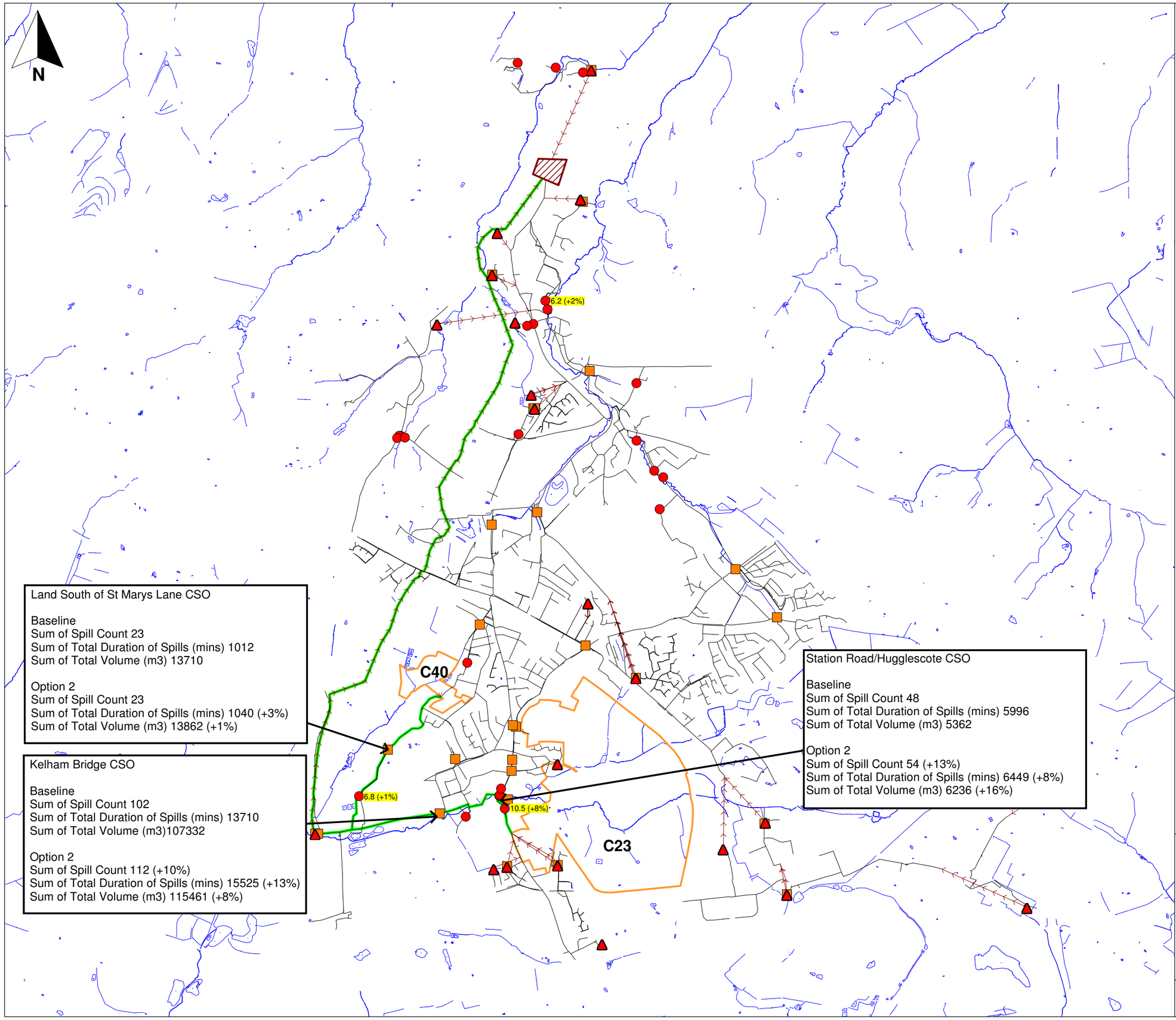


Key

Proposed Development Site

Site With Site Reference

Modelled Sewer Key

- Foul/Combined Sewer
- Foul/Combined Rising Main
- Proposed Sites Drainage Path To WwTW
- 1.3 Future Predicted Flooding Increase (Increases over 5m3 labelled)

Ancillaries Key

- Foul/Combined Pumping Station
- Combined Sewer Overflow
- Sewage Treatment Works (STW)

0 km — 2 km

Scale 2km @ A3

Coalville
Proposed Development Sites
Option 2

Aug 2011
29438-S002 CAMPP

amec

6.3 Rest of the District

Severn Trent Water provided high level comments on the impact of each potential development site in Castle Donington, Ibstock and Kegworth on sewer network capacity for the Outline WCS based on readily available information, and not based on detailed hydraulic modelling. This is because the details of each development have not been confirmed, and so when the development plans have more information they will be modelled by Severn Trent Water to assess capacity and any potential upgrades required. Severn Trent Water have reviewed their previous comments and confirmed that for the Detailed Study the comments are still valid for potential development sites in these areas. Additional comments have been provided for the impact of potential development sites on the sewer network in Measham.

The high level assessment indicates that there are no major constraints associated with the sewer network for the potential development sites in Castle Donington, Measham, Ibstock and Kegworth. One of the potential development sites in the Ibstock area would however drain to Snarrows WwTW that serves Coalville. The potential impact on sewerage from this site has been assessed as medium due to the association with Coalville developments and potential capacity issues with Kelham Bridge Pumping Station. The assessment, which was undertaken by Severn Trent Water however, does not take into account the ongoing work by Severn Trent Water on the issues of infiltration/surface water ingress into the Coalville network.

The summary review of network capacity for potential development sites in the rest of the District is presented in **Table 6.6** below.

Table 6.6 Potential impact of proposed developments on sewerage infrastructure assets

Site Ref	Site Name	No of dwellings	WwTW	Sewerage Comment	Potential impact on sewerage infrastructure
Castle Donington					
CD3	South of Park Lane - now CD4 with larger site area	700	Castle Donington	Site is located to the south of an existing catchment with a separate drainage system which then drains by gravity to the treatment works. There are a few isolated known external flooding problems downstream but subject to hydraulic modelling and any localised reinforcement works this site is not expected to result in any capacity issues	Low - subject to hydraulic modelling
Ibstock					
I1	Leicester Road / Ravenstone Road - now Ib18 (300)	131	Snarrows	There are 225mm dia foul and surface water sewer crossing this site which drain north towards Kelham Bridge SPS. Draining this site to Kelham Bridge SPS is not expected to be a problem but there may be capacity issues with the pumping station due to the significant development proposed to the south of Coalville	Medium due to association with Coalville developments and potential capacity issues with Kelham Bridge SPS (see Section 6.2.2 for Coalville capacity assessments)

Table 6.6 (continued) Potential impact of proposed developments on sewerage infrastructure assets

Site Ref	Site Name	No of dwellings	WwTW	Sewerage Comment	Potential impact on sewerage infrastructure
I2	Off Leicester Road - now Ib10 (230)	220	Ibstock	A 300mm dia foul sewer runs within the western boundary of this site. There are no known flooding problems downstream and subject to hydraulic modelling only localised reinforcement would be expected to cater for this development	Low - subject to hydraulic modelling
I4	South of Ashby Road - now Ib16 (285)	290	Ibstock	This site is located to the west of a catchment which drains to a small sewage pumping station on Station Road which lifts flows up to the nearby foul sewer before gravitating down to Ibstock STW. There are no known flooding problems downstream of this site and subject to hydraulic analysis this site should not have any significant capacity issues but may need the pumping station to be upsized	Low - but may need pumping station upsizing/replacement
I6	Station Road - now Ib15 (135)	180	Ibstock	This site is located to the west of a small sewage pumping station on Station Road which lifts flows up to the nearby foul sewer before gravitating down to Ibstock STW. There are no known flooding problems downstream of this site and subject to hydraulic analysis this site should not have any significant capacity issues but may need the pumping station to be upsized	Low - but may need pumping station upsizing/replacement
Kegworth					
K1	Adjoining Cott Factory - now K4 (80 - smaller site)	404	Kegworth	This site is located to the west of Kegworth STW and so should not have any capacity issues. There is a 375mm dia foul sewer crossing part of the site plus a 250mm dia rising main	Low - subject to hydraulic modelling
Measham					
M2	Land between Burton Road and New Street - now M9 (350), includes site M1	400	Measham	All foul flows from Measham are pumped to Measham STW via a 1.2km rising main from Westminster Industrial Estate sewage pumping station. Hydraulic capacity would need to be checked to ensure there is sufficient capacity to accept additional development flows in Measham. This site is close to Westminster Industrial Estate sewage pumping station and there are no known sewer flooding problems downstream of this site. There is a 225mm dia foul water sewer crossing this site and is protected by a combined sewer overflow immediately upstream of the development. Due to the size of the development it is unlikely that sufficient spare capacity would be available in a 225mm dia sewer to accept additional foul flows and to ensure there is no adverse impact on the CSO performance. Whilst detailed hydraulic modelling would be required to confirm the extent of the reinforcement work the worst case would be that approx 650m of sewer would need to be upsized.	Low (subject to pumping capacity checks)

Table 6.6 (continued) Potential impact of proposed developments on sewerage infrastructure assets

Site Ref	Site Name	No of dwellings	WwTW	Sewerage Comment	Potential impact on sewerage infrastructure
M3	North east of Atherstone Road - now M6 (410)	410	Measham	All foul flows from Measham are pumped to Measham STW via a 1.2km rising main from Westminster Industrial Estate sewage pumping station. Hydraulic capacity would need to be checked to ensure there is sufficient capacity to accept additional development flows in Measham.There is an existing 225mm dia foul sewer to the west of the development site which passes through rear gardens before draining through a combined sewer overflow on Tamworth Road and then on to Westminster Industrial Estate sewage pumping station. Whilst there are no known flooding problems on downstream of the site detailed hydraulic modelling would be required to confirm that there is adequate spare capacity. Whilst acceptance of foul flows in to this sewer is not expected to be an issue any downstream upsizing would be difficult as the route of the sewer passes through rear gardens	Low (subject to pumping capacity checks)
M8	M8 Bosworth Road, Measham	77	Measham	All foul flows from Measham are pumped to Measham STW via a 1.2km rising main from Westminster Industrial Estate sewage pumping station. Hydraulic capacity would need to be checked to ensure there is sufficient capacity to accept additional development flows in Measham. There is a 150mm diameter combined sewer crossing the site from east to west. There are no known flooding incidents in the downstream sewer network. Subject to hydraulic modelling, any capacity improvements to accommodate flows from this development are likely to be localised.	Low (subject to pumping capacity checks and hydraulic modelling)
M11	M11 Leicester Road / Grassy Land, Measham	360	Measham	All foul flows from Measham are pumped to Measham STW via a 1.2km rising main from Westminster Industrial Estate sewage pumping station. Hydraulic capacity would need to be checked to ensure there is sufficient capacity to accept additional development flows in Measham. There is a cluster of recorded flooding incidents on the downstream sewer network. Sewer capacity upgrades are likely to be required to accommodate foul flows from a further 360 dwellings, though improvement works are likely to be localised.	Low (subject to pumping capacity checks and hydraulic modelling)

7. Sustainable Drainage Requirements

7.1 Introduction

Sustainable Drainage Systems (SuDS) are systems that are designed to mimic natural processes of runoff and infiltration, as opposed to traditional piped systems, to improve management of surface water. In traditional systems, pipes are designed to convey surface water quickly away from urban areas, which can potentially increase the rate and volume at which runoff enters the river systems, and hence increase flooding downstream. Furthermore, as urbanisation increases, the capacity of piped systems reduces, so that the latest developments may not be able to connect to surface water sewers without contributing to necessary upsizing of the sewer system.

The risk of flooding from surface water run-off, sewers and culverted watercourses can be relatively high in urban areas. It was identified in the Outline phase that the areas of the District most at risk from fluvial flooding correspond with areas of fairly extensive areas of intermediate or high levels of susceptibility to surface water flooding (Ashby, Castle Donington and Kegworth).

The Outline WCS summarises the benefits of using SuDS, for flood management, water quality, amenity and biodiversity. The drivers for using SuDS on new and existing developments are also discussed, which include:

- Reducing surface water flood risk, by managing surface water separately to the sewerage systems;
- Promotion within Planning Policy Statement 25: Development and Flood Risk;
- The Government's Water Strategies *Making Space for Water* (2005) and *Future Water* (2008) require a more sustainable approach to drainage;
- The Water Framework Directive also requires a more sustainable approach to drainage and flood risk management; and
- The Pitt Review (2008), which recommended that local authorities should be responsible for adopting and maintaining new build (and re-developed) SuDS on highways and in the local realm.

Since publication of the previous Outline WCS, the Floods and Water Management Act has been published in 2010. This includes a section on sustainable drainage, and requires developers to include sustainable drainage, where practicable, in new developments. The Act also amends Section 106 of the Water Industry Act 1991, by making the right to connect surface water run-off to public sewers conditional on meeting new standards. It gives responsibility for approving sustainable drainage systems in new development, and adopting and maintaining them where they affect more than one property, to a SuDS Approving Body (SAB), generally the Lead Local Flood Authorities (LLFA). The LLFA in this case is Leicestershire County Council.

The SAB will be a statutory consultee on the planning process to approve drainage systems in new developments and redevelopments, before construction can commence. The SAB will also have responsibility for adopting and maintaining sustainable drainage systems. There have, however, been delays from Defra in advising when new

standards and SABs will come into force. The full regulatory system headed up by new SABs may now not be expected to commence until Spring 2012.

In the previous phase of the WCS, it was recommended that surface water flooding should be a material planning consideration. New developments were advised to apply sustainable drainage techniques to control flood risk, whilst also providing benefit in terms of water quality, amenity value and green infrastructure targets. The Outline WCS also included a recommended policy for SuDS, so that planning policy would require all new developers to use SuDS where possible to prevent any increase in surface water flooding and reduce existing surface water flooding.

Whilst infiltration techniques are the preferred method of SuDS because they control surface water at the source at which it is generated, it was identified that infiltration capacity of the District might be low. This was due to the low permeability of soils and geology present.

Attenuation techniques such as ponds, wetlands, green roofs and water recycling schemes which hold back run-off volumes and rates and allow water reuse should be considered where infiltration potential is low. It was advised that developers should be encouraged to consider the land take required for SuDS at the earliest opportunity, as typically SuDS need a greater footprint than traditional piped drainage systems.

This phase of the WCS provides an indicative assessment of selected SHLAA sites, to determine the suitability of SuDS and likely attenuation volumes needed to comply with PPS25 requirements: that is to prevent run-off increasing from the site post development. Various datasets are cross referenced to provide an indication of whether infiltration or attenuation techniques are likely to be appropriate. Simple calculations are undertaken to determine existing runoff rates and hence required attenuation requirements in the future. A summary of likely costs, funding and maintenance requirements is also included.

7.2 Approach Used for SuDS Assessment

7.2.1 General Approach

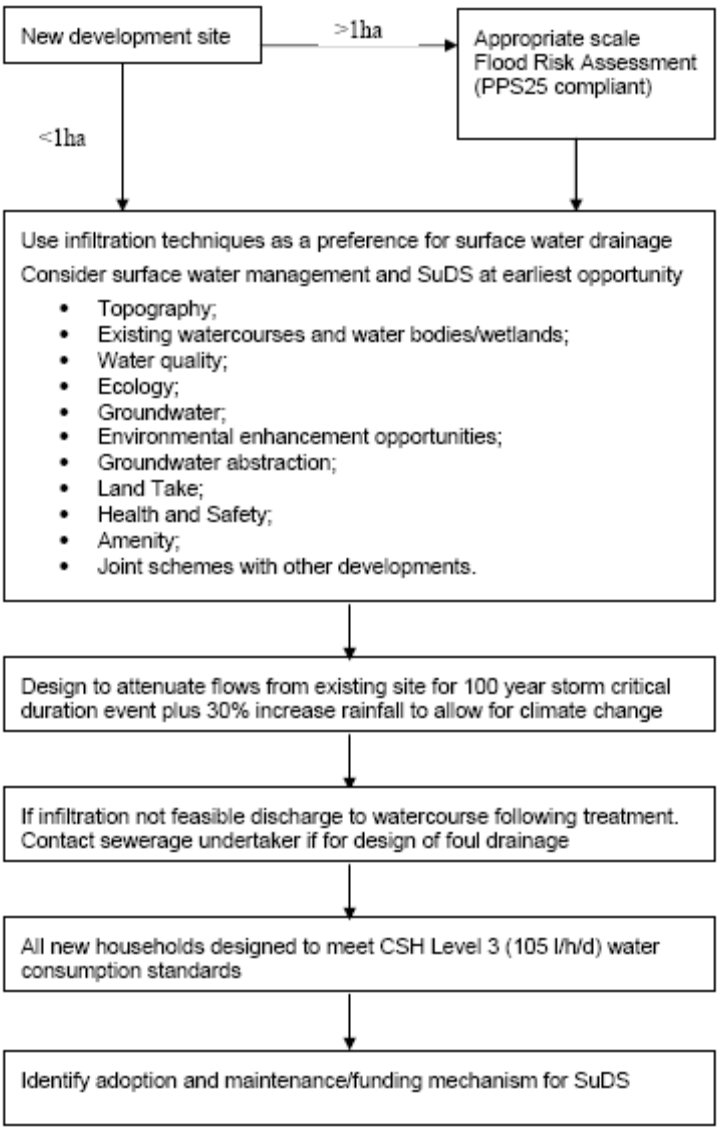
The assessment of SuDS suitability has been designed around the developer checklist requirements provided in the Outline WCS and replicated below in **Figure 7.1**. For each site, information on the development type and existing site has been gathered and used to estimate indicative drainage requirements. Ordnance survey mapping and GIS data on watercourses and culverts have been assessed to identify at a high level if a watercourse is located near to the site to be able to accept surface water run-off. This is only a mapping based exercise and developers proposing to develop the SHLAA sites will require more detailed site investigations to identify suitable drainage arrangements.

The potential for infiltration at each site has been assessed based on the soils description from the NSRI website. Soilscapes is not intended as a means for supporting detailed assessments, such as land planning applications or site investigations. For such applications, a parallel service Soils Site Reporter provides comprehensive reporting for

specific locations. Developers should not base their detailed drainage design on this information, but should instead carry out detailed site investigation and soakaway tests to determine infiltration rates specific to each site.

The requirements for a Flood Risk Assessment (FRA) have been determined based on the size of the site development boundary, and cross referencing with the Environment Agency's online flood map. The results for each site are tabulated and presented in **Appendix D**. A guide for FRA requirements is in **Appendix E**.

Figure 7.1 Developer Guidance Checklist (Outline WCS, 2010)



7.2.2 Sources of Data

The Council provided information on the sites that required SuDS assessment, through links to online data and from a schedule of sites provided in excel and GIS. Details on the sites such as area, current land use, proposed number of dwellings, have been taken from the Strategic Housing Land Availability Assessment (SHLAA) documentation from April 2011 (http://www.nwleics.gov.uk/pages/strategic_housing_land_availabilty_asessment). Where information on area or number of dwellings is missing from the online data, the schedule of sites data has been used instead. The GIS files of the site boundaries for each site were used to cross reference with online mapping of hydrological and geological features, and with sewerage data from Severn Trent Water. The GIS files were also used to obtain grid references of the centre point of each site, for use in the SuDS calculations.

The following sources of data have then been consulted to review SuDS suitability:

- British Geological Survey GeoIndex (http://maps.bgs.ac.uk/GeoIndex/default.aspx);
- National Soils Resources Institute (NSRI) Soilscapes (http://www.landis.org.uk/soilscapes/);
- Environment Agency online mapping for flood zones, groundwater source protection zones, aquifer status (http://www.environment-agency.gov.uk);
- Severn Trent Water sewer records;
- Flood Estimation Handbook CD-ROM version 2.0 for catchment characteristics (NERC (CEH) 2006); and
- The Wallingford Procedure, Volume 3 Maps.

7.2.3 Indicative Drainage Calculations

Existing Run-off Calculations

Indicative attenuation volumes have been modelled for each site, assuming that run-off will be managed to existing run-off rates. For greenfield/undeveloped sites, existing run-off has been calculated using the Institute of Hydrology Report 124 method for small catchments, less than 200 hectares. The calculation is based upon the following factors:

- **Area** Catchment Area (ha), for sites less than 50 ha the area of the site has been set to 50 ha to determine runoff rates per unit area for comparison with each sub-catchment;
- **SAAR** Average annual rainfall from version 2 of the Flood Estimation Handbook CD-ROM, for the catchment to the site's central grid reference;
- **Soil** Soil index of the catchment from Wallingford Procedure Volume 3. Soil Types 1 to 5 have Soil Index Values of 0.15, 0.3, 0.4, 0.45 and 0.5 respectively. For the majority of sites in the District, the soil type is 4, with Index Value 0.45;

- **Urban** This has been set to zero in order to calculate Greenfield runoff rates;
- **Region Number** Region number of the catchment based on FSR **Figure I.2.4**, which is 4 for the District.

For brownfield/previously developed sites, the Modified Rational Method has been used, which is recommended by the EA and industry for the design of urban drainage systems. The calculation is based upon the following factors:

- **Area** Drainage Area (km^2) – the existing impermeable area of brownfield sites has been derived by assuming 80% of the site is impermeable;
- **Rainfall (mm/hr)** Rainfall intensity for the critical storm duration, taken from version 2 of the FEH CD Rom using the Depth Duration Frequency module for each catchment, located using the central grid reference of the site.
- **Runoff coefficient (C)** Assumed to be 0.84, which is the standard value used for impermeable areas for a winter profile.

It should be noted that brownfield/previously developed sites are likely to have existing sewerage or drainage infrastructure, and by the nature of the development may not be located close to a watercourse. Surface water run-off from the redevelopment of the site might therefore need to use the drainage infrastructure. This should be used as a last resort. The capacity of the drains will represent the limiting run-off to which on site drains should be designed. Furthermore, PPS25 seeks betterment, so that the redevelopment of brownfield sites should look to reduce run-off rates post development. No reduction has been factored in to the calculations, however the Environment Agency has commented that they would expect brownfield developments to give consideration to reducing surface water run-off by at least 20% in order to allow for the effects of climate change. This should be considered on a site by site basis by the developer.

Indicative Attenuation Requirements

Indicative calculations of the required attenuation volume have been undertaken using WinDes drainage software, an industry recognised software for design of drainage and SuDS. Within this software package, the existing run-off is input as the limiting discharge rate. The maximum volume required to attenuate surface water generated by the increase in hardstanding is then calculated, by using rainfall data for the catchment and inputting the future hardstanding area.

A simple pond feature has been used to size the attenuation requirements for each site, based on a 1 in 100 year annual probability rainfall event. Within the software a range of storm durations are analysed for, from 15 minutes up to 10080 minutes (or 7 days) are assessed. This is checked to ensure that the critical duration event (i.e. maximum potential volume of rainfall generated) is included within the analysis. The attenuation volume and the critical duration event are presented in the SuDS table for each site.

A 30% increase in rainfall has been included in the calculations based on the guidance in PPS25 for a design horizon up to 2115. Rainfall inputs are calculated within Windes based on the hydrological catchment which is loaded from the Flood Estimation Handbook CD Rom, for the central grid reference of each site.

Attenuation volumes have been estimated assuming that the future hardstanding area (impermeable areas of buildings and parking) represents 65% of the site area for greenfield sites. For brownfield sites it has been assumed that the percentage of hardstanding is already high, and therefore future development on the site might also have a high percentage of hardstanding. A value of 80% impermeable areas has been assumed. If the future hardstanding area is different to these assumptions, the attenuation volumes and costs will also subsequently be affected.

The site information and results have been tabulated in Appendix D as an easy reference tool for the Council and for use by developers in designing the site and required drainage. It should be noted that there are a number of assumptions used in the calculations (**see Box 3**), and that each developer should undertake site specific assessments for drainage and SuDS requirements. Furthermore, this assessment does not replace any required flood risk assessment, drainage impact assessment or detailed drainage design.

To reiterate, the assumptions used in the calculations are presented in Box 3 below

Box 3 **Assumption used in SuDS Assessment**
For existing brownfield sites, it is assumed that 80% of the site is impermeable
Run off coefficient for brownfield run off is 0.84
A simple pond feature is used to determine attenuation volume
For greenfield sites, future hardstanding (impermeable) areas cover 65% of the site
A 30% increase is applied to rainfall inputs to allow for climate change
A simple pond (or infiltration basin) is modelled to determine attenuation volumes for the critical duration
Discharge rates are set to the 1 in 100 year limit
Where infiltration capacity is considered medium, based on soils description “Freely draining slightly acid sandy loam”, infiltration rates of 0.5 m/hr. This value should not be used in detail design. Rather on site infiltration tests should be undertaken to determine site specific infiltration rates.

7.2.4 Indicative Costs

As highlighted above, a number of assumptions have been necessary in the SuDS assessment, as the majority of sites are not yet progressed to the masterplanning/development design stage. Therefore there is no information about site layout or proportion of impermeable and permeable surfaces. Nevertheless, indicative SuDS calculations have been provided to show estimates of the storage volume that would need to be provided through sustainable drainage techniques.

To provide the developer, and the Council, with indicative costs associated with the storage volumes required, construction costs have been estimated for a range of pond sizes. For this assessment, the “construction cost” means general excavation, excavation and filling ancillaries and landscaping (i.e. the material and labour costs for

the pond construction). General construction items such as site supervisor, temporary compounds etc are not included. No costs are included for the detailed design that would also be required prior to construction, or for any ancillary pipework for connecting run-off to the pond or for the pond outfall.

It is recognised that there are a number of SuDS options that could be used to provide or contribute to the attenuation requirements on future developments. Indicative unit costs have also therefore been provided for swales and permeable paving, which are considered the most likely options that will be considered by developers.

The financial estimates are also based on a number of assumptions that are listed in **Box 4** below.

Box 4 Assumption used in financial estimates
Estimated from CESMM3[13] and bench marked against term contract, framework and competitive rates
Good ground conditions (i.e. No hard material)
Good site access
Non contaminated material
Assumes 75% of excavated material used for landscaping onsite & 25% disposed of off site
Swale costs are built up assuming 2m wide x 1m deep x 10m long

The indicative costs for a range of pond sizes are presented in **Table 7.1** below, which are used in the summary tables in **Appendix D**.

Table 7.1 Indicative pond construction costs

Pond Size (m^3)	Indicative Construction Cost (to nearest £500)
500	£18,000
2,500	£61,000
5,000	£114,500
10,000	£209,000
25,000	£485,000

Unit costs have also been determined for swales and permeable paving. The financial estimates have assumed:

- Swale unit is 10m long, 2m wide, 1m deep;

[13] Civil Engineering Standard Method of Measurement Third Edition, Institution of Civil Engineers, 1991

- Permeable paving unit is 10m^2, 150mm sub-base thickness; and
- Rectangular permeable block paving system: incorporating a 5mm spacer design that provides a 5mm void allowing ingress water through the subbase storage system, bedded on a 50mm thick 2-6.3mm clean, angular, free draining uncompacted aggregate; joints infilled with 3mm clean grit. Infilta:200x100x80mm thick: natural grey[14]

The unit costs are presented in **Table 7.2** below. However, it should be noted that efficiencies will be achieved as the area of swales or permeable paving increases, and therefore as for the pond indicative costs, these guide prices should be treated with caution.

Table 7.2 Indicative unit costs

Item	Indicative Construction Cost (to nearest £500)
Swale (10m x 2m x 1m)	£474
Permeable paving (10m^2)	£343

7.2.5 Explanation of Results Tables

An example of the site tables and explanations for the source of information is provided in **Table 7.3** below. The results table for each potential strategic development site are presented in **Appendix D**.

[14] From Spons External Works & Landscaping Price Book 2011, Taylor and Francis (2010)

Table 7.3 SuDS Assessment Tables and Data Sources Explained

Location	Settlement in which site is located
Site Reference	SHLAA site reference
Site Description	Description from SHLAA tables
Size	Site area in hectares, taken from SHLAA proformas, or if not on proformas from site schedule
Grid Reference	Central grid reference of site from GIS manipulation
Current Use	Existing use of site from SHLAA
Land Use Type	Greenfield/brownfield, from SHLAA
Proposed number of dwellings	From SHLAA or site schedule
Proposed development status	From SHLAA market interest
Flood Zone	Fluvial flood zone from Environment Agency website
FRA Requirements	States if an FRA is required for the site to comply with PPS25 requirements and why. FRAs are required for any development greater than 1 hectare, and if the site lies in Flood Zone 2 or 3.
Existing Drainage	Assessment of drainage from Severn Trent data. **Note** this may not be accurate or up to date and developers must contact Severn Trent if intending to use infrastructure for surface water run-off
Nearest Watercourse	Taken from GIS data and Ordnance Survey mapping
Underlying Geology & Soils	**Bedrock Geology / Superficial Geology:** From BGS website **Soils:** From NSRI website
Aquifer Status	**Bedrock Geology / Superficial Geology:** From EA website
Source Protection Zone	From EA website
Infiltration Potential	Low / Medium / High based on soils description and professional judgement
Drainage Requirement	Limiting discharge rate per hectare, derived from Institute of Hydrology 124 method for greenfield sites, or Modified Rational Method for brownfield sites. Indicative maximum attenuation required, based on 1 in 100 year storm event and 30% increase in rainfall for climate change, and for critical storm duration. Assume 65% of site area is impermeable post development for greenfield sites, and 80% of site area is impermeable post development for brownfield sites.
Potential SuDS	SuDS types listed depending on suitability for infiltration or attenuation on site. Lists all possible types that could be considered for site. A combination or single type of SuDS could be used
Indicative costs	Indicative costs, based on assumptions described in Section 1.2.4 above, are provided based on a simple pond feature. In reality attenuation can be provided by a range of features. Costs are provided as an indicative guide only.

7.3 Funding for Development

Developers will act as the primary infrastructure provider for SuDS. It will, therefore, be important that the planning applications submitted by the developers take on board the recommendations on SuDS within the WCS, so that financial planning for SuDS can be included in the development.

In addition to funding the SuDS construction, a financial 'non-performance' bond may be requested by the SuDS Approval Body (i.e. Leicestershire County Council, see **Section 7.4** below) prior to works commencing on a site to

ensure that SuDS are constructed to a suitable standard by developers. On satisfactory completion of the SuDS the bond will be returned. This is similar to current arrangements for adopted surface water sewers and highways.

Where regional SuDS are identified as an opportunity (for example a community pond feature might be able to serve the drainage requirements from a group of development sites) it might be possible for funding of the regional SuDS to be supported by a Community Infrastructure Fund (CIL). The Community Infrastructure Levy Regulations 2010 give local authorities the ability to charge developers to help fund new infrastructure provision. A levy can be applied to all new developments (residential and commercial) in their area, subject to a low de minimise threshold. Where appropriate the local planning authority would use a CIL to supplement a negotiated agreement, which may be required for site specific matters, including affordable housing. Standard charges would be set, which may vary from area to area and according to the nature of development proposed.

Under the new Localism Bill, which aims to empower local communities by increasing local control of public finance, it states that local authorities will be required "to allocate a proportion of Community Infrastructure Levy revenues back to the neighbourhood from which it was raised. This will allow those most directly affected by development to benefit from it".

7.4 Adoption and Maintenance

One of the biggest challenges in achieving the wider uptake of SuDS is the issue of eventual ownership of the systems and, in particular, who will maintain and repair them. Without a formal maintenance and adoption regime there is a risk that SuDS can increase the risk of flooding by becoming eroded or outlets becoming blocked. This can also increase the risk that environmental quality standards are not met, if SuDS are poorly maintained, as they may not operate correctly and allow pollutants to enter the watercourse that they are draining to.

It is for this reason that the Floods and Water Management Act 2010 has introduced the role of a Suds Approval Body (SAB), to ensure that SuDS are designed to appropriate standards, and are adopted and maintained throughout their lifetime. Development proposals should be submitted to the SAB, for them to approve the design, construction, maintenance and operation of the proposed SuDS prior to construction. Where the proposals are for more than one property, it will be the responsibility of the SAB to adopt and maintain the SuDS.

Under the 2010 Act, Defra intends to fund the maintenance of SuDS adopted by SABs using the new Local Services Support Grant[15]. Leicestershire County Council is the relevant SAB for development in North West Leicestershire and in 2011 received £153.1k to administer its duties under the Floods and Water Management Act (source: http://www.defra.gov.uk/news/2010/12/23/flood-funding/). This includes developing local flood risk management strategies; surface water management plans and priority actions; mapping, running oversight and scrutiny committees; and administering consents for private changes to ordinary watercourses. Funds within the

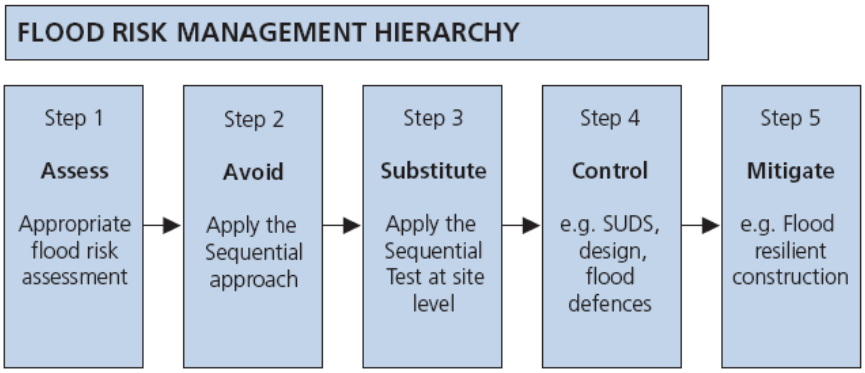
[15] Flood and Water Management Act 2010 and the EU Floods Directive Funding local authority burdens: Spending Review 2010 outcome, Local Government Association and Defra

grant allowance are unringfenced therefore it is up to individual local authorities to decide how much they spend on managing flood risk.

In the future grants are likely to be provided directly to LLFAs based on actual uptake of SuDS by new developments following commencement, and their adoption over time. The requirement to adopt SuDS on new developments is not expected to start until spring 2012, and be phased in after that date. This requirement is also supported by the Localism Bill, which encourages local community involvement in risk management, co-ordinated planning and sustainability and the need to balance national and local activities and funding.

7.5 FRA Guidance

With the exception of one or two sites identified in the SHLAA, all sites will be required to submit a Flood Risk Assessment with their planning applications on account of the sites being greater than 1 hectare. The FRA should be commensurate with scale of the development, and should focus on the management of surface water drainage to prevent increases in flooding downstream and on the sewer network. Specifically, PPS25 states that the FRA should "*be proportionate to the risk and appropriate to the scale, nature and location of the development*". PPS25 is the overarching policy on flood risk to development and requires flooding to be considered throughout all stages of the planning process, by following the flood risk management hierarchy:



By following this hierarchy, inappropriate development can be avoided in flood risk areas which will help deliver sustainable development in the future.

The guidance checklist presented in **Appendix E** below is provided to assist developers in preparing FRA's for the SHLAA sites, and to assist planners in the Council in reviewing the planning applications.

8. Water Efficiency Requirements

8.1 Introduction and Scope

Water resources in the geographic area that provide water supplies to the District are under significant pressure. The total household population across the East Midlands water resource zone is approximately 2,840,000. The Outline WCS described how STW manages its water resources and supplies at a 'water resource scale' and showed that North West Leicestershire is supplied with water from within the East Midlands resource zone.

This chapter of the Detailed WCS provides the additional information that the Council needs to take forward the preferred recommendations from the Outline WCS:

- All new homes that are built in the area should meet the Code for Sustainable Homes (CSH) Level 3/4 for water consumption (105 litres per person per day). The Council has requested further information on the feasibility of delivering CSH Level 3/4 across the area over the growth period, identifying options for non-households, and providing support to encourage people to use water wisely;
- The Council should take action to encourage water efficiency in existing homes as reducing demand in this way is fundamental to STW's long term strategy to secure public water supplies (i.e. a balance between demand and supply.

The Council should support STW's efforts to raise awareness of water consumption and efficiency across all customers (including existing households and non-household water customers). In doing so environmental benefits of water efficiency will also be achieved. Water efficiency can help reduce carbon emissions associated with water treatment and supply. The efficient use of water resources is therefore important as a climate change adaptation and mitigation measure.

The Outline WCS examined the need for water neutrality and concluded that the cost and social implications of additional demand management as required to achieve neutrality may not be justifiable in this area. Severn Trent Water's long-term Water Resource Management Plan (WRMP) shows that a small surplus of supply (exceeding demand) is forecast based on its range of strategic demand and supply side measures. In that plan STW has already set out its aim to achieve savings equalling 5.7 litres per person by 2015 (STW, Draft WRMP, 2008). It would be very difficult to justify the extra financial resource required to deliver further demand savings to achieve water neutrality.

At the time that the Outline WCS was completed Severn Trent Water had published its draft WRMP which forecast there would be a deficit of supply below demand[16] in this area by 2011/12 if no new demand or supply intervention

[16] In a dry year

policies are introduced. The recommendations in the Outline WCS were based on that original forecast deficit increasing to 112 megalitres per day (Ml/d)[17] by 2034/35 and the actions that STW had proposed to resolve this.

As part of the overall company business plan the draft WRMP was subject to statutory public consultation and technical review by the regulators (Environment Agency and Ofwat). As a result of that process Severn Trent Water modified its assessment of both supply and demand, and re-examined its proposed strategy to secure supplies over the next 25 years.

The main difference between the draft WRMP and the final WRMP is that the deficit is not expected to occur until 2015/16 and will be less severe, falling to 65Ml/d rather than 112 Ml/d by 2034/35. However, this deficit is still a risk to security of supply and increases the risk of water shortages. Recommendations to support Severn Trent Water's water efficiency strategy are still important. The Outline assessment of the water resources available for public water supply abstraction is still valid. In many of the water catchments supplying North West Leicestershire there are few resources left from which abstraction can increase. All actions to conserve water, such as implementing water efficient fittings in new and existing homes, increasing water efficiency in the non-household sector, and providing advice on how to use water wisely are essential to use existing resources more effectively.

8.1.1 Water Efficiency Scope

This detailed study focuses on water efficiency in households (new and existing homes). The key question for builders (and development designers) is how to achieve these requirements, and the Council needs to be confident that its planning requirements are acceptable. This study presents the key issues and feasibility of CSH level 3/4 for water and includes guidance and a checklist for both the Council and developers to demonstrate compliance. There is a vast number of combinations of fittings and appliances that can be used to achieve CSH level 3/4 consumption levels. It is generally recognised that level 3/4 can be achieved using simple cost-effective measures such as reduced flush volume toilets and efficient taps. A report by the Environment Agency (Environment Agency, 2008) concluded that rainwater harvesting and greywater reuse systems are not required to achieve level 3/4. In domestic properties these technologies are not considered to be a viable alternative to the more straightforward measures. At the household scale these technologies are less cost-effective than reduced flow fittings and have a higher carbon footprint. Where water is more scarce and in developments which offer better economies of scale or better technical options these technologies may be valuable to further drive down demand for potable water. However, based on the cost, the need, and technical and social feasibility issues these technologies are not considered to be applicable to widespread implementation across North West Leicestershire and so are not included within the scope of this project.

This chapter examines the feasibility of achieving water efficiency levels in the most typical types of housing developments that are planned in the area. It does not include an additional quantitative revision to the anticipated water savings that were prepared in the Outline WCS. The focus is to suggest practical measures for the Council to ensure new homes meet water efficiency standards and to raise awareness to encourage people more generally to use water wisely.

[17] 1 Ml/d is 1 million litres)

8.1.2 What is CSH level 3/4 for Water

To achieve CSH level 3/4 for water a developer must demonstrate that a new home is designed so that the maximum daily volume of water used per person is 105 litres (i.e. 105 litres per head per day or l/h/d). This excludes outdoor use. **Figure 8.1** is an extract from the CSH Technical Guide illustrating the various mandatory maximum standards of water consumption for each level of the Code.

Figure 8.1 Water consumption levels in the Code for Sustainable Homes

Code Levels for Mandatory Maximum Standards in Indoor Water Consumption	
Code Level	Maximum indoor water consumption in litres per person per day
Level 1 (★)	120
Level 2 (★★)	120
Level 3 (★★★)	105
Level 4 (★★★★)	105
Level 5 (★★★★★)	80
Level 6 (★★★★★★)	80

8.1.3 Water Use in Households

Domestic water use can be broken down into its constituent parts, commonly referred to as the micro-components of water use. Whilst these components are common to all housing types, the proportions and absolute amounts used vary in different types of buildings. Within the household sector the main attributes that influence water use are as follows:

- **Water meters:** STW assumes that customers who have a water meter installed and switch to a measured based charge reduce their water consumption by 10 per cent[18];
- **Occupancy rate**: the volume of water used per person is significantly influenced by the number of people living in a property, and the relationship between those people. High occupant, family homes may use more water but there are per capita efficiencies when people optimise their use of dishwashers and washing machines. These efficiencies may not be available to people living in low/single person occupancies, or shared houses;

[18] based on evidence from a number of companies studied in the 2003 UKWIR study "*The impact of household metering on consumption*".

- **External use**: households that have access to a garden are assumed to have an element of 'outdoor use'. This may be garden watering, external cleaning, car washing etc. Water using activities that people in flats, upper floor residences etc. do not partake in;

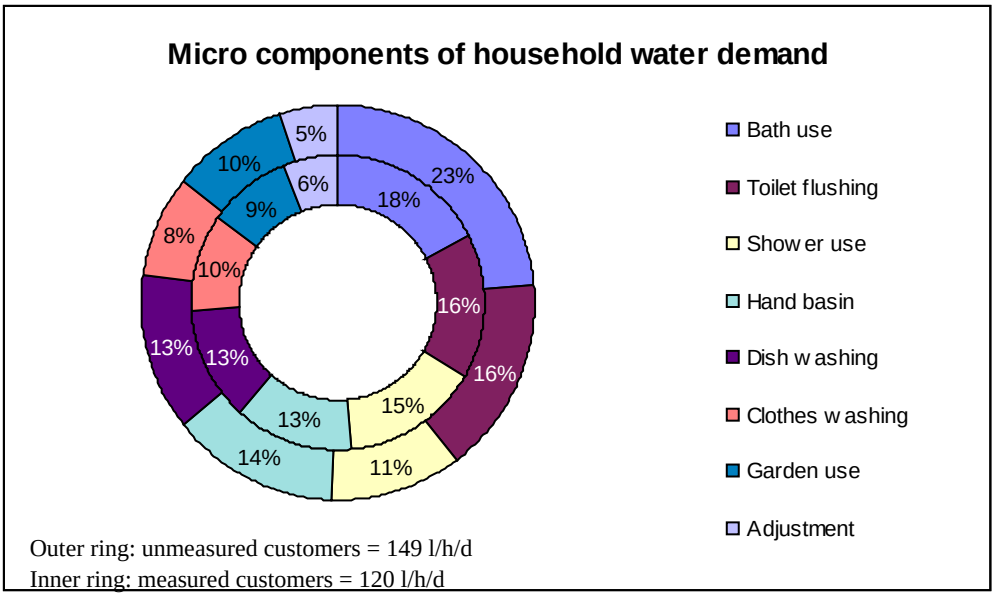
- **Space**: smaller households and flats do not always have a bath due to space constraints and so personal washing may be dominated by showering;

- **Installed water fittings and fixtures**.

In 2006 the number of existing homes in the District was approximately 37,000 (NWLDC, March 2011). In terms of overall housing numbers there are two development scenarios being considered: a high growth scenario in which there will be 7,883 additional homes; and a lower growth scenario of 5,683 additional new homes. It is important to consider growth within the context of existing housing stock. 82 to 87 percent of all the homes in 2031 have already been built. Council action targeting water consumption in new homes will directly impact on the 13 to 18 per cent of 'new homes'. This shows the opportunity that is available to the Council to enable large changes in consumption in new homes, but also the importance of engaging with Severn Trent Water to continually target the existing stock. Proposed actions to target these two different housing groups are provided later within this section.

Figure 8.2 shows the result of STW's assessment of how water use in homes breaks down in to each type of use. As the existing housing stock is composed of measured and unmeasured customers both sets of results are shown. The measured customer ring reflects the combination of new build homes, all of which are metered and have some element of water efficiency built in, and previously unmeasured households that have had a meter installed.

Figure 8.2 Severn Trent Water East Midlands WRZ breakdown of household micro components of water demand



The key point to draw from **Figure 8.2** is that unmeasured customers use on average almost 30 litres per day more than measured customers. Whilst the general proportions are similar, measured customers tend to use proportionately more water than unmeasured customers in the shower and less from using baths. With the

exception of power showers, showering is generally considered to be more water efficient than filling a bath. This is highly dependent on factors such as the flow rate of the shower head and duration of the shower.

The impact of metering on how customers use water is clearly very significant. However, metering needs to be supported by campaigns to educate and inform customers on what they can do to use water more wisely. Widespread dissemination of practical advice and support significantly helps to increase the success of schemes to retrofit existing homes with more water efficient technologies, and this is one area where the Council is able to help provide information to residents.

The other important area to target is new developments. It is much easier to ensure that consumption in buildings is minimised if water efficiency measures are embedded in the design of the building. The Code for Sustainable Homes is a scheme which sets out various resource efficiency levels and provides information on the specific requirements to achieve them. The Outline WCS recommended that the Council sets a requirement for all new homes to meet level 3/4 for water (105 litres per person per day). The next section provides more information on what that means, how it can be achieved, and the evidence demonstrating that this is a feasible requirement for the Council to require.

8.2 Building Homes to meet CSH Level 3/4

8.2.1 Water Use in Typical Development Types

The Environment Agency has published information on how homes built to level 3/4 are expected to use water (105 l/h/d in the home plus an allowance of 10 litres used outdoors). **Figure 8.3** shows how water use in a CSH level 3/4 home compares to the current average household supplied by STW. The volumetric comparisons are listed in **Table 8.1**. However, it should be noted that these comparisons are simply indications of the type of savings enabled by the CSH. Work under taken by Entec for the London Development Agency using the Code for Sustainable Homes water use calculator (CLG, 2009) concluded that different configurations are possible to achieve level 3/4 resulting in slightly different proportions of use.

Figure 8.3 Household micro components in a CSH level 3/4 home as a percentage

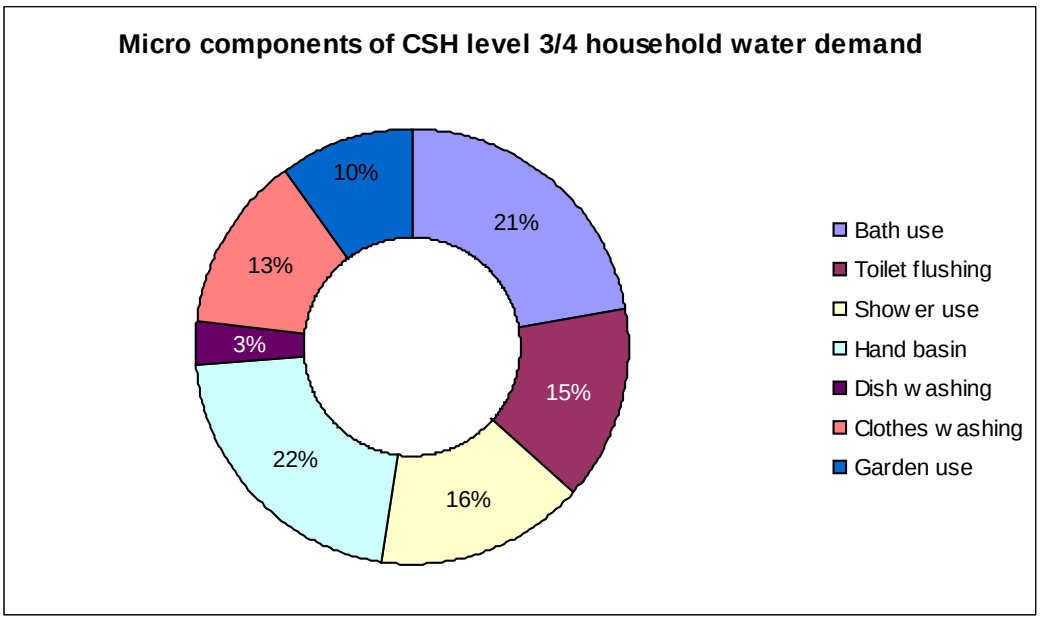


Table 8.1 Water use per person (l/h/d) in average STW customer home and CSH level 3/4 home

Micro component of use	Average STW unmeasured customer	Average STW measured customer	CSH level 3/4 home*
Bath use	34.78	21.44	25.6
Toilet flushing	24.26	19.28	16.8
Shower use	15.82	18.81	18.0
Hand basin	20.70	15.95	24.9 (all taps)
Dish washing	18.85	15.36	3.6
Clothes washing	12.34	12.80	15.3
Outdoor use	14.93	12.00	11.5
Miscellaneous / adjustment	6.98	7.35	0
Total	148.66	123.00	115.7

*as defined in Defra 2008 *Future Water*

The comparison shows that average demand per person in a new build home could be between 7 and 33 litres less per day than in existing homes. The data indicates that compared to existing unmeasured homes, the main areas to target in new homes are reducing the volume of water used by baths, toilet flushing, and taps (especially by targeting dish washing). Reducing the total volume of water used in baths and by taps will also reduce hot water use, and thus has positive implications for energy and carbon. However, the relationship between domestic water use and efficiency, and energy efficiency and carbon emissions is complex, and beyond the scope of this project.

More information is available in the Environment Agency and Energy Savings Trust joint report, *Quantifying the energy and carbon effects of water saving* (Energy Saving Trust, 2009).

8.2.2 Development Types Proposed in NW Leicestershire

The Council has not yet confirmed what the composition of housing types are expected to be, although it has indicated that there will be few apartments built. The main types of property will include 2-3 bed houses in large scale developments; flats in purpose built large scale developments; individual houses e.g. infill; flats in converted buildings; and non-housing buildings e.g. offices/warehousing/other commercial. Based on information provided by the Council, the following breakdown of possible house types has been used to inform the feasibility of achieving water efficiency across the District:

- 1 bed homes – 7 per cent;
- 2 bed homes – 15 per cent;
- 3 bed homes – 53 per cent; and
- 4 bed homes – 25 per cent.

All housing developments, regardless of the building size, location, density of properties and residents, share common water demand traits (see **Section 8.1.3** above). Whilst not all developments will be able to make use of water efficiency measures designed to target gardens, all homes will benefit from basic measures to reduce the unnecessary amount of water that is used in bathrooms and kitchens. Simple, well established water efficiency measures can be installed and operated easily, at minimal cost, and minimal disruption to either the developer or the resident. These include dual flush toilets, limited flow hand basin taps, efficient showers, and streamlined baths.

The majority of the new homes planned for NW Leicestershire will have a minimum of three bedrooms (75 percent). This suggests that the typical demographic being catered for will be families rather than individuals. Baths are still a very popular feature in this type of home and so for the majority of these new homes, CSH options that are developed on the basis of shower only are probably not feasible. More information on feasibility is provided in **Section 8.3** below.

8.3 Determining Feasibility

It is important to the Council that it can demonstrate that building homes to meet CSH level 3/4 in North West Leicestershire is feasible and there are three aspects to this:

- Technical performance - do the options to save water fit for purpose?
- Financial - how much does CSH cost and is this proportionate/acceptable with regard to the savings?
- Social - are the options to save water socially acceptable?

8.3.1 Technical Performance Feasibility

There are two main approaches to meeting water consumption targets; fittings-based, and water reuse-based. In a new development it is best (from a cost-benefit and sustainability viewpoint) to first consider reducing overall water consumption through specifying water-efficient appliances before considering water reuse[19]. A recent study completed by Entec UK Ltd for the London Development Agency (Entec, 2009) demonstrated that basic water efficiency measures are feasible in terms of performance and customer satisfaction, and are sufficient to enable all types of new households to reach CSH level 3/4. Therefore this study does not explore the need for other water efficiency options such as, reducing pressure, rainwater harvesting, greywater reuse, and other non potable supplies but focuses solely on the fittings based approach. This does not mean that such measures should not be encouraged, but rather they are not essential for meeting CSH level 3/4.

Table 8.2 is based on the CSH water use calculator and presents three alternative combinations of water fittings that would deliver CSH level 3/4 in households (Scenario A, B, and C). There are a vast number of possible combinations of fittings that could achieve level 3/4 but these three reflect typical considerations. It shows how the expected consumption is calculated based on the fittings that are installed. The Sustainable Building Association (AECB- Association for Environment Conscious Building) has published a set of water standards that are designed to deliver buildings with excellent water and energy performance. The AECB water consumption levels are quoted here as these have recently been used to develop technical water efficiency guidance for Defra and the Waste Resources Action Programme (WRAP).

Table 8.2 Options to deliver CSH level 3/4 for water

				Scenario A		Scenario B		Scenario C	
Installation type	**Unit of Measure**	**Use Factor***	**Fixed Use (l/h/d)**	**Volume**	**l/h/d**	**Volume**	**l/h/d**	**Volume**	**l/h/d**
WC (fixed flush)	Flush vol (litres)	4.4	0.0	-	-				
WC (dual flush)	Full flush vol (litres)	1.5	0.0	4.5	6.57	6	8.76	6	8.76
	Part flush vol (litres)	3.0	0.0	2.6	7.70	4	11.84	4	11.84
Hand basin taps	Flow rate (litres/min)	1.6	1.6	4	7.90	4	7.90	6	11.06
Bath (shower also present)	Capacity to overflow (litres)	0.1	0.0	180	19.80	-	-	180	19.80
Shower (bath also present)	Flow rate (litres/min)	4.4	0.0	10	43.70	-	-	8	34.96

[19] http://www.water-efficient-buildings.org.uk/?page_id=990

Table 8.2 (continued) Options to deliver CSH level 3/4 for water

Installation type	Unit of Measure	Use Factor*	Fixed Use (l/h/d)	Scenario A Volume	Scenario A l/h/d	Scenario B Volume	Scenario B l/h/d	Scenario C Volume	Scenario C l/h/d
Shower only	Flow rate (litres/min)	5.6				10	56.00	-	-
Kitchen sink taps	Flow rate (litres/min)	0.4	10.4	8	13.88	8	13.88	8	13.88
Washing machine	Litres/kg dry load	2.1	0.0	6.14	12.89	6.14	12.89	6.14	12.89
Dishwasher	Litres/place setting	3.6	0.0	0.67	2.41	0.67	2.41	0.67	2.41
	(5)	**Total calculated use (litres/person/day) = Σ (column 4)**			114.85		113.69		115.61
	(6)	Contribution from greywater (litres/person/day)			0		0		0.0
	(7)	Contribution from rainwater (litres/person/day)			0		0		0.0
	(8)	Normalisation factor			0.91		0.91		0.91
	(9)	Total water consumption = [(5) - (6) - (7)]* (8) (litres person/day)			**104.52**		**103.45**		**105.20**

Based on the Updated Water Use Calculator©, presented in CLG, 2009, p10. The three scenarios relate to differing combinations of fittings (used to achieve water efficiency (e.g. Scenario A uses 4.5 litre WCS, Scenario B and C use 6 litre WC),

The types of products that will deliver CSH level 3/4 are outlined below:

- Dual flush toilet: 6 litre full/4 litre part flush where personal washing facilities include a bath and an 8 litre/minute shower, where there is no bath a 6/4 litre dual flush combined with a 10 litre/min shower can also meet CSH level 3/4. This type of toilet has been routinely installed since it came on to the market in 1999 and it is estimated that by 2010 45 per cent of all toilets installed in people's homes in England and Wales were 6/4 litre dual flush;

- Dual flush toilet: 4.5 litre full/2.6 litre part flush where personal washing facilities include a bath and up to 10 litre/minute shower. This type of toilet has been available on the market for a shorter amount of time and initially there was some debate over the technical performance of lower volume flush toilets. However, all WCs are required to perform to the same testing standards set out in the WC performance specification of the Water Supply (Water Fittings) Regulations 1999 before being made available to consumers;

- Flow restricted hand basin taps: flow restricted to a maximum of 6 litres/minute. Flows between 4-6 litres/minute are considered Good Practice within the AECB Water Standards. However, industry research has shown that the average internal tap flow is less than this at 3.54 litres per minute[20];

- Kitchen taps: flow restricted to eight litres per minute. It is important that water efficient products also deliver required performance. In kitchens, tap use is generally geared towards filling vessels: kettles, pans, sink, cleaning buckets etc. Reduced flow rates may simply increase the time the taps are used and create customer dissatisfaction with the specific taps and potentially the concept of water efficiency. Between six and eight litres/minute is considered Good Practice within the AECB Water Standards;

- Showers with a maximum flow rate of 10 litres/minute. This is slightly higher than the Good Practice water standards published by the AECB but is less than the average existing shower (around 12 litres per minute) and much less than pumped or power showers (can exceed 15 litres/minute). When combined with other appropriate water efficiency measures 10 litres per minute can still achieve CSH level 3/4. However, as shown in **Table 8.2** if the lower dual flush toilet is not installed, and if there is also a (water efficient) bath then the shower flow rate may need to be restricted to 8 litres per minute to remain within the CSH consumption limit;

- Bath with a maximum full capacity of 180 litres. Many 'standard' rectangular baths have a capacity around 230 litres. The 50 litre reduction can be delivered in subtly different ways. Baths are available that are tapered at one end, or 'pinched' in the middle to maintain the length and depth favoured by most people when bathing. Styles are available that are shallower or shorter than 'standard' baths. Whilst these may be acceptable for some customers this is not universal. The AECB water standards considers good practice to be less than or equal to180 litres measured to the centre line of overflow without allowing for the displacement of a person.

This product specific information is provided for the benefit of the Council, to help address some of the technical issues that can arise in the field of household water efficiency. However, it is probably unwise for the Council to attempt to specify specific product types. It may be an option for the construction client (e.g. developer organisation) to specify this detail within its development specification. In consultation with clients and practitioners WRAP has recently developed guidance and contract model clauses to enable developers to embed water efficiency in to procurement contracts[21].

8.3.2 Financial Feasibility

In order to propose a policy requiring that certain building design standards are met the Council needs to understand the potential cost implications on developers. The Department for Communities and Local Government (CLG) has undertaken research to investigate the range in price of water efficient products compared to standard and high-end counterparts. Delivering CSH level 3/4 following the fittings-based approach is estimated to cost

[20] WRc Identiflow data quoted by Waterwise, http://www.waterwise.org.uk/reducing_water_wastage_in_the_uk/house_and_garden/washing_up_2.html

[21] http://www.wrap.org.uk/construction/tools_and_guidance/procurement.html

£125 per home on top of other construction costs. The Waterwise sponsored Water Efficient Buildings Guide[22] also confirms that bathroom manufacturers are increasingly looking to provide 'whole-building' solutions for developers. As such, developers can approach product manufacturers with a desired specification or a water consumption target, particularly for larger developments. The Council should take confidence from this that from a technical, financial, and ease of construction point of view, CSH level 3/4 is feasible for the entire District (with regard to water efficiency Level 3 is the same as Level 4, i.e. they are both 105 l/h/d, see **Figure 8.1**).

8.3.3 Social Feasibility

User acceptance of water efficient fittings has been subject to much research from organisations such as Waterwise, housing associations, academics, water companies, and other related groups. When deciding on fittings, the performance that they offer the end user (householder) should be considered. Consumers want technology that is "fit and forget". Evidence shows that they rarely consider their water use in the course of their everyday lives. Including technologies that impact on the lifestyle, convenience or enjoyment of the occupant are unlikely to be considered as acceptable.

It is recommended that measures that reduce the demand for hot water within the home should be prioritised, i.e. the hot shower and hot hand basin taps. These could offer benefits for meeting other sustainability targets relating to the need to reduce energy use (and carbon footprint) of new developments. Reducing the use of hot water will also save householders money on their energy bills.

8.4 Results

Severn Trent Water has forecast the per capita consumption of people living in new homes (all of which will be measured), and in measured and unmeasured existing households. These data are taken from the Final Water Resource Management Plan (2010).

Building on the analysis in the Outline WCS, updated with Severn Trent Water's latest June 2010 data, under a scenario where people living in new homes using 130 litres per day, and people in existing homes using between 140 and 129 litres per day, if 10,183 new homes are built by 2031, demand for water from households in the Council district would be 14.4 million litres per day (Ml/d).

However, by making it easier for people living in new homes to reduce their consumption to 105 litres per day by demanding that new homes meet CSH Level 3/4 standards, the Council will actively contribute to creating the conditions required to meet the demand projections, on which Severn Trent Water's strategy to secure supplies is based. By also targeting existing homes to reduce unmeasured pcc to 135 litres, and measured pcc to 120 litres, demand for water from households in the study area could be as much as 1Ml/d less, at 13.3Ml/d.

A sensitivity analysis undertaken for the Outline WCS tested the implications of alternative growth scenarios and consumption levels per head on household demand. The Outline WCS concluded that demand in the NW

[22] Whole building specification: http://www.water-efficient-buildings.org.uk

Leicestershire local authority area alone could deviate by ± 2Ml/d (2 million litres per day) from the forecast calculated using Severn Trent Water's per household forecasts. This clearly demonstrates the significance of rolling out water efficiency measures and advice for all customers.

8.5 Conclusions and Guidance

The Outline WCS recommended NW Leicestershire's Core Strategy to include policies that support the water companies' water efficiency activities for existing households. These activities are to meter households on change of occupancy which is being implemented now in Ashby and Coalville (East Midlands zone is the only zone where this is to be rolled out in AMP5), free metering for people opting for a meter, domestic water audits and provision of water efficiency measures (focusing on social housing), an element of product subsidy, and general education and awareness raising[23]. **Table 8.3** below highlights some of the key actions that the Council can do to ensure water is used more wisely across the District.

Table 8.3 Water efficiency actions and areas where the Council can support Severn Trent Water

Severn Trent Water WRMP water efficiency strategy	Recommendations to the Council - ACTIONS
Per capita consumption in all **new build** homes in the East Midlands zone to continue to fall from 110 litres per day to less than 100 litres per day.	Enforce requirements for all new homes to be built to CSH Level 3/4 for water (105 l/h/d). It is not recommended that the Council pursues the next level of the Code (level 5/6) which demands a maximum consumption of 80 litres per person per day. There may be opportunities to 'signpost' developments to aim for this but as a general policy for all developments this may not be financially or socially feasible.
Actively promoting and distributing 'Save-a-Flush' devices. Currently only one in six homes has such a device installed. These devices will be targeted at householders with older, larger cisterns.	Water efficiency measures should be promoted through Council planning policy and awareness campaigns developed and implemented in conjunction with Severn Trent Water. The Council should be confident to take a proactive lead where there is a need or an opportunity. Support Severn Trent Water by inviting opportunities for representatives to engage with the public, e.g. water saving demonstrations in town.
Installing water efficient devices in the Social Housing sector	Work with Severn Trent Water to understand how to approach and target customers in social housing so that water efficiency is viewed as a positive and supporting measure. This may include proactively informing Severn Trent Water of other activities in social housing to which water efficiency could be attached to reduce disruption, provide a more cohesive experience for residents, and increase cost-effectiveness.

[23] Section 8.5.3 of Severn Trent Water's Final Water Resource Management Plan (June 2010).

Table 8.3 (continued) Water efficiency actions and areas where the Council can support Severn Trent Water

Severn Trent Water WRMP water efficiency strategy	Recommendations to the Council - ACTIONS
Encouraging all customers to undertake self audits of their water use and making information available to all consumers on how they can be more water efficient	Highlight water efficiency on the Council website homepage and provide clear links to Severn Trent Water and Waterwise websites[24] that provide information on support, instructions, and ideas for householders to save water. Work with Severn Trent Water to review and seize opportunities for the Council to promote positive water conservation messages prior to and during drought/prolonged dry spells.
Partnering with a range of product manufacturers and suppliers to increase customers' access to water efficiency products and services, and to promote changes in behaviour.	Become involved with Severn Trent Water on this initiative and promote the information on the Council website. Take the opportunity to work with local manufacturers or retailers to make the Council's water efficiency aims clear and promote this at 'point of sale' to send a clear message to customers.
Reducing consumption in its own offices and buildings	Undertake an audit of water consumption in Council offices and buildings and adopt cost-effective water efficiency measures. Promote the simplicity and benefits of using water wisely.
Water audits and product retrofits in commercial properties and retrofit.	Work with Severn Trent Water to facilitate dialogue and access to Council owned properties where water audits would be beneficial. Encourage Severn Trent Water to complete audits. There may be opportunities for the water company to collaborate with other energy utilities to undertake joint audits to minimise disruption to residents/commercial occupants, to improve the level of service provided to residents, and to increase efficiency for the utility companies. The Council should use its position to encourage and facilitate partnership approaches. If there are additional benefits that could arise from actions not funded by the utilities the Council should consider the value that Community Infrastructure Levy's could contribute.

The key action for the Council is to embed CSH level 3/4 within its planning requirements. However, in addition to creating this type of policy, the Council should consider providing support to developers to make the process simpler.

Various checklists are available that provide guidance to developers. In 2006 the Environment Agency published a guidance document providing practical advice on how to add value to a development site (Environment Agency, 2006). That document contains a list of actions that it recommends developers should undertake to ensure their developments 'use water wisely'. More specifically, the Code for Sustainable Homes Technical Guide (CLG, 2010)[25] sets out what information developers are required to present to demonstrate compliance. Building water-saving measures into a development can do a lot to reduce overall demand. Such measures will be viewed positively by the Environment Agency, water companies and planning authorities.

[24] www.waterwise.org

[25] http://www.planningportal.gov.uk/uploads/code_for_sustainable_homes_techguide.pdf

The checklist in **Appendix E** has been developed for North West Leicestershire combining these two sources of information in one place, to clarify what is recommended and what is required to meet the Environment Agency's expectations and CSH requirements.

9. Development Strategy (Water Infrastructure)

The Detailed Water Cycle Study has reviewed infrastructure requirements to meet water quality targets, to prevent increased flood risk from surface water and sewerage and to meet CSH Level 3/4 for water efficiency to protect the region's water resources. The assessments have been undertaken using a range of proposed housing numbers and development sites for the District, which have been selected to capture the range of likely development scenarios between 2011 and 2031 (see **Section 3**).

This section summarises the water infrastructure strategy for the District against growth targets to inform the Core Strategy so that growth is managed sustainably and in order to contribute to meeting the requirements of environmental directives, including the Water Framework Directive and the Habitats Directive. The strategy has been based on assessments within this study, which have been subject to assumptions on growth options and on a number of technical assumptions, which have been highlighted throughout the report in **Boxes 1 to 4.** These have been necessary where limited detailed information has been available. However, the strategy summarises the findings of the assessments within this report to enable sustainable development within the District and contribute to meeting targets set by the WFD and Habitats Directive. It provides advice and recommendations to the Council, but also highlights the need for support from various stakeholders, including the Environment Agency, Natural England, Severn Trent Water, developers and residents, in order to achieve sustainable development

The text is followed by a programme for delivery of the required infrastructure and solutions throughout the proposed Core Strategy growth period to 2031.

9.1 Summary of Water Quality Solutions

One of the main constraints to growth in the District has been identified as the environmental capacity of the River Mease with regard to phosphorus levels. Any new development that will discharge sewerage into the river risks increasing the levels of phosphorus, which despite notable improvements in recent years, continue to remain significantly above the Conservation Objective, as required by the Habitats Directive for the River Mease SAC.

This study has reviewed the potential impacts on water quality from a number of proposed solutions to wastewater treatment. The preferred short to medium term solution is Option 2, which would permit new development to connect to the sewerage network that discharges at Packington WwTW within the existing flow and quality consent limits. Once the flow consent limit is reached, Severn Trent Water will apply a "maintenance of load" for any flow greater than the existing flow consent. The aim of this option is to ensure that the quality of treated effluent entering the river is maintained at the same load as currently being discharged. By reducing the concentration of phosphorus in proportion to the increase in flow, the load should remain the same. This would be achieved if required by increasing the chemical dosing at the works.

This option was not considered viable over 12 months ago, but revisions in the headroom calculations, improved treatment which has been operational since March 2012, and a reduction in housing targets for Ashby, as well as the evidence provided from the water quality modelling results makes this a viable option **in the short to medium**

term (i.e. the next 5 years). The water quality modelling has identified that as long as the works maintains the existing discharge consent criteria for water quality with regard to the loading into the river, then there will be no change to the existing P levels in the river. There will conversely also be no improvement toward reaching the Habitats Directive target unless treatment levels are increased to reduce the load. A Developer Contribution Scheme (DCS) is therefore being prepared to offset any potential impact this short term solution may have on reaching the Habitats Directive target.

Option 2, maintenance of load, has also been assessed against agreed sustainability criteria. The sustainability assessment also indicates that in the short term this option would be preferable, as it results in no negative and no positive impacts. It has been assumed that maintaining the load can be achieved without additional treatment, as a result of the growth being a small proportion of the existing population. Therefore no carbon costs, landscape impacts or waste generation is expected other than connection from developments to the network, which would also be required under Options 1, 4b, 4c and 5. As Option 2 does not contribute to meeting the Conservation Objective in the river, it is only a viable option in the short term in conjunction with the medium/longer term solution of additional treatment in some form one or both of the two main WwTW, in order to realise the Water Framework Directive target and Habitats Directive SAC Conservation Objective.

In the longer term (5-15 years), the water quality modelling results and sustainability appraisal indicate that improved treatment to below the 1mg/l phosphorus consent at Packington WwTW is likely to have the biggest improvement in the river quality and is the preferred solution for addressing wastewater treatment for Ashby and Packington urban areas. These results are based on a discharge of 0.06mg/l or 0.25 mg/l phosphorus, which have been discussed as being potentially beyond the best available technology. The risks associated with reed bed technology for phosphorus removal have been discussed, as currently in the UK reed beds are not primarily used for phosphorus removal to below 1 mg/l, and there are no published results demonstrating continued compliance with phosphorus consents lower than 1 mg/l. The longer term sustainability of reed bed treatment has also been considered, and due to the required maintenance and replacement of reed bed media, there are possible adverse effects over the lifetime of such an option, on use of resources, landscape and energy costs.

A review of wastewater treatment in other countries has been summarised for this study and indicates that consents of 0.3mg/l have been achieved through a combination of biological removal, chemical treatment and sand filters. It is therefore recommended that Severn Trent Water investigate the most cost effective and sustainable option for increased phosphorus removal at Packington WwTW during AMP6 (2015 to 2020), for implementation at the works during AMP7 (2020 to 2025). The timescales are presented against development and environmental targets in **Figure 9.1**.

Any option put forward by Severn Trent Water will also need to review potential emissions of other pollutants, for example iron dosing is a common form of treatment for phosphorus removal, but iron itself is set as a priority substance in the Water Framework Directive so standards in the river will need to be maintained.

During this period of investigation, it is expected that phosphorus levels in the River Mease should reduce as a result of measures set out within the River Mease Water Quality Management Plan and measures planned to reduce phosphorus emissions from diffuse sources such as agricultural run-off, as set out in the Environment Agency's Diffuse Water Pollution Plan. These measures have not been reviewed or included in this report. Headroom

available at the works will also be reviewed by Severn Trent Water to be reported annually to the River Mease Technical Group and the Council to inform future development.

A comparison of the overall costs for each option has not been included. This is due to the uncertainty associated with feasibility of using reed beds or alternative treatment methods to achieve the required tight standards of phosphorus below 1mg/l financial costs for Options 3 and 4 have not been included. Whilst costs for existing reed beds might be available, they could be misleading as additional new treatment and therefore additional costs that are not yet foreseen may be required. However, it can be assumed that the costs involved in reed bed construction would include: digger hire and excavation of the beds; importation of formation material/media and reeds to site; lining material for beds; dewatering; pumping equipment; ancillary pipework/outflow structures; and water quality testing. It can be expected that the only costs required for Options 1 and 2 would be the sewerage connection to the network, as minimal changes to treatment are anticipated for Option 2. The Packington Growth report (Atkins 2010) indicates capital costs for the transfer from Willesley Lane pumping station as being £2.5 million.

Furthermore a Developer Contribution Scheme is currently being developed, which recognises that in the River Mease SAC Water Quality Management Plan (EA, 2011) positive actions are recommended to offset the negative potential for any increases in phosphorus associated with new development in the immediate timescales. The Developer Contribution Scheme provides a mechanism through which any new development which will increase wastewater flows to the mains within the existing headroom will contribute to reducing the equivalent amount of phosphorus through various measures. The scheme is currently in development and should help inform future sustainable development within the Mease catchment within the existing headroom of the sewage works. Once the existing headroom is used up, then Option 2 “Maintenance of Load” will be required. The DCS will therefore ensure that actual deterioration.

9.2 Summary of Solutions and Recommendations

An assessment of required measures to contribute toward sustainable development, with regard to the other elements of the natural and urban water cycle, has also been included in this study by way of assessing sewerage, sustainable drainage and water efficiency requirements. **Table 9.1** below summarises the proposed measures and recommendations under each topic area.

Table 9.1 Summary of recommendations for sewerage, water efficiency and SuDS

Topic Area	Recommendation/Infrastructure Requirement
Sewerage	The network modelling for Growth Option 1 and 3 would require an off line tank with pumped return at the junction of Abby Drive and Moira Road Ashby (manhole SK34166601) as a result of a relatively small increase in the predicted volume of flooding at this manhole) a short distance downstream of the connection point where there was an increase in the volume of flooding of approximately 10m^3. As the development proposals are not confirmed, it is recommended that the developer contact Severn Trent so that they can confirm the capacity improvements required. The network modelling for the Growth Option 1 in Coalville used in this study (Bardon Grange 4500 dwellings, Stephenson Green 1800 dwellings, Standard Hill 500 dwellings) indicates that 74m sewer requires upsizing from 1050 to 1200 mm to prevent increased sewer flooding from the new developments. The dwellings per site figures have been based on the expected total capacity of each site. It is recommended that the developers of each site contact Severn Trent Water when exact housing numbers and proposed use of each site is confirmed. A further assessment would then be undertaken to confirm is improvements were required. Severn Trent Water is continuing to investigate infiltration reduction measures in the sewerage network draining to Snarrows WwTW. The Council should keep in contact with Severn Trent to request regular updates on this work, and to help facilitate their infrastructure planning by updating Severn Trent with proposed development site applications. Developers in Coalville and parts of Ibstock (site IB10 Leics Rd drains to Snarrows WwTW) will need to contact Severn Trent as early as possible in the application process, so that detailed capacity assessments can be undertaken to accommodate new development.
Water Efficiency	Recommended that the Council enforce requirements for all new homes to be built to CSH Level 3/4 for water (105 l/h/d). Example checklists for developers to comply with the EA and CSH guidance on water efficiency are provided in **Appendix E**. Recommendations for the Council to take action in supporting Severn Trent's Water WRMP water efficiency strategy are listed in **Table 8.3**. Water efficiency measures should be promoted through Council planning policy and awareness campaigns developed and implemented in conjunction with Severn Trent Water. Existing householders could opt for meters and water audits to contribute to reduced demand. It is recommended that the Council work with Severn Trent Water to understand how to approach and target customers in social housing so that water efficiency is viewed as a positive and supporting measure.
SuDS and Flood Risk	The recommendation for a SuDS policy to be included in local planning policy should be followed. New development sites to provide for separate surface water run-off drainage, using SuDS where possible and ensuring the SuDS are provided on site. If there is no obvious watercourse or drain to discharge surface water into, consider a regional SuDS solution before connecting to sewers. Hierarchy of preferred management of surface water is first infiltration measures, secondly attenuation and discharge to watercourses, and if these cannot be met either through local or regional solutions, through discharge to surface water only sewers. For redevelopment of brownfield sites or sites that have combined drainage (surface water and foul water systems), the developer should seek to separate surface run-off from the sewers as part of the redevelopment. This could be implemented through planning policy. For all sites greater than 1 hectare, a Flood Risk Assessment should be prepared in line with PPS25, which sets out how surface water will be managed to at least existing runoff rates. Where possible a reduction to greenfield run-off rates should be aimed for.

Table 9.1 (continued) Summary of recommendations for sewerage, water efficiency and SuDS

Topic Area	Recommendation/Infrastructure Requirement
	SuDs should be sensitively designed and located to promote improved bio-diversity, an enhanced landscape and good quality spaces that improve public amenities in the area. Potential climate change impacts on rainfall and flood risk should be taken into account to ensure that SuDS are appropriately sized. Leicestershire County Council as the SuDS Approving Body will need to be contacted through NWLDC to ensure developers proposed SuDS are suitable.

These measures require the collaborative working between the Council and developers as well as stakeholders including the Environment Agency, Severn Trent Water and Natural England. Targeting the existing population through advertising and awareness campaign can also contribute to water resource and water quality measures, for example encouraging water efficiency in existing homes, improving understanding of the drainage and ensuring no misconnections, and retrofitting of SuDS features.

The checklists and guidance presented in **Appendix D** are aimed toward housing developers and the Council to ensure new development complies with the recommendations within this report.

This study has focussed on housing growth only. The Council could also consider a policy for non-household development making it mandatory for commercial buildings to be assessed by a BREEAM assessor, with the expectation that buildings meet Good standard for water consumption targets for the building type (industrial/commercial/office/retail/education etc).

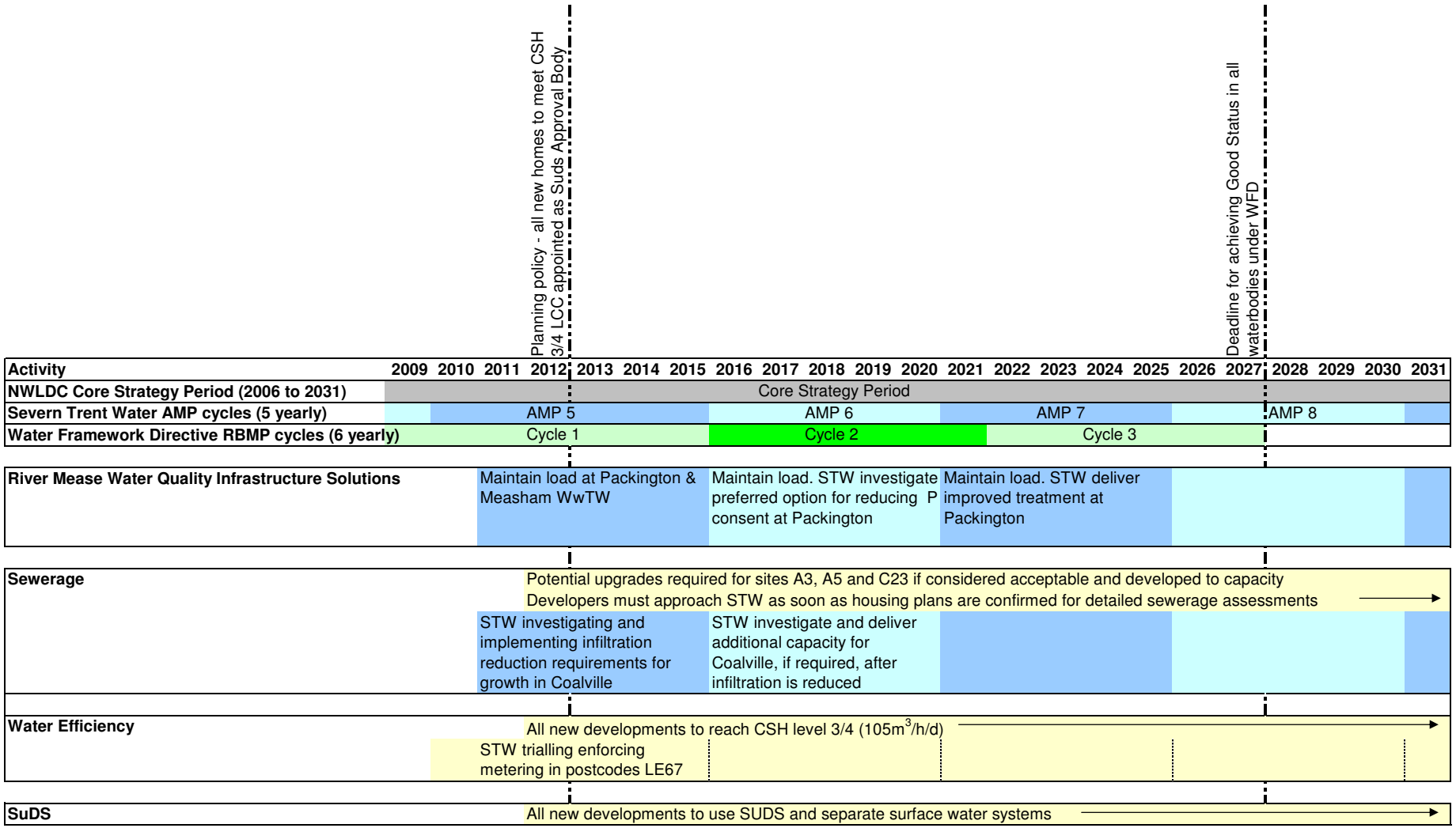
The Council may also wish to consider a policy which makes it compulsory for all new developments to submit a Water Sustainability Assessment as part of their planning application. This would enable developers to demonstrate that their application meets the criteria recommended in checklists and guidance. That is, developers should demonstrate:

- The development will meet the water consumption level 3/4 from the Code for Sustainable Homes for all residential developments;
- For all developments SuDS have been incorporated to control surface water run-off;
- For the redevelopment of brownfield sites, any surface water draining to the foul sewer network has been disconnected and is managed through SuDS;
- A Flood Risk Assessment has been completed where required. This should be approved by the Environment Agency and in line with the requirements of Planning Policy Statement 25;
- The developer has contacted the sewerage provider to assess the capacity of the receiving foul sewer network and the need to contribute to any additional off site connections for the development; and

- The developer has contacted the water supply provider to assess the requirements for supply infrastructure to the development.

Figure 9.1 presents the recommended infrastructure investigations and solutions against the Core Strategy timeline, including other relevant timescales including asset management and EU target deadlines. Whilst the Habitats Directive has no specific deadlines, it is expected by the EU that where designated sites are unfavourable that measures will be taken to achieve the favourable conservation status. The River Mease SAC Water Quality Management Plan sets out the actions to be put in place in order to achieve conservation status in line with the Habitats Directive, and commits to achieving this by 2027.

This Strategy should be reviewed on an agreed timescale alongside development progress and annual housing trajectory, and be part of the discussions at steering group meetings for the River Mease Water Quality Management Plan.



North West Leicestershire
Detailed Water Cycle Study

Figure 9.1
Water Cycle Strategy

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April 2012
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Appendix A
River Mease Designation

COUNTY: Leicestershire
Staffordshire
Derbyshire

SITE NAME: River Mease

DISTRICTS: North-west Leicestershire
Lichfield
South Derbyshire

STATUS: **Site of Special Scientific Interest (SSSI) notified under Section 28 of the *Wildlife and Countryside Act 1981* (as amended)**

Local Planning Authorities: North-west Leicestershire District Council
Lichfield District Council
South Derbyshire District Council

National Grid Reference: SK360144 - SK195148

Area: 21.86 **(ha)** 54.02 **(ac)**

Ordnance Survey Sheet: 1:50,000: 128

1:10,000: SK21SE SK31SW SK31SE SK11SE

Date Notified (under 1981 Act): 16 August 2000

Reasons for notification

The River Mease represents a lowland clay river supporting nationally significant populations of spined loach *Cobitis taenia* and bullhead *Cottus gobio*, two internationally notable species of native freshwater fish with a restricted distribution in England.

Description

Rising at 130 metres above sea level in the Coal Measures of north-west Leicestershire, the River Mease flows approximately 25 kilometres westwards across a largely rural and agricultural landscape to its confluence with the River Trent at Croxall. The river forms an eastern tributary of the Trent and flows throughout its course across alluvial soils overlying bands of Sherwood Sandstone and Mercia Mudstone. Of special interest are the resident populations of two of the UK's smallest freshwater fish species, spined loach *Cobitis taenia* and bullhead *Cottus gobio*, which occur in association with a diverse freshwater fish community. As a relatively un-modified lowland river, the River Mease contains a diverse range of physical in-channel features, including riffles, pools, slacks, vegetated channel margins and bankside tree cover, which provide the conditions necessary to sustain populations of both spined loach and bullhead.

The head of the site includes the lower reaches of the Gilwiskaw Brook which flows along a steep gradient across bands of interbedded mudstones and sandstones. Due to the fast-flowing nature of the river, aquatic vegetation is sparse and marginal vegetation restricted to stands of floating sweet-grass *Glyceria fluitans* but these sections provide valuable habitat for bullhead *Cottus gobio*, a bottom-dwelling native fish which favours clean coarse gravels for spawning and is often found where flows are consistently strong and sediment deposition minimal. Populations of bullhead also occur in the lower reaches of the Mease where river substrates are finer but woody debris lying within the river channel becomes more important in providing suitable breeding habitat.

contd/

Below Snarestone the descent becomes more gradual and the river enters a broad lowland floodplain. The slow-moving river meanders tightly across floodplain deposits, occasionally exposing underlying sandstones and fluvial sands and gravels. These middle reaches of the River Mease provide excellent habitat for a nationally significant population of spined loach *Cobitis taenia*. Confined in its UK range to a limited number of catchments in central and eastern England, this largely sedentary fish is closely associated with the open sandy substrates of the river bed which act as important feeding and spawning grounds. As a small fish, refuges from predators and strong river flows are very important and this is provided by aquatic and marginal vegetation within the river channel. Stands of marginal vegetation are typically dominated by common club-rush *Schoenoplectus lacustris*, *Glyceria fluitans*, reed canary-grass *Phalaris arundinacea*, branched bur-reed *Sparganium erectum*, greater pond sedge *Carex riparia* and bulrush *Typha latifolia*. Submerged aquatic vegetation becomes more varied on the lower reaches of the river with river water-crowfoot *Ranunculus fluitans*, common water-crowfoot *R.aquatilis*, blunt-leaved pondweed *Potamogeton obtusifolius*, fennel pondweed *P. pectinatus*, arrowhead *Sagittaria sagittifolia* and yellow water-lily *Nuphar lutea* becoming increasingly frequent.

Bankside tree cover is very variable but an important feature of the river channel as submerged root systems of larger trees provide important in-channel cover for fish and provide woody debris to the watercourse in the form of fallen branches. In many places the river is largely open, flanked by semi-improved pasture and arable land adjacent to the bank edge. Where tree cover is present, banks are frequently lined with alder *Alnus glutinosa*, ash *Fraxinus excelsior* and various species of willow *Salix* spp. including good numbers of large pollarded crack willow *Salix fragilis*. Some sections of bank are flanked by dense scrub dominated by hawthorn *Crataegus monogyna* and blackthorn *Prunus spinosa*.

Additional interest is provided by populations of freshwater white-clawed crayfish *Austropotamobius pallipes* and otter *Lutra lutra*, both animals with a restricted distribution within the East Midlands and which receive special legal protection.

Other Information

This is a new site.

Spined loach *Cobitis taenia* and bullhead *Cottus gobio* are both listed on Annex II of the Council Directive (92/43/EEC) on the Conservation of Natural Habitats and of Wild Flora and Fauna.

Date Notified: 16 August 2000
Grid Reference SK360144 - SK195148

Appendix B
Environment Agency's General Policy on Wastewater Treatment

July 2012
Doc Reg No. 29438d038

For most development, wastewater is collected and treated by the sewerage provider. The Environment Agency, the regulator of wastewater discharges, expects all new development to connect to the public foul sewers, where it is reasonable to do so. Consents for private treatments will not normally be granted where a public foul sewer is available: generally if there is a public sewer within 30 metres of a development, connection to the sewer is expected. Connection to the public sewer is generally preferred as it can be funded through Ofwat and the AMP process, and it reduces the risk of environmental pollution, as many householders are unaware of the maintenance requirements for private systems, or what to do in the event of a failure. The Environment Agency's hierarchy for sewer connection is provided in Table 4.1 below.

Table B1 Environment Agency Hierarchy for Sewer Connection

	Building Regulations	DETR March 1999 / WO Circular October 1999	Planning Policy Wales (March 2002)
1	Public sewer where reasonably practicable	Public sewer where feasible	Public sewer where feasible
2	Private sewer connecting to a public sewer	Package sewage treatment plant	Private system
3	Private sewage treatment plant (including septic tanks)	Septic tank	-
4	Cesspool	-	-

Under the Water Industries Act 1991 (WIA 1991), sewerage providers are required to provide and maintain public sewers. Processes are set out for developers to requisition a sewer from the provider, and for sewerage providers to adopt sewers and sewage treatment works for drainage from more than a single property. Section 106 of the Act provides a right to connection to a sewer where sewerage already exists. If developers or householders propose non mains drainage, the following must be demonstrated:

- **Step 1** Formally approach the sewerage undertaker regarding a connection under section 98 or section 106 of the WIA 1991, as appropriate;
- **Step 2** Serve notice for connection under section 98 or section 106 of the WIA 1991 if the sewerage undertaker has refused connection;
- **Step 3** Provide details of the reasons given by the sewerage undertaker if it has refused connection under section 106 of the WIA 1991 and confirmation that they have appealed against this decision OR Provide details of the undertakings, security and payment required by the sewerage undertaker under section 98 of the WIA 1991. They must provide these together with confirmation that the applicant considers these to be reasonable and does not intend to appeal against them;
- **Step 4** Demonstrate that it is not reasonable to connect to the public foul sewer;

- **Step 5** Where it is not reasonable to connect to the public foul sewer, demonstrate that they have considered requesting that the sewerage undertaker adopt their proposed system.

Where it can be demonstrated that private sewage treatment is viable, developers might choose from options such as cesspools, septic tanks, package treatment plants, reed beds etc. These must all meet the requirements of paragraph 6 of Circular 3/99/10/99 (Planning requirement in respect of the Use of Non-Mains Sewerage incorporating Septic Tanks in New Development). For package treatment plants discharging to controlled waters an Environment Agency consent/permit will be required.

Appendix C
Sustainability Criteria

Detailed Water Cycle Study: Methodology for Sustainability Analysis of WwTW options

1. Methodology

1.1 Introduction

The purpose of the sustainability assessment is to provide a qualitative assessment of the likely *significant* effects on the environment of implementing the WwTW options and where relevant to propose measures to avoid, manage or mitigate any significant adverse effects and to enhance any beneficial ones. The assessment will provide a relative assessment of the strengths and weaknesses of the options proposed. It will also provide an indication of the option(s) that perform well from a sustainability perspective.

This technical note defines the scope of the assessment and presents the proposed sustainability assessment framework.

The proposed topics to be included in the sustainability assessment are based on an analysis of other relevant strategic assessments (either Strategic Environmental Assessments (SEAs) or Sustainability Appraisals (SAs)). This is presented in **Table 1.2**. The analysis identifies the common topics and relevant assessment objectives and criteria pertinent to this sustainability assessment. The determination of relevance will be informed by an understanding of the possible environmental effects of the proposed WwTW options. Those topics that are not considered relevant to the assessment are identified and are scoped out of the assessment (**Table 1.3)**.

The proposed assessment framework is also presented (**Table 1.4 and 1.5)**. This includes proposed objectives and guide questions/criteria. This is supported by proposed definitions of significance that will help the reader understand how the assessor has determined the impact of WwTW against the objectives (**Table 1.8)**.

We would welcome your views on these proposals.

1.2 Proposed Scope of the Assessment

1.2.1 Review of existing SEA/SAs

As a first step to developing a robust sustainability assessment framework, relevant recent SEAs and SAs have been reviewed. The assessments used are set out in **Table 1.1**. In common with all assessments that are compliant with the requirements of the SEA regulation[1] the scope of each of these assessment is based on a review of relevant legislation, policies plans and programmes including European Directive requirements, (such as Water Framework Directive and Habitats Directive). All such assessments also require consultation with statutory environmental protection bodies such as the Environment Agency and Natural England. In consequence, in developing an assessment framework that is consistent with the themes and assessment objectives of these other SEAs and SAs, it will also be aligned with relevant UK legislation and national policies.

Table 1.1 Existing SEA/SAs Reviewed

Company/ Authority	Title of SEA/SA	Rationale
Severn Trent	Strategic Environmental Assessment (SEA) Final Environmental Report Severn Trent Water Ltd Water Resources Management Plan (WRMP) (June 2010)	WwTW options may impact on water quality and river flows which would affect water resource and abstraction. Severn Trent Water Ltd is the water company which provides water service for the Leicestershire area, their Water Resource Management Plan shows how they intend to maintain a balance between supply and demand for 25 years.
EA	Strategic Environmental Assessment of the Draft River Basin Management Plan for the Humber river basin district (Dec 2008)	WwTW options may affect flow rates and water quality within the River Mease. The River Mease is within the Humber River Basin and the River Basin Management Plan describes the river basin district, and the pressures that the water environment faces. The EA has statutory responsibilities for the protection and improvement of water quality. It is also a named SEA consultee.

[1] Statutory Instrument No.1633 - The Environmental Assessment of Plans and Programmes Regulations 2004

Company/ Authority	Title of SEA/SA	Rationale
NW Leicestershire District Council	Sustainability Appraisal of the North West Leicestershire Local Development Framework – Core Strategy Further Consultation (November 2008)	The Core Strategy when complete will set out the vision, strategic objectives and spatial strategy for future developments within North West Leicestershire. Like all spatial plans, it is subject to sustainability appraisal (which also fulfils the requirements of the SEA regulation). Failure to meet EU standards on water quality, exceedance of sewage network capacity and pressure on water resources are issues within NW Leicestershire which constrain future development and are likely to be affected by WwTW options.

In each of the three SEA/SAs reviewed, the assessment framework used is based on a number of assessment objectives and guide questions. Broadly, the objectives present the preferred environmental outcome which usually involves minimising detrimental effects and enhancing positive effects. The objectives are structured according to a number of consistent topics. These topics are:

- Biodiversity Enhancements;
- Environmental Sustainability;
- Population;
- Existing Infrastructure/Landscape;
- Energy Use and Climate Change.

Table 1.2 presents the assessment objectives used by each assessment, structured according to the five main topics.

Table 1.2 SEA Objectives from Existing Assessments

Topic	Severn Trent WRMP SEA	EA RBMP SEA	NW Leicestershire Core Strategy SA
Biodiversity Enhancements			
Biodiversity	Protected sites and species Biodiversity and Ecosystems	Promote development that is not detrimental to biodiversity Prevent habitat fragmentation	Protect and enhance the District's Biodiversity and Geodiversity

Topic	Severn Trent WRMP SEA	EA RBMP SEA	NW Leicestershire Core Strategy SA
		Control the spread of non-native species	
Environmental Sustainability			
Water quality and resources	River morphology, river flow, groundwater, flooding, water table Water quality, risk of pollution	Reduce pressure on water quality Improve coastal bathing waters	Reduce water pollution to levels to avoid damage to natural systems and protect human health
	Sustainable water supply, reduce demand for water, increase efficiency of water use, resilience	Improve water quality Reduce the pressure on water resources Manage water abstraction in a sustainable manner	Reduce water consumption
Soil	Soil and Geology Soil Moisture	Promote development that is not detrimental to soils Promote appropriate soil management practices Promote remediation of former waste, industrial or mining sites Prevent loss of nutrients from agricultural sources Promote appropriate agricultural management	
Waste		Only generate waste that does not need to be land filled	Reduce waste generation and promote re-use and recycling
Population			
Health	Air Quality and Noise		Improve the health and wellbeing of the district's population Reduce air, water, light and noise pollution to levels to avoid damage to natural systems and protect human health
Community	Tourism and recreation Housing Agriculture	Promote recreational activities Support farmers who either wish to or do not wish to diversify	Maintain and enhance open space, sport and recreation provision Provide good quality homes that meet local needs and reflect local circumstances Promote social inclusion and reduce inequalities across the District

Topic	Severn Trent WRMP SEA	EA RBMP SEA	NW Leicestershire Core Strategy SA
		Promote regeneration in more deprived areas	Reduce crime and fear of crime Increase education attainment and promote lifelong learning and training
Economy			Encourage jobs that match the skills and needs of local residents Provide an adequate supply of good quality employment land needed to encourage and accommodate indigenous and inward investment Help develop a prosperous, competitive and diverse rural economy which adds value to existing agricultural, forestry and leisure sectors
			Enhance the vitality and viability of existing town centres and village centres
Existing Infrastructure/Landscape			
Transport and built environment	Transportation Material Assets		Reduce the need to travel and extend public transport choices for non car modes Conserve and enhance the character, diversity and local distinctiveness of the District's built environment Support sustainable extraction and the reuse and recycling of minerals and aggregate resources
Historical culture	Historic Environment and Archaeology	Improve or maintain historic structures associated with the water environment Maintain preserved archaeology	Conserve and enhance the character, diversity and local distinctiveness of the District's cultural, historic and archaeological heritage
Landscape	Landscape	Improve or maintain the landscape character of the area Promote the recreational value of the landscape	Conserve and enhance the quality of the District's landscape character Make the most efficient use of land
Energy Use and Climate Change			
Energy	Energy Consumption and CO2		Reduce energy requirements across the District and increase the proportion of that requirement met from renewable or low carbon sources

Topic	Severn Trent WRMP SEA	EA RBMP SEA	NW Leicestershire Core Strategy SA
	Renewable Energy	Promote the use of renewable energy sources	
Robustness to climate change	Flood Drought	Promote urban drainage systems for new development Reduce risk of flooding (pluvial, fluvial and sewer) Promote agricultural land management as a away of reducing flood risk Able to achieve and maintain what it sets out to with climate change taken into account Promote awareness and action on future impacts on agricultural practices from climate change	Reduce flood risk and impact from flooding

1.2.2 Topics included within the Sustainability Assessment

The topics and assessment objectives covered in the reviewed SEA/SAs has been used to identify provisional topic areas for inclusion in this sustainability assessment. These provisional topic areas are set out in **Table 1.3**. Consideration has then been given to the likely effects of the WwTW options with a view to scoping out those topic areas that are not considered relevant. **Table 1.3** provides the justification for scoping in/out of the topic areas.

Table 1.3 Basis for Scoping Topic Areas

Topic Area	Sub-topic Area	Propose to include in assessment?	Justification for Proposal
Biodiversity Protection and Enhancements	N/a	Yes	*Include within assessment framework.* WwTW options may impact on water quality (especially phosphate levels) which may impact on ecosystems function and structure which may affect populations of species and biodiversity levels. This is especially an issue in sensitive or protected areas such as SSSIs and SACs. Water quality in the River Mease Special Area of Conservation is currently failing to meet European standards on ortho-phosphate. Packington WwTW is currently the main works discharging to this area. New developments will put additional strain on water quality; hence the requirement for WwTW options to treat effluent water. However, the different options may affect water quality to differing extents. The WwTW options may also affect river flows to differing extents which will have an indirect impact on water quality through affecting dilution of pollutants such as phosphates. The transfer of effluent to Stanton STW in another river catchment may reduce volume of flow being discharged into the Mease, reducing both pollutant loading and the effects of dilution. Construction of WwTW infrastructure such as a pipeline and/or reed beds may impact on existing biodiversity. A pipeline will require direct loss of surface vegetation along the route, cause disruption from excavation and other physically intrusive activities and temporary severance of habitats. It is understood that the pipeline would be of between 9.4km and 11.6km in length. If the proposed pipeline route was to follow the freight railway, biodiversity along the route is comparatively low and there would be minimal impact, however, if the route was through open greenspace, biodiversity levels would be expected to be greater. Inclusion of this topic within the assessment allows for the relative effects of the options to be recorded.
Environmental Sustainability	Water Quality and Resources	Yes	*Include within assessment framework.* Differing discharge volumes from the differing WwTW options may affect river flows within the River Mease and its tributaries. For example, the transfer of effluent to Stanton STW in another river catchment may reduce volume of flow being discharged into the Mease This could have impacts on river water quality through changes in level of phosphate discharged or changes in river flow which may affect river dilution of existing pollutant loads. The impact these options have on existing water resources is especially important as local water resources are currently constrained especially during periods of low flow. Inclusion of this topic within the assessment allows for the relative potential benefits of the options to be recorded.

Topic Area	Sub-topic Area	Propose to include in assessment?	Justification for Proposal
	Soil	Yes	*Include within assessment framework.* Excavation is likely to be required for a number of options in order to construct reed beds or for the new pipeline to Stanton STW. Depending on the exact routing of the pipeline and location of reed beds this may impact on this objective, as it will lead to a loss of topsoil (unless the soil is stored or reused elsewhere). The significance of the impact will depend on the quality of the soil, its use and the permanence of the effect. For example, proposed routing which follows the freight railway is expected to have minimal effect as the soil is assumed to be of low quality however, proposed routing through any arable fields is likely to have a greater impact as the soil quality in these areas will be greater. Inclusion of this topic within the assessment allows for the relative effects of the options to be recorded.
	Waste	Yes	*Include within assessment framework.* The operation of each of the WwTW options is unlikely to use/generate significant volumes of materials or waste. However, for a number of options greater volumes of materials and waste may be required or generated during construction of the necessary infrastructure e.g. reedbeds, a new pipeline and/or modifications to a pumping station. There may also be opportunities for recycling and reuse during these options. Inclusion of this topic within the assessment allows for the relative effects of the options to be recorded.
Population	Health	Yes	*Include within assessment framework.* WwTW options may indirectly affect health by affecting recreation along the River Mease and Saltersford Brook. It is expected that air and noise pollution will be minimal during operation of the WwTW options and any adverse effects during any required construction will be minimal and temporary. Odour has been highlighted as an issue for local residents near the Packington WwTW. Changes to WwTW may beneficially affect levels of odour within Packington, Measham and Stanton. Inclusion of this topic within the assessment allows for the effects of the options to be recorded.
	Community	No	*Not included within assessment framework.* WwTW options are intended to address water quality constraints which will make the identified development possible. However, given that the proposed WwTW options do not include any changes to housing, open space, land use patterns or community facilities it is not expected that it will impact on this objective.
	Economy	Yes	*Include within assessment framework* Although for most options, the scale of the infrastructure and associated jobs required for construction and maintenance of WwTW options (if any) will be minor, the construction of between 9.4km to 11.4km of pipeline may result in enough jobs to impact on this objective.

Topic Area	Sub-topic Area	Propose to include in assessment?	Justification for Proposal
Existing Infrastructure/ Landscape	Transport and built environment	No	*Not included within assessment framework.* Infrastructure for the WwTW options are not expected to impact on the transport network or built environment. The pipeline transferring water to Stanton WwTW has the largest potential for affecting this criteria however as it is expected to either follow the route of railway line or through open fields, the built environment is unlikely to be affected.
	Historical culture	No	*Not included within assessment framework.* Land excavation is likely to be required for a number of options in order to construct reed beds or for new pipeline to Stanton WwTW. Depending on the exact routing of the pipeline this may impact on this objective. For example, proposed routing which follows the route of freight railway is expected to have no impact as the presence of any existing underground archaeological remains will already be known. However, the proposed route which is predominantly through open fields may impact on currently unknown archaeological remains. Given the difficulties in anticipating whether such remains would be uncovered, for the purposes of the assessment it is not proposed to include this topic; however, the issue remains a risk for the pipeline option. This will be reflected in specific commentary against this option. Although there is a conservation area within Ashby-de-la-Zouch which 2 of the new developments would be within close proximity, the infrastructure required for WwTW options within these areas will be small (if any), comprising of reed beds and possibly a small outflow control structure. Therefore, it is not expected that the WwTW options will cause a visual intrusion to the conservation area above created by the new developments themselves.
	Landscape	Yes	*Include within assessment framework.* Although the infrastructure required is considered to be small for most of the WwTW options, the requirement of 9.4km to 11.6km of pipeline to transfer water flows to Stanton WwTW for treatment could have a visual impact on landscape depending on the route of the pipeline, given that development of the pipeline would occur within the National Forest area.
Energy Use and Climate Change	Energy Use	Yes	*Include within assessment framework.* Energy use will be required for construction of any necessary infrastructure such as pipelines, reedbeds, modifications to pumping house etc. Although for most options, energy use for operation will be minimal the pumping of water to another catchment to be treated at another WwTW could also require additional energy use. Depending on the fuel used or how any power is generated, if there are associated carbon emissions, this would contribute toward local greenhouse gas emissions. Those options that require significant quantities of material (such as plastics, steels or concrete) may also include significant quantities of embodied carbon. Inclusion of this topic within the assessment allows for the relative effects of the options to be recorded.

Topic Area	Sub-topic Area	Propose to include in assessment?	Justification for Proposal
	Robustness to climate change	Yes	*Include within assessment framework.* WwTW options may affect river flows. This could exacerbate the vulnerability of water resources and water quality to the effects of flooding and drought. These events are expected to increase in severity and frequency with changes in climate. Low flow during drought is especially a concern for the area as water resources are significantly constrained, the transfer of effluent to Stanton WwTW in another river catchment may worsen this effect. Inclusion of this topic within the assessment allows for the relative effects of the options to be recorded.

In consequence it is proposed that the following sub-topic areas are scoped out of the assessment: community; transport and built environment and historical culture. For community and transport this reflects the lack of any anticipated effects. For the historical culture sub-topic it reflects both the lack of effects and the inherent uncertainties of including the potential effects on yet to be discovered underground archaeological remains. Given that this issue remains a risk for the option including the pipeline, the potential effects on archaeological remains will be included in the specific commentary on this option.

1.3 Proposed Assessment Objectives and Guide Questions

Consistent with the other strategic assessments and good practice, we propose to use a number of assessment objectives and guide questions for the identified topics to assess the potential effects of the WwTW options on the environment. Each WwTW option will be assessed against each of the objectives in turn. By completing the assessment of each WwTW option, we will identify where each option contributes to sustainability, where it might have a negative effect, and where its effect could be improved.

The proposed assessment objectives and associated guide questions are presented in **Table 1.4**.

Table 1.4 Proposed Assessment Objectives and Guide Questions for the WwTW options

	Proposed Assessment Objective	Proposed Guide Questions
Biodiversity Protection and Enhancement		
1	Protection and enhancement of biodiversity, key habitats and species	*Will the WwTW option protect and enhance the status of the River Mease SAC?* *Will the WwTW option protect and enhance UK Biodiversity Action Plan (BAP) Assets?* *Will the WwTW option increase biodiversity levels across the district?* *Will the WwTW option ensure the requirements of the Habitat Directive are met regarding water quality (i.e. the ortho-phosphate levels for River Mease SAC)?* *Will the WwTW option ensure the requirements of the Water Framework Directive are met regarding ecological status within the River Mease?* *Will disturbance from construction during the WwTW option affect biodiversity?*
Environmental Sustainability		
2	Protection and enhancement of the water quality and resources	*Will the WwTW option lead to changes in river flows in River Mease and its tributaries?* *Will the WwTW option affect the sustainability of water abstraction in the local area? (e.g. – by affecting flow rate)* *Will the WwTW option affect surface water quality (e.g. - phosphate levels) and quantity?* *Will the WwTW option ensure the requirements of the Water Framework Directive are met regarding chemical status?*
3	Protection and enhancement of soil quality	*Will any excavation associated with the WwTW option have an effect on soil quality, variety, extent and/or compaction levels?* *Will the WwTW option have an effect on soil function and processes?*
4	Promoting the sustainable use of resources and minimising generation of waste	*Will the design and construction for the WwTW option seek to minimise the demand for additional raw materials?* *Will the WwTW option encourage the reuse and recycling of waste?* *Will the WwTW option encourage sustainable design or use of sustainable materials?*
Population		
5	Protection and enhancement of human health and wellbeing	*Will the WwTW option ensure that surface water quality is maintained within statutory standards?*

	Proposed Assessment Objective	Proposed Guide Questions
		Will the WwTW option significantly affect odour levels observed by local communities near STW or within the new developments? *Will the WwTW option affect opportunities for recreation? (i.e. – through affecting water quality/flow rates?)*
6	Economy	*Will the construction stages of the WwTW option increase the number of jobs within the local economy?*
Existing Infrastructure/Landscape		
7	Protection and enhancement of landscape character	*Is it likely that the WwTW option will have a visual impact on landscape and townscape character?*
Energy Use and Climate Change		
8	Energy Use & Climate Change	*Is it likely that the WwTW option will result in an increase, directly or indirectly, in greenhouse gas emissions (including embodied carbon within materials in construction)?* *Will the WwTW option promote the use of renewable energy sources and increase the proportion of the district's energy from renewable/low carbon sources?* *Will the WwTW option be affected by climate change (for example, changes in precipitation affecting flow rate, or flooding of sewage etc)?* *Will the WwTW option affect how climate change may impact on the wider environment?*

1.4 The Assessment Framework

The assessment framework will be used to record the assessment of the WwTW options against the objectives (once confirmed following scoping). The format of the matrix which will record the assessments for each option is shown in **Table 1.5**. The first column of the matrix sets out the assessment objectives, the second column summarises the expected effect of the measure on the chances of achieving the objective and the rationale for this relationship will be explained in more detail in the final column. Four detailed assessment matrices will be completed, one for each option.

Table 1.5 Proposed Assessment Matrix

Objective	Relationship	Commentary
1. Protection and enhancement of biodiversity, key habitats and species *Will the WwTW option protect and enhance the status of the River Mease SAC?*	+ +	The construction of a reedbed and polishing station is likely to have a minor positive effect on biodiversity through reducing phosphate levels and improving water quality. As a result, Water Framework Directive and Habitat Requirements are likely to be met or exceeded, improving

Objective	Relationship	Commentary
Will the WwTW option protect and enhance UK Biodiversity Action Plan (BAP) Assets? *Will the WwTW option increase biodiversity levels across the district?* *Will the WwTW option ensure the requirements of the Habitat Directive are met regarding water quality (i.e. the ortho-phosphate levels for River Mease SAC)?* *Will the WwTW option ensure the requirements of the Water Framework Directive are met regarding ecological status within the River Mease?* *Will disturbance from construction during the WwTW option affect biodiversity?*		ecological status of the water within River A and SAC B.
2. Protection and enhancement of the water quality and resources *Will the WwTW option lead to changes in river flows in River Mease and its tributaries?* *Will the WwTW option affect the sustainability of water abstraction in the local area? (e.g. – by affecting flow rate)* *Will the WwTW option affect surface water quality (e.g. - phosphate levels) and quantity?* *Will the WwTW option ensure the requirements of the Water Framework Directive are met regarding chemical status?*	+	
This is an example matrix. Further assessment against each of the remaining objectives will be in a separate row.		

Table 1.6 shows how the relationship between the WwTW options and each objective will be summarised. This assessment of the relationship will be inserted into the second column of the assessment matrix (as shown in **Table 1.5**). For example, where there is a strong positive effect, measures will be assessed as having a "++" effect. Where a very strong negative effect of the measure is identified, the "- -" symbol will be used. The commentary will be structured to consider the factors listed in **Table 1.7**.

Table 1.6 Key to Assessment Matrices

Symbol	Meaning
++	Very strong positive effect of the WwTW option on this objective
+	Positive effect of the WwTW option on this objective
0	Overall neutral effect of the WwTW option on this objective
-	Negative effect of the WwTW option on this objective
--	Very strong negative effect of the WwTW option on this objective
?	Uncertain effect of the WwTW option on this objective

Table 1.7 Contents of Commentary Column (where relevant)

Commentary column text to be included in assessment
The nature of the potential effect (what is expected to happen)
The reasons for any uncertainty where this is identified
The timing of the potential effect
The potential effect on vulnerable communities or sensitive habitats
The geographic scale of the potential effect (e.g. local, regional, national)
The location of the potential effect (e.g. whether it affects rural or urban communities, or those in particular parts of the region)
The duration of the potential effect (e.g. short, medium, or long term)

1.5 Definitions of Significance

To ensure a consistent approach to interpreting the significance of the effects and to help the reader understand the decisions made by the assessor, a series of quantitative and semi-quantitative 'thresholds' have been defined (shown in **Table 1.8**) to provide direction on what constitutes a significant effect. It is intended to use these thresholds to guide the assessment of the WwTW options.

Table 1.8 Proposed Definitions of Significance

Objective	Key Questions	Effect	Description	Illustrative Guidance
1. Protection and enhancement of biodiversity, key habitats and species	*Will the WwTW option protect and enhance the status of the River Mease SAC?* *Will the WwTW option protect and enhance UK Biodiversity Action Plan (BAP) Assets?* *Will the WwTW option increase biodiversity levels across the district?* *Will the WwTW option ensure the requirements of the Habitat Directive are met regarding water quality (i.e. the ortho-phosphate levels for River Mease SAC)?* *Will the WwTW option ensure the requirements of the Water Framework Directive are met regarding ecological status within the River Mease?* *Will disturbance from construction during the WwTW option*	++	Significant Positive	WwTW option would have a major positive and sustained effect on the River Mease SAC/SSSI and/or protected species (e.g. –all conservation objectives on site are exceeded, long term increase in water quality (including decrease in ortho-phosphate levels), long term increase in populations of designated species). WwTW option would have strong positive effects on local biodiversity (e.g. – through significant improvements in water quality, or considerable increase of habitat leading to long term increase of ecosystem structure and function). WwTW option will improve water quality in the River Mease such that it will be significantly closer to meeting water quality conservation objectives (without decreases in diffuse pollution from other sources the WFD target is considered unobtainable).
		+	Positive	WwTW option would have minor residual positive impact on the River Mease SAC/SSSI and/or protected species (e.g. – short term increase in population of designated species, short term increase in water quality (including decrease in ortho-phosphate levels), some conservation objectives exceeded). WwTW option would have minor short-term positive effects on non-designated conservation sites and species (e.g. – through small improvements to water quality, increase in habitat). WwTW option will improve water quality in the River Mease such that it will be closer to meeting water quality conservation objectives (without decreases in diffuse pollution from other sources the WFD target is considered unobtainable).
		0	Neutral	WwTW option would not have any effects on European or national designated sites and/or any species (including both designated and non-designated species).
		-	Negative	WwTW option would have minor residual negative impact on River Mease SAC/SSSI and/or protected sites (e.g. – prevents reaching one of the conservation objectives on site, short term decrease in water quality (including increase in ortho-phosphate levels) short term decrease in population of designated species). These impacts could not be effectively avoided but could be effectively compensated for. WwTW option would have minor short-term negative effects on non-designated conservation sites and species (e.g. – through decreases in flows/water quality, or some loss of habitat leading to temporary loss of ecosystem structure and function).
		--	Significant Negative	WwTW option would have a major negative and sustained effect on River Mease SAC/SSSI sites and/or protected species (e.g. – prevents reaching all conservation objectives on site, long term decrease in water quality (including increase in ortho-phosphate levels) long term decrease in populations of designated species). These impacts could not reasonably be compensated for. WwTW option would have strong negative effects on local biodiversity (e.g. – through decreases in flows/water quality, or

Objective	Key Questions	Effect	Description	Illustrative Guidance
	affect biodiversity?			considerable loss of habitat leading to long term loss of ecosystem structure and function).
		?	Uncertain	From the level of information available the impact that the option would have on this objective is uncertain
2. Protection and enhancement of the quality and quantity of the surface water environment and the groundwater resource	*Will the WwTW option lead to changes in river flows in River Mease and its tributaries?* *Will the WwTW option affect the sustainability of water abstraction in the local area? (e.g. – by affecting flow rate)* *Will the WwTW option affect surface water quality (e.g. - phosphate levels) and quantity?* *Will the WwTW option ensure the requirements of the Water Framework Directive are met regarding chemical status?*	++	Significant Positive	WwTW option would prevent decreases in river flows within the River Mease and its tributaries, improving sustainability of water abstraction over long periods. Water quality and quantity in designated nature conservation sites and elsewhere will be significantly improved (e.g. – significantly reducing phosphate levels in the long term). WwTW option will improve water quality in the River Mease such that it will be significantly closer to meeting Water Framework Directive targets (without decreases in diffuse pollution from other sources the WFD target is considered unobtainable).
		+	Positive	WwTW option would prevent decreases in river flows within the River Mease and its tributaries, improving sustainability of water abstraction for short periods. Water quality and quantity in designated nature conservation sites and elsewhere will be improved (e.g. – reducing phosphate levels in the short term). WwTW option will improve water quality in the River Mease such that it will be significantly closer to meeting Water Framework Directive targets (without decreases in diffuse pollution from other sources the WFD target is considered unobtainable).
		0	Neutral	WwTW option would have no discernable impact on river flows or on water quality or quantity along the stretch of the River Mease.
		-	Negative	WwTW option would lead to minor decreases in river flows within the River Mease and its tributaries which may negatively affect abstraction during short periods of time. Water quality and quantity in designated nature conservation sites may be impacted by the measure (e.g. – prevents reaching one of the conservation objectives on site, short term decrease in population of designated species). These impacts could not be effectively avoided but could be effectively compensated for.
		--	Significant Negative	WwTW option measure would lead to major decreases in river flows within the River Mease and its tributaries, resulting in over-abstraction of water within the local area over long periods. Water quality and quantity in designated nature conservation sites may be impacted by the measure (e.g. g. – prevents reaching all conservation objectives on site, long term decrease in populations of designated species). These impacts could not reasonably be compensated for.

Objective	Key Questions	Effect	Description	Illustrative Guidance
		?	Uncertain	From the level of information available the impact that the option would have on this objective is uncertain
3. Protection and enhancement of soil quality	*Will any excavation associated with the WwTW option have an effect on soil quality, variety, extent and/or compaction levels?* *Will the WwTW option have an effect on soil function and processes?*	++	Significant Positive	N/a. No WwTW option is anticipated to have significant positive impacts against this objective
		+	Positive	N/a. No WwTW option is anticipated to have positive impacts against this objective
		0	Neutral	WwTW option will have no effect on soil quality, function or structure and there will be no loss of top soil.
		-	Negative	WwTW option will have a minor and temporary negative effect on soil quality, function and structure (eg – from land excavation during construction). WwTW option will cause a loss of minor volumes of topsoil to be lost for a temporary period of time.
		--	Significant Negative	WwTW option will have a significant and sustained negative effect on soil quality, function and structure. WwTW option will result in a permanent loss of significant volumes of topsoil of high quality.
		?	Uncertain	From the level of information available the impact that the option would have on this objective is uncertain
4. Promoting the sustainable use of resources and minimising generation of waste	*Will the design and construction for the WwTW option seek to minimise the demand for additional raw materials?* *Will the WwTW option encourage the reuse*	++	Significant Positive	WwTW option will minimise use of additional raw material for the design and construction of infrastructure (such as pipelines, reedbeds etc) and will provide an example of sustainable design and use of sustainable materials. WwTW option will promote the reuse and recycling of waste within the district.
		+	Positive	WwTW option will minimise use of additional raw materials for the design and construction of infrastructure (such as pipelines, reedbeds etc) and some opportunities for reuse and recycling of waste will be utilised.
		0	Neutral	WwTW option will not require any additional raw materials and will not influence recycling/reuse of waste.

Objective	Key Questions	Effect	Description	Illustrative Guidance
	and recycling of waste? *Will the WwTW option encourage sustainable design or use of sustainable materials?*	-	Negative	WwTW option requires additional raw materials for the construction and design of necessary infrastructure (such as pipelines, reedbeds etc) and during maintenance. No effort or opportunity has been taken to minimise demand for materials or incorporate sustainable design features. Limited opportunity or appetite for reuse and recycling of waste.
		--	Significant Negative	WwTW option requires significant volumes of additional raw material during construction of necessary infrastructure (such as pipelines, reedbeds etc), with no opportunity for reuse and recycling of waste or sustainable design.
		?	Uncertain	From the level of information available the impact that the option would have on this objective is uncertain
5. Economy	*Will the construction stages of the WwTW option increase the number of jobs within the local economy?*	++	Significant Positive	Construction of the infrastructure for the WwTW option (e.g. – pipelines, reedbeds etc) will significantly increase the number of construction jobs within the district (making up at least 5% of the baseline construction jobs found in the district for a sustained period of time).
		+	Positive	Construction of the infrastructure for the WwTW option (e.g. – pipelines, reedbeds etc) will increase the number of construction jobs within the district for a temporary period.
		0	Neutral	WwTW option will not create any jobs within the local economy.
			Negative	N/a. No WwTW option is anticipated to have negative impacts against this objective
		--	Significant Negative	N/a. No WwTW option is anticipated to have significant negative impacts against this objective
		?	Uncertain	From the level of information available the impact that the option would have on this objective is uncertain
6. Protection and	*Is it likely that the WwTW option will*	++	Significant Positive	WwTW option will permanently improve the visual amenity in the local area and will enhance the landscape and townscape. The WwTW option will contribute towards the National Forest plans to transform the landscape.

Objective	Key Questions	Effect	Description	Illustrative Guidance
enhancement of landscape character	*have a visual impact on landscape and townscape character?*	+	Positive	WwTW option would temporarily improve the visual amenity and landscape/townscape within the local area.
		0	Neutral	WwTW option will have no visual impact on the local landscape and townscape.
		-	Negative	The infrastructure (e.g. – reedbeds, pipelines, modifications to STWs etc) required for the WwTW option will have a temporary negative effect (e.g. – during construction) on the landscape and townscape character within the local area.
		--	Significant Negative	The construction of infrastructure (e.g. – reedbeds, pipelines, modifications to STWs etc) for the WwTW option will have a sustained negative effect (e.g. – for the lifetime of the infrastructure) on the landscape and townscape character for a large area (e.g. – along considerable length of the pipeline) and will interfere with the plans to increase woodland cover and transform the landscape of the National Forest.
		?	Uncertain	From the level of information available the impact that the option would have on this objective is uncertain
7. Energy Use & Climate Change	*Is it likely that the WwTW option will result in an increase, directly or indirectly, in greenhouse gas emissions (including embodied carbon within materials in construction)?* *Will the WwTW option promote the use of renewable energy sources and increase the proportion of the district's energy from renewable/low carbon sources?*	++	Significant Positive	WwTW options (including the embodied carbon within resources used) will lead to a major decrease in greenhouse gas emissions and increase the proportion of the district's energy from renewable/low carbon sources. WwTW options will considerably increase resilience/decrease vulnerability to climate change in the wider environment (e.g. reduction in water demand during summer, potential flooding in winter).
		+	Positive	WwTW option (including the embodied carbon within resources used) will lead to a minor decrease in greenhouse gas emissions and increase the proportion of the district's energy from renewable/low carbon sources. WwTW option may increase resilience/decrease vulnerability to climate change in the wider environment (e.g. reduction in water demand during summer, potential flooding in winter).
		0	Neutral	WwTW option would have no discernable impact on greenhouse gas emissions, nor does the measure increase resilience/decrease vulnerability to climate change in the wider environment.
		-	Negative	WwTW option (including the embodied carbon within resources used) will lead to a minor increase in greenhouse gas emissions and may lead to minor decreases in the proportion of the district's energy from renewable/low carbon sources. WwTW option may increase resilience/decrease vulnerability to climate change in the wider environment (e.g. reduction in water demand during summer, potential flooding in winter).

Objective	Key Questions	Effect	Description	Illustrative Guidance
	Will the WwTW option be affected by climate change (for example, changes in precipitation affecting flow rate, or flooding of sewage etc)?	--	Significant Negative	WwTW option (including the embodied carbon within resources used) will lead to a major increase in greenhouse gas emissions and will considerably decrease the proportion of the district's energy from renewable/low carbon sources. WwTW option increases vulnerability to climate change in the wider environment (e.g. reduction in water demand during summer, potential flooding in winter).
	Will the WwTW option affect how climate change may impact on the wider environment?	?	Uncertain	From the level of information available the impact that the option would have on this objective is uncertain

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Appendix D
SuDS Assessment

These tables should be read in conjunction with notes provided in Chapter 7 of WCS report

A1 Leics Rd

Location	Ashby
Site Reference	A1
Site Description	Leicester Road. Greenfield site allocated for housing in Local Plan
Size	14.33ha
Grid Reference	436631 316367
Current Use	1 dwelling / agriculture
Land Use Type	Approx. 95% Greenfield
Proposed number of dwellings	261
Proposed development status	Application from single housebuilder
Flood Zone	Mainly Zone 1, part in Zone 3 at southern boundary
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage. Very small section of Flood Zone 3 associated with tributary of Gilwiskaw Brook along southern site boundary. Fluvial flooding should not be a constraint to development. Development should avoid flood risk area in any masterplan layout.
Existing Drainage	Potentially agricultural underdrainage? No sewers
Nearest Watercourse	Gilwiskaw Brook (or unnamed tributary of?) to east of boundary
Underlying Geology & Soils	**Bedrock Geology:** Pennine Lower Coal Measures Formation and South Wales Lower Coal Measures Formation (Undifferentiated mudstone, siltstone, sandstone, coal, ironstone and ferricrete) **Superficial Geology:** Not present **Soils:** Slowly permeable seasonally wet acid loamy and clayey soils
Aquifer Status	**Bedrock Geology:** Secondary A Aquifer **Superficial Geology:** Not designated / present
Source Protection Zone	Not present
Infiltration Potential	Medium to Low, assume infiltration not possible
Drainage Requirement	Limited to Greenfield run-off, 10.99 l/s/ha Estimated attenuation = 5615 m^3 for 480 minute winter storm, critical duration
Potential SuDS	Attenuation ponds, Swales, Filter drains, Permeable Paving (with lining), Wetlands, Green roofs, Rainwater harvesting
Indicative costs	In the region of £114,500 for construction based on pond SuDS feature

A3 Holywell Spring Farm

Location	Ashby
Site Reference	A3
Site Description	Holywell Spring Farm. Greenfield site bisected by a public footpath. The land slopes up to the rear and is adjoined by housing to the east and industrial land to the north. To the west is open countryside.
Size	19.9ha
Grid Reference	434945 317250
Current Use	Agriculture
Land Use Type	Greenfield
Proposed number of dwellings	500 (at 30 dph)
Proposed development status	Promoted originally by Commercial Property Estates and now Nurton Developments
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Potentially agricultural underdrainage? No sewers
Nearest Watercourse	Gilwiskaw Brook (or unnamed tributary of) to east of boundary appears to be culverted through housing area. Spring located at east of boundary associated with this tributary Uncertainty around route of channel and capacity to accept surface flows, requires further on site investigation
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - interbedded sandstone and conglomerate **Superficial Geology:** Not present **Soils:** Freely draining slightly acid loamy soils
Aquifer Status	**Bedrock Geology:** Principal Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not present
Infiltration Potential	Medium, potentially High based on soils description. Recommend soakaway tests are undertaken.
Drainage Requirement	Limited to Greenfield run-off, 10.91 l/s/ha Attenuation of 7812m^3 for critical storm 480 minute winter storm Reduction if infiltration used (to 0.5m/hr) is to 4890m^3 volume for 60 minute critical storm.
Potential SuDS	Attenuation ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting Infiltration basins and trenches, soakaways, Permeable Paving could be used if on site soakaway tests demonstrate appropriate infiltration rates and groundwater levels
Indicative costs	In the region of £114,500 to £209,000 for construction based on pond feature

A5 Money Hill

Location	Ashby
Site Reference	A5
Site Description	Money Hill, Ashby. Large Greenfield site sloping up to the rear. Part enclosed by an embankment to the A511 with several mature hedges bisecting the site. Existing access point to the south with public rights of way (Ivanhoe Way). No vehicle access onto A511
Size	128.56ha
Grid Reference	436125 317140
Current Use	Agriculture / residential
Land Use Type	Greenfield
Proposed number of dwellings	1600 (at 30 dph)
Proposed development status	
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Potentially agricultural underdrainage? No sewers on site.
Nearest Watercourse	Gilwiskaw Brook immediately west of boundary and should be considered for discharge of surface water at greenfield rates.
Underlying Geology & Soils	**Bedrock Geology:** Pennine Lower Coal Measures Formation and South Wales Lower Coal Measures Formation (Undifferentiated mudstone, siltstone, sandstone, coal, ironstone and ferricrete) **Superficial Geology:** Not present **Soils:** Slowly permeable seasonally wet acid loamy and clayey soils / Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Secondary A Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not present
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off, 9.84 l/s/ha 53687m^3 for critical storm duration 720minutes (winter). It is assumed however that the site would be developed in sections, therefore future attenuation should be designed to the run-off limit above of 9.84 l/s/ha.
Potential SuDS	Attenuation ponds, Swales, Filter drains, Permeable Paving (with lining), Wetlands, Green roofs, Rainwater harvesting. The potential for a cascade of SuDS features should be explored due to the size of the site, which may affect volumes
Indicative costs	Estimate of £485,000 per pond measuring 25,000.

A7 Packington Nook

Location	Ashby
Site Reference	A7
Site Description	Packington Nook
Size	102.47ha
Grid Reference	435748 315415
Current Use	Agriculture
Land Use Type	Greenfield
Proposed number of dwellings	1100
Proposed development status	The site is being promoted by a Hallam Land Management
Flood Zone	Mainly Flood Zone 1, Gilwiskaw Brook to east with some areas of Flood Zone 2 and 3
FRA Requirements	FRA required as site is greater than 1 ha and includes Flood Zone 2 and 3 of the Gilwiskaw Brook. Development within Flood Zone 3 should be avoided if possible. If required, then les vulnerable or water compatible uses should be located in the highest flood risk areas. Exception Test will be required if housing development is proposed within Flood Zone 3.
Existing Drainage	Potentially agricultural underdrainage? No sewers?
Nearest Watercourse	Gilwiskaw Brook
Underlying Geology & Soils	**Bedrock Geology:** Pennine Lower Coal Measures Formation and South Wales Lower Coal Measures Formation (Undifferentiated mudstone, siltstone, sandstone, coal, ironstone and ferricrete) **Superficial Geology:** Not present **Soils:** Slowly permeable seasonally wet acid loamy and clayey soils
Aquifer Status	**Bedrock Geology:** Mainly Secondary A Aquifer, with small strip of Principal Aquifer present to west **Superficial Geology:** Partly Secondary A Aquifer
Source Protection Zone	Not present
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off, 10.03 l/s/ha Attenuation 42228m3, 720 minute winter storm is critical duration. It is assumed however that the site would be developed in sections, therefore future attenuation should be designed to the run-off limit above of 10.03 l/s/ha with consideration for the entire site's attenuation requirements.
Potential SuDS	Attenuation ponds, Swales, Filter drains, Permeable Paving (with lining), Wetlands, Green roofs, Rainwater harvesting. The potential for a cascade of SuDS features should be explores due to the size of the site, which may affect volumes
Indicative costs	Estimate of £485,000 per pond measuring 25,000.

A9 Moira Rd

Location	Ashby
Site Reference	A9
Site Description	Moira Road, Ashby. Steeply sloping site with the road on the frontage at the higher level. Site enclosed partly by mature hedges and is adjoined to the east by housing and also faced housing on the opposite side of Moira Road.
Size	2.56ha
Grid Reference	434638 316476
Current Use	Agriculture
Land Use Type	Greenfield
Proposed number of dwellings	85 (at 30 dph)
Proposed development status	The site is being promoted by a housebuilder (Bloor Homes)
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Potentially agricultural underdrainage? No sewers
Nearest Watercourse	Unnamed watercourse of Saltersford Brook on western boundary
Underlying Geology & Soils	**Bedrock Geology:** Pennine Lower Coal Measures Formation and South Wales Lower Coal Measures Formation (Undifferentiated mudstone, siltstone, sandstone, coal, ironstone and ferricrete) **Superficial Geology:** Not present **Soils:** Slowly permeable seasonally wet acid loamy and clayey soils
Aquifer Status	**Bedrock Geology:** Mainly Secondary A Aquifer, with small strip of Principal Aquifer present **Superficial Geology:** Not present
Source Protection Zone	Not present
Infiltration Potential	Medium/Low based on soils description
Drainage Requirement	Limited to Greenfield run-off, 10.6 l/s/ha Attenuation of 1020 m^3 required for 480 minute storm duration
Potential SuDS	Attenuation ponds, Swales, Filter drains, Permeable Paving (with lining), Wetlands, Green roofs, Rainwater harvesting
Indicative costs	Estimate costs would be between £18,000 and £61,000 for construction based on pond SuDS feature

C18 Land at Thornborough Road, New Swannington

Location	Coalville
Site Reference	C19
Site Description	Land at Thornborough Road, New Swannington
Size	18.60ha
Grid Reference	443000 315698
Current Use	Agriculture / Allotments
Land Use Type	Greenfield
Proposed number of dwellings	500
Proposed development status	N/A
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Potentially agricultural underdrainage? No sewers on site but adjacent to site.
Nearest Watercourse	Tributary of River Soar runs parallel to site and should be considered for accepting surface water flows
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Not present **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not designated
Source Protection Zone	Total Catchment
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off, 11.42 l/s/ha Manage run-off at source. Discharge excess to nearby tributaries Attenuation of 7829m^3, for critical duration 720 minute winter storm
Potential SuDS	Attenuation techniques: swales, filter strips, ponds, green roofs, rainwater harvesting
Indicative costs	In the region of £114,500 to £209,000 for construction based on pond feature

C19 Stephenson Green

Location	Coalville
Site Reference	C19
Site Description	Stephenson Green, Coalville
Size	114.77ha
Grid Reference	443738 315073
Current Use	Agriculture (Green Wedge)
Land Use Type	Greenfield
Proposed number of dwellings	1800
Proposed development status	William Davis, Jelson, Persimmon, Davidsons. Planning application submitted for part of the site and significant work ongoing for the remaining site to address technical issues with a view to removing all doubts as to delivery
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Potentially agricultural underdrainage? No sewers on site but potentially along surrounding highways
Nearest Watercourse	Unnamed tributary of Long Whatton Brook approx 250 m to north east of site. No obvious watercourse on site for connection. Further investigation needed to determine if flows could go to watercourse or to sewer.
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Diamicton **Soils:** Slowly permeable seasonally wet acid loamy and clayey soils
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not designated
Source Protection Zone	Mainly Total Catchment Small section of site near Hall Lane in NE in SPZ 1 and 2 (Inner and Outer Zone)
Infiltration Potential	Low due to soils description
Drainage Requirement	Limited to Greenfield run-off, 10.82 l/s/ha Manage run-off at source. Discharge excess to nearby tributaries if possible. 49265 m^3 attenuation for 960 minute winter storm critical duration
Potential SuDS	Attenuation ponds, Swales, Filter drains, Permeable Paving (with lining), Wetlands, Green roofs, Rainwater harvesting. The potential for a cascade of SuDS features should be explores due to the size of the site, which may affect volumes Consider using regional SuDS control with other nearby developments if source and site controls not possible
Indicative costs	Estimate of £485,000 per pond measuring 25,000.

C21 Land rear of Bardon Road, Coalville [north]

Location	Coalville
Site Reference	C21
Site Description	Land rear of Bardon Road, Coalville [north]
Size	1.04ha
Grid Reference	443627 313497
Current Use	Agriculture
Land Use Type	Greenfield
Proposed number of dwellings	360 with adjacent site (C22)
Proposed development status	Interest from Wilson homes
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Sewers adjacent to site
Nearest Watercourse	Unnamed tributary of River Sence between C21 and C22 sites
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Diamicton **Soils:** Slowly permeable seasonally wet acid but base rich loamy and clayey soils
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not designated
Source Protection Zone	Total Catchment
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off, 11.65l/s/ha Manage run-off at source, discharge to local watercourses 426m^3 attenuation, 480 minute storm critical duration
Potential SuDS	Attenuation pond and or swales should be sufficient for volume required
Indicative costs	In the region of £18,000 for construction based on pond SuDS feature

C22 Land rear of Bardon Road, Coalville [south]

Location	Coalville
Site Reference	C22
Site Description	Land rear of Bardon Road, Coalville [south]
Size	9.3ha
Grid Reference	443927 313249
Current Use	Agriculture
Land Use Type	Greenfield
Proposed number of dwellings	360 with adjacent site (C21)
Proposed development status	Interest from Wilson homes
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Sewers adjacent to site
Nearest Watercourse	Unnamed tributary of River Sence to north of site should be considered for discharge of surface water
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Diamicton **Soils:** Slowly permeable seasonally wet acid but base rich loamy and clayey soils
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not designated
Source Protection Zone	Total Catchment
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off, 11.88 l/s/ha Manage run-off at source, discharge to local watercourses 3745 m^3 attenuation for 600 minute winter storm critical duration
Potential SuDS	Attenuation ponds, Swales, Filter drains, Permeable Paving (with lining), Wetlands, Green roofs, Rainwater harvesting
Indicative costs	Estimates between £61,000 and £114,500 for construction based on pond SuDS feature

C23 South of Grange Road, Hugglescote

Location	Coalville
Site Reference	C23
Site Description	South of Grange Road, Hugglescote
Size	59.92ha
Grid Reference	444295 312401
Current Use	Agriculture
Land Use Type	Greenfield
Proposed number of dwellings	2600
Proposed development status	
Flood Zone	Mainly Flood Zone 1, Flood Zones 2 and 3 of River Sence within site
FRA Requirements	FRA required as site is greater than 1 ha and includes Flood Zone 2 and 3. Where possible, development within flood zone areas should be avoided. As most of the site boundary is in Flood Zone 1 this should in theory be aheivable. Exception Test will be required if housing development is proposed in Flood Zone 3.
Existing Drainage	Potentially agricultural underdrainage? No sewers on site.
Nearest Watercourse	Unnamed tributary of and River Sence run through the site. These should be considered for careful disposal of surface water
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Diamicton **Soils:** Slowly permeable seasonally wet acid loamy and clayey soils
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Secondary A Aquifer in small sections
Source Protection Zone	Partly Total Catchment, remaining is undesignated
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off, 11.66 l/s/ha Manage run-off at source, discharge to local watercourses 25102m^3 attenuation for entire site required, critical duration 720 minute winter storm. It is assumed however that the site would be developed in sections, therefore future attenuation should be designed to the run-off limit above of 11.66l/s/ha
Potential SuDS	Attenuation ponds, Swales, Filter drains, Permeable Paving (with lining), Wetlands, Green roofs, Rainwater harvesting. The potential for a cascade of SuDS features should be explores due to the size of the site, which may affect volumes
Indicative costs	Estimate of £485,000 for construction costs of pond measuring 25,000.

C26 Berryhill Lane (west)

Location	Coalville
Site Reference	C26
Site Description	Berryhill Lane, Donington le Heath. Agricultural land to the north of a small ribbon of residential properties fronting Berry Hill Lane.
Size	5.58ha
Grid Reference	441511 312739
Current Use	Agriculture
Land Use Type	Greenfield
Proposed number of dwellings	167
Proposed development status	N/A
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Unknown, assume no drainage. No sewers on site.
Nearest Watercourse	River Sence and tributary present approximately 300 to 400 metres to north and south of site. Should be potentially considered for surface water discharge depending on potential to cross neighbouring land to reach channels. Site may require infrastructure if cannot discharge to drains/ground
Underlying Geology & Soils	**Bedrock Geology:** Pennine Lower Coal Measures and South Wales Lower Coal Measures Formations **Superficial Geology:** Diamicton **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Some Secondary A Aquifer in small sections
Source Protection Zone	Not present
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off, 11.18 l/s/ha Manage run-off at source, discharge to local watercourses 2246m^3 attenuation required for 720 minute winter storm critical duration
Potential SuDS	Attenuation ponds, Swales, Filter drains, Permeable Paving (with lining), Wetlands, Green roofs, Rainwater harvesting Consider using regional SuDS control with other nearby developments if source and site controls not possible
Indicative costs	Estimates in the region of £61,000 for construction based on pond SuDS feature

C27 Berryhill Lane (East)

Location	Coalville
Site Reference	C27
Site Description	Berryhill Lane, Donington le Heath. The site is immediately to the west of the present extent of development in Donington le Health
Size	8.86ha
Grid Reference	441645 313076
Current Use	Agriculture
Land Use Type	Greenfield
Proposed number of dwellings	350
Proposed development status	Market interest achievable
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Potentially agricultural underdrainage? No sewers on site.
Nearest Watercourse	River Sence and tributary present approximately 300 to 400 metres to north and south of site. Should be potentially considered for surface water discharge depending on potential to cross neighbouring land to reach channels. Site may require infrastructure if cannot discharge to drains/ground
Underlying Geology & Soils	**Bedrock Geology:** Partly Pennine and South Wales Lower Coal Measures Formation and partly Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Not present **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Secondary A Aquifer in small sections
Source Protection Zone	Not present
Infiltration Potential	Low, see soils description
Drainage Requirement	Limited to Greenfield run-off, 11.20 l/s/ha Manage run-off at source, discharge to local watercourses 3524m^3 attenuation for critical duration of 720 minutes winter storm
Potential SuDS	Attenuation ponds, Swales, Filter drains, Permeable Paving (with lining), Wetlands, Green roofs, Rainwater harvesting Consider using regional SuDS control with other nearby developments if source and site controls not possible
Indicative costs	Estimates between £61,000 and £114,500 for construction based on pond SuDS feature

C28 Land at Wolsey Road

Location	Coalville
Site Reference	C28
Site Description	Land at Wolsey Rd, Coalville
Size	2.06ha
Grid Reference	442345 314511
Current Use	No information available
Land Use Type	Brownfield (from OS mapping)
Proposed number of dwellings	62
Proposed development status	No info
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Sewers on site, brownfield site
Nearest Watercourse	No obvious watercourses nearby, may be able to use existing infrastructure? Preference would be to separate surface water flows from foul flows.
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Not present **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not designated
Source Protection Zone	Not present
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to brownfield run-off, 167.46 l/s/ha Manage run-off at source, discharge to local watercourses if possible. 4637m^3 of attenuation would be required to limit run-off to calculated brownfield rate, and for critical duration storm of 240minutes. Developers should check with Severn Trent if discharging to sewers to ensure capacity exists, and will need to revise storage calculations accordingly. The developer should aim to separate surface water flows from the sewerage system and from foul flows.
Potential SuDS	Attenuation ponds, Swales, Filter drains, Permeable Paving (with lining), Wetlands, Green roofs, Rainwater harvesting Consider using regional SuDS control with other nearby developments if source and site controls not possible
Indicative costs	Estimates between £61,000 and £114,500 for construction based on pond SuDS feature

C29 Owen Street Allotments.

Location	Coalville
Site Reference	C29
Site Description	Owen Street Allotments, Coalville. Site is adjacent to urban areas with Industrial and housing in the immediate vicinity.
Size	5.79ha
Grid Reference	442034 313755
Current Use	Allotments
Land Use Type	Greenfield
Proposed number of dwellings	173
Proposed development status	Promoted by Andrew Granger
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Flood Zone	Flood Zone 1
Existing Drainage	No drainage, no sewers on site
Nearest Watercourse	Small drain adjacent to site boundary, consider discharging surface water here, to connect to tributary of R Sence
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Diamicton **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not designated
Source Protection Zone	Not designated
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off, 11.31l/s/ha Manage run-off at source, discharge to watercourse 2272m^3 attenuation for critical duration 480 minute winter storm
Potential SuDS	Attenuation ponds, Swales, Filter drains, Permeable Paving (with lining), Wetlands, Green roofs, Rainwater harvesting
Indicative costs	Estimates in the region of £61,000 for construction based on pond SuDS feature

C30 South of Ravenstone Road

Location	Coalville
Site Reference	C30
Site Description	South of Ravenstone Road, Coalville. Agricultural land bounded by low hedges. Adjaent to other land to the east and north being promoted for housing.
Size	27.58ha
Grid Reference	441243 313496
Current Use	Agricultural
Land Use Type	Greenfield
Proposed number of dwellings	527
Proposed development status	Promoted by Bellway Homes
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	No formal drainage, but sewer runs through site
Nearest Watercourse	Potential small drain to connect to, approximately 300m south of site, tributary of R Sence
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Not present **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not designated
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off, 11.20 l/s/ha Manage run-off at source, discharge to watercourse 10856 m^3 attenuation for 720 minute winter storm (critical duration)
Potential SuDS	Attenuation ponds, Swales, Filter drains, Permeable Paving (with lining), Wetlands, Green roofs, Rainwater harvesting
Indicative costs	Estimates of £209,000 for construction based on pond SuDS feature

C31 Ravenstone Road

Location	Coalville
Site Reference	C31
Site Description	Land south of Ravenstone Road, Coalville. Agricultural land with low hedges faced by housing on the opposite site of Ravenstone Road and adjacent to Industrial land to the east.
Size	7.09ha
Grid Reference	441325 314192
Current Use	Agricultural
Land Use Type	Greenfield
Proposed number of dwellings	212
Proposed development status	Site promoted on behalf of St Modwens. No housebuilder.
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	No formal drainage but sewer adjacent to south of site
Nearest Watercourse	Tributary of River Sence approximately 800m south of site No obvious watercourse to connect to near site.
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Not present **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not designated
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off, 11.14 l/s/ha Manage run-off at source, discharge to watercourse 2835 m^3 attenuation for the 480 minute critical storm (winter)
Potential SuDS	Attenuation ponds, Swales, Filter drains, Permeable Paving (with lining), Wetlands, Green roofs, Rainwater harvesting Consider using regional SuDS control with other nearby developments if source and site controls not possible
Indicative costs	Estimates in the region of £61,000 for construction based on pond SuDS feature

C40 Standard Hill

Location	Coalville
Site Reference	C40
Site Description	Standard Hill, Coalville. Agricultural land with access available onto Standard hill and Highfield Street.
Size	5.97ha
Grid Reference	441541 313383
Current Use	Agriculture / Scrubland
Land Use Type	Greenfield
Proposed number of dwellings	500
Proposed development status	Miller Homes
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Potentially agricultural underdrainage? No sewers on site but present in urban areas next to site
Nearest Watercourse	Unnamed tributary of River Sence runs through site and should be considered for discharging surface water to at greenfield rates
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Not present **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not designated
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off, 11.20 l/s/ha Manage run-off at source, discharge to watercourse 2376 m^3 for 720 minute winter storm (Critical duration)
Potential SuDS	Attenuation ponds, Swales, Filter drains, Permeable Paving (with lining), Wetlands, Green roofs, Rainwater harvesting
Indicative costs	Estimates in the region of £61,000 for construction based on pond SuDS feature

C41 Terex Pegson Site

Location	Coalville
Site Reference	C41
Site Description	Terex Pegson, Whitwick Road, Coalville. Now part vacant industrial site.
Size	4.88 ha
Current Use	Industrial / Commercial
Land Use Type	Brownfield / Previously Developed Land (PDL)
Proposed number of dwellings	146
Proposed development status	Unknown
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Likely to have existing drainage
Nearest Watercourse	unknown, may have to drain to sewer
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Not present **Soils:** Slightly acid loamy and clayey soils with impeded drainage, likely to be overlain by made ground
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not designated
Infiltration Potential	Low based on soils description and PDL
Drainage Requirement	Limited to brownfield run-off, 171.70 l/s/ha Manage run-off at source, estimated attenuation of 1064m^3 required for 30minute winter storm (critical duration). However, if discharging to existing drain, developer will need to contact Severn Trent Water to determine if capacity exists in system.
Potential SuDS	Attenuation ponds and or swales might be sufficient. Consider lined permeable paving, Green roofs, Rainwater harvesting Consider using regional SuDS control with other nearby developments if source and site controls not possible
Indicative costs	Estimates in the region of between £18,000 to 61,000 for construction based on pond SuDS feature

CD4 Castle Donington

Location	Castle Donington
Site Reference	CD4
Site Description	South of Park Lane, Agricultural land with mature hedges. Residential properties adjoin the site to the north east. Opposite the site is agricultural land with planning permission for housing..
Size	47.46ha
Grid Reference	443523 327027
Current Use	Agriculture
Land Use Type	Greenfield
Proposed number of dwellings	975
Proposed development status	Miller Homes Planning Application under consideration
Flood Zone	Mainly Flood Zone 1, field in very northern section adjacent to Back Lane in Flood Zone 3 of River Trent
FRA Requirements	FRA required as site is greater than 1 ha and within Flood Zone 3 (only in very northern section). The majority of the site is in Flood Zone 1 therefore this part of the site should be prioritised for development. Nevertheless at greater than 1 ha an FRA will be required to consider surface water drainage. Development should avoid Flood Zone 3. Exception Test required if housing proposed in Flood Zone 3.
Existing Drainage	Potentially agricultural underdrainage? No sewers on site
Nearest Watercourse	Stud Brook flows along western boundary and through one field in west of site. This should be used for discharge of surface water at existing greenfield rates.
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Interbedded Sandstone and Conglomerate, with Triassic Mudstone, siltstone and Sandstone in northern corner **Superficial Geology:** Alluvial clay silt and sand present north of Park Lane, no deposits south of Park Lane **Soils:** Freely draining slightly acid loamy soils
Aquifer Status	**Bedrock Geology:** Mainly Principal Aquifer, very northern section adjacent to Back Lane Secondary A Aquifer **Superficial Geology:** Not designated except for very northern section adjacent to Back Lane, Secondary A Aquifer
Source Protection Zone	Not present
Infiltration Potential	High to Medium based on soils description. Soakaway tests required on site.
Drainage Requirement	Limited to Greenfield run-off, 10.19 l/s/ha Attenuation of 18467m^3 for 720 minute winter storm critical duration. If infiltration used, the attenuation required would be 11343m^3 for the 60 minute winter storm. On site soakaway tests are required to confirm the infiltration rate to inform any drainage design.
Potential SuDS	Attenuation ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting. Infiltration could be used if on site soakaway tests demonstrate appropriate infiltration rates and groundwater levels: infiltration basins and trenches, soakaways, permeable paving The potential for a cascade of SuDS features should be explored due to the size of the site, which may affect volumes
Indicative costs	Estimate of £485,000 per pond measuring 25,000m^3.

CD1 Towles Pasture

Location	Castle Donington
Site Reference	CD1
Site Description	Towles Pasture, Castle Donington
Size	0.53ha
Grid Reference	444272 327164
Current Use	Residential cartilage / paddock with mature hedgerows
Land Use Type	Greenfield
Proposed number of dwellings	16
Proposed development status	
Flood Zone	Flood Zone 1
FRA Requirements	FRA would not be required by the EA as site is less than 1 ha. However developer should aim to control surface water drainage to Greenfield rates (see Drainage Requirements section).
Existing Drainage	Site within urban area therefore sewers located in adjacent streets
Nearest Watercourse	Tributary of Lockington Brook? Located approximately 1 km to east. May require infrastructure for drainage
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Interbedded Sandstone and Conglomerate **Superficial Geology:** Not present **Soils:** Freely draining slightly acid loamy soils
Aquifer Status	**Bedrock Geology:** Principal Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not present
Infiltration Potential	High to Medium based on soils description
Drainage Requirement	PPS25 only requires developments greater than 1 hectare to provide a drainage impact assessment. However, limiting run-off from this site to greenfield rates will also prevent any increases in the drainage system Greenfield run-off is 10.13 l/s/ha. Attenuation 196m^3 for 480 minute winter storm. Infiltration techniques should be used if rates are suitable. Indicative volume of 123m^3 required for infiltration basin. Soakaway tests will be required to inform any design of infiltration techniques.
Potential SuDS	Recommended provided on site through landscaping using swales, filter drains and permeable paving, with additional ponds if required
Indicative costs	Less than £18,000 for pond construction

K2 Computer Centre, Derby Rd

Location	Kegworth
Site Reference	K2
Site Description	Computer Centre, Derby Road, Kegworth. Existing Compute/ RBS Data centre and land to the rear which slopes steeply up to housing development.
Size	4.61
Grid Reference	448042 327089
Current Use	Offices
Land Use Type	PDL
Proposed number of dwellings	272
Proposed development status	
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Sewer runs adjacent to site
Nearest Watercourse	River Soar, no obvious watercourse near site to connect to
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone with some interbedded sandstone and conglomerate **Superficial Geology:** Not present **Soils:** Freely draining slightly acid loamy soils
Aquifer Status	**Bedrock Geology:** Partly Principal Aquifer and partly Secondary B Aquifer **Superficial Geology:** Undifferentiated secondary aquifer
Source Protection Zone	Not present
Infiltration Potential	Medium/High based on soils description
Drainage Requirement	Limited to brownfield run-off, 167.64 l/s/ha, however if discharging to sewer, developer must consult with Severn Trent to determine pipe capacity for receiving flows. Attenuation of 1003 m^3 required for 30 minute winter storm critical duration.
Potential SuDS	Swales, ponds, permeable paving Soils description suggests soils are permeable, however site is brownfield so made ground likely to be present, limiting potential for infiltration techniques. Developer should demonstrate why infiltration might not be suitable
Indicative costs	Assuming a pond required, costs could range between £18,000 and £61,000

K4 Adjacent to Cott Factory

Location	Kegworth
Site Reference	K4
Site Description	Field adjacent to Cott Factory
Size	2.89ha
Grid Reference	448290 327285
Current Use	Agriculture
Land Use Type	Greenfield
Proposed number of dwellings	86
Proposed development status	Application under consideration, FRA has been accepted by EA
Flood Zone	Flood Zone 3 of River Soar
FRA Requirements	FRA appears to have already been submitted and accepted by EA.
Existing Drainage	Potentially agricultural underdrainage? No sewers?
Nearest Watercourse	Unnamed tributary of River Soar flows through site
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone with some interbedded sandstone and conglomerate **Superficial Geology:** Not present **Soils:** Freely draining slightly acid loamy soils
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Secondary A Aquifer
Source Protection Zone	Not present
Infiltration Potential	Medium/High based on soils description
Drainage Requirement	Limited to Greenfield run-off, 9.94 l/s/ha Attenuation of 1136m^3 required for critical duration 480 minute winter storm If infiltration can be used, volume required on site would be reduced. Indicative calculations suggest a volume of 687m^3 would be required for the 60 minute winter critical storm
Potential SuDS	Recommended provided on site through landscaping using swales, filter drains and permeable paving, with additional ponds if required
Indicative costs	Costs likely to be in the region of £18,000 an upwards for pond construction

K7 Ashby Road

Location	Kegworth
Site Reference	K7
Site Description	North of Ashby Road, Kegworth. Agricultural land in close proximity to the M1 Motorway. To the east are existing dwellings in Kegworth.
Size	10.89ha
Grid Reference	447644 326818
Current Use	Agriculture / scrubland
Land Use Type	Greenfield
Proposed number of dwellings	140
Proposed development status	Promoted by Hallam Land
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Greenfield site
Nearest Watercourse	River Soar , no obvious channel near site to connect to
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Alluvial clay, silt and sand **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Parts of Principal, Secondary A, Secondary B Aquifer present **Superficial Geology:** Not present
Source Protection Zone	Not present
Infiltration Potential	Medium/Low based on soils description
Drainage Requirement	Limited to Greenfield run-off, 9.98 l/s/ha Attenuation of 4305m^3 for 720 minute winter storm critical duration
Potential SuDS	Attenuation likely to be more suitable: ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting.
Indicative costs	Pond construction costs in the order of £114,500

Ib 10 Land rear of Leics Rd

Location	Ibstock
Site Reference	Ib10
Site Description	Land rear of Leicester Road, Ibstock
Size	8.30ha
Grid Reference	441176 311012
Current Use	Brickworks
Land Use Type	Brownfield, but currently mainly permeable surfaces
Proposed number of dwellings	200 - 240
Proposed development status	Interest from David Wilson hones
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Existing sewerage close to site
Nearest Watercourse	Tributary of Ibstock Brook approximately 500m south of site River Sence approximately 1 km north of site
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Diamicton **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not present
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Brownfield run-off, 169.34 l/s/ha, requires 1817m3 attenuation for 30 minute winter storm (critical duration) Requires assessment of drainage capacity
Potential SuDS	Attenuation likely to be more suitable: ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting.
Indicative costs	Pond construction costs in the order of £61,000

Ib15 Station Rd

Location	Ibstock
Site Reference	Ib15
Site Description	Land at Station Road. Site is on the south western edge of the village and has an urban edge character adjoined by existing housing.
Size	4.71ha
Grid Reference	440087 309970
Current Use	Agricultural
Land Use Type	Greenfield
Proposed number of dwellings	135 (40 dpa)
Proposed development status	
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Existing sewerage close to site
Nearest Watercourse	Ibstock Brook approximately 600m south of site River Sence approximately 700 m west of site
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Diamicton **Soils:** Freely draining slightly acid loamy soils
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not present
Infiltration Potential	Medium based on soils description
Drainage Requirement	Limited to Greenfield run-off, 11.01 l/s/ha 1891 m^3 attenuation needed for 480 minute winter storm 1144m^3 volume for infiltration basin for 60 minute winter storm (on site soakaway tests needed to confirm infiltration rate).
Potential SuDS	Attenuation ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting. Infiltration could be used if on site soakaway tests demonstrate appropriate infiltration rates and groundwater levels: infiltration basins and trenches, soakaways, permeable paving
Indicative costs	Pond construction costs in the order of £18,000 to £61,000

Ib16 South of Ashby Road

Location	Ibstock
Site Reference	Ib16
Site Description	Land at Ashby Road, Ibstock (south)
Size	8.50ha
Grid Reference	440052 310506
Current Use	Countryside
Land Use Type	Greenfield
Proposed number of dwellings	285
Proposed development status	Interest from Bellway Hones
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Existing sewerage close to site
Nearest Watercourse	River Sence approximately 400m west of site
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Diamicton **Soils:** Freely draining slightly acid loamy soils
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not present
Infiltration Potential	Medium based on soils description
Drainage Requirement	Limited to Greenfield run-off, 11.14 l/s/ha 3368m^3 attenuation required for 720 minute winter storm (critical duration) If infiltration techniques are used, volume could be reduced to 2028m^3 for the 60 minute winter storm. On site soakaway tests would be needed to determine site specific infiltration rates.
Potential SuDS	Attenuation ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting. Infiltration could be used if on site soakaway tests demonstrate appropriate infiltration rates and groundwater levels: infiltration basins and trenches, soakaways, permeable paving
Indicative costs	Pond construction costs in the order of £61,000

Ib18 Melbourne Rd / Leics Rd

Location	Ibstock
Site Reference	Ib18
Site Description	Melbourne Road / Leicester Road, Ibstock
Size	20.11ha
Grid Reference	440909 311393
Current Use	Agriculture / Countryside
Land Use Type	Greenfield
Proposed number of dwellings	300
Proposed development status	Promoted by a planning agent
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Existing sewerage close to site
Nearest Watercourse	River Sence approximately 300 m north and west of site
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Diamicton **Soils:** Freely draining slightly acid loamy soils
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not present
Infiltration Potential	Medium based on soils description
Drainage Requirement	Limited to Greenfield run-off, 10.93 l/s/ha 7926m^3 attenuation required for 720 minute winter storm
Potential SuDS	
Indicative costs	

M1 Youth Club

Location	Measham
Site Reference	M1
Site Description	Former Youth Club and land west of High Street, Measham. Site forms part of the Canal basin proposed to be restored.
Size	1.37ha (from tables)
Grid Reference	
Current Use	Youth Club / Countryside / Canal basin
Land Use Type	Mixed
Proposed number of dwellings	18
Proposed development status	-
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Likely to be existing STW drainage
Nearest Watercourse	River Mease approximately 700m south west of site. Advise on using SuDS on site to reduce run-off, and separate surface water from foul water if using existing sewers
Underlying Geology & Soils	**Bedrock Geology:** Permian Rocks (undifferentiated) - Interbedded Sandstone and Conglomerate **Superficial Geology:** Not present **Soils:** Freely draining slightly acid sandy soils
Aquifer Status	**Bedrock Geology:** Principal Aquifer **Superficial Geology:** Not present
Source Protection Zone	Total Catchment
Infiltration Potential	Medium/High based on soils description
Drainage Requirement	Limited to Greenfield run-off, 10.15 l/s/ha to provide betterment 528m^3 attenuation required for the 480 minute winter storm (critical duration) Infiltration techniques should be investigated for this site as soils description suggests they might be suitable. However it depends on existing made ground coverage and results of on site soakaway tests.
Potential SuDS	Attenuation likely to be more suitable: ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting.
Indicative costs	Pond construction costs in the order of £18,000

M6 Measham Brickworks

Location	Measham
Site Reference	M6
Site Description	Land adjacent Atherstone Road, Measham. Existing brickworks on southern edge of the village
Size	34.77ha
Grid Reference	433601 311107
Current Use	Residential (? Stated in SHLAA, from mapping appears to be brickworks and greenfield)
Land Use Type	Brownfield
Proposed number of dwellings	410
Proposed development status	Strong market interest
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Likely to be existing STW drainage
Nearest Watercourse	River Mease approximately 300m south of site. Advise on using SuDS on site to reduce run-off, but must ensure quality is sufficient to discharge to Mease.
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Interbedded Sandstone and Conglomerate **Superficial Geology:** Not present **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Principal Aquifer **Superficial Geology:** Not present
Source Protection Zone	Total Catchment
Infiltration Potential	Low based on soils description
Drainage Requirement	If limited to brownfield run-off, 172.64 l/s/ha 6344 m^3 attenuation required for this limiting discharge rate, for the 30 minute winter storm (critical duration). However it is likely that any redevelopment will use the existing infrastructure (in which case the capacity of the infrastructure should be assessed) or to the River Mease, (in which case greenfield limits should be applied). If limited to greenfield run-off for entire site, 10.06 l/s/ha Attenuation of 13659m^3 required for 480 minute winter storm
Potential SuDS	Attenuation ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting.
Indicative costs	Pond construction costs in the order of £114,500 to £209,000

M8 Bosworth Road

Location	Measham
Site Reference	M8
Site Description	Land rear of Bosworth Road, Measham. Existing Nursey adjoined by housing and open countryside.
Size	2.55ha
Grid Reference	433727 311830
Current Use	Nursery
Land Use Type	Greenfield
Proposed number of dwellings	77 (from tables)
Proposed development status	Interest from Wilson's Homes
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Sewers in road to north of site
Nearest Watercourse	Field drain approximately 350m east of site. River Mease approximately 1 km south of site. Advise on using SuDS on site to reduce run-off, but must ensure quality is sufficient to discharge to Mease.
Underlying Geology & Soils	**Bedrock Geology:** Permian Rocks (undifferentiated) - Interbedded Sandstone and Conglomerate **Superficial Geology:** Not present **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Principal Aquifer **Superficial Geology:** Not present
Source Protection Zone	Total Catchment
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off to 10.15 l/s/ha Attenuation of 985m^3 needed for 480 minute winter storm (critical duration)
Potential SuDS	Attenuation likely to be more suitable: ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting.
Indicative costs	Pond construction costs between £18,000 and £61,000

M9 Adjacent A42 / Canal Basin,

Location	Measham
Site Reference	M9
Site Description	Youth Club / Sports Ground / A42. Large area of land enclosed by housing on three sites and the A42 to the north west.
Size	20.26ha
Grid Reference	432806 312304
Current Use	Agriculture
Land Use Type	Mixed
Proposed number of dwellings	350 - 400
Proposed development status	Market Interest
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Sewers in road to south of site
Nearest Watercourse	Small drain (tributary of River Mease) in north west corner of site, should be considered for discharge of surface of water. Site survey needed to confirm location and suitability. Advise on using SuDS on site to reduce run-off, but must ensure quality is sufficient to discharge to Mease.
Underlying Geology & Soils	**Bedrock Geology:** Part Permian Rocks (undifferentiated) - Interbedded Sandstone and Conglomerate and part Triassic Rocks (Undifferentiated) - Interbedded Sandstone and Conglomerate **Superficial Geology:** Not present **Soils:** Freely draining slightly acid sandy soils
Aquifer Status	**Bedrock Geology:** Principal Aquifer **Superficial Geology:** Not present
Source Protection Zone	Total Catchment
Infiltration Potential	Medium/high based on soils description
Drainage Requirement	Limited to Greenfield run-off, 10.15 l/s/ha Attenuation of 7866m^3 required for 480 minute winter storm critical duration. Soils suggest infiltration may be possible. Volume could potentially be reduced to 4908m^3 for infiltration techniques assuming infiltration basin used, and for 60 minute winter storm.
Potential SuDS	Attenuation ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting. Infiltration could be used if on site soakaway tests demonstrate appropriate infiltration rates and groundwater levels: infiltration basins and trenches, soakaways, permeable paving etc
Indicative costs	Pond construction costs in the order of £114,500 to £209,000

M11 Adjacent A42 / Canal Basin,

Location	Measham
Site Reference	M11
Site Description	Leicester Road / Grassy Lane. Ribbon of housing on the north eastern edge of the village abuts the site to the south.
Size	12.01ha
Current Use	Agriculture
Land Use Type	Greenfield
Proposed number of dwellings	360
Proposed development status	Strong Market Interest
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Sewers in road to south of site
Nearest Watercourse	Field drain in field south of site and road. River Mease approximately 1.3km south east of site
Underlying Geology & Soils	**Bedrock Geology:** Pennine Middle Coal Measures Formation And South Wales Middle Coal Measures Formation (Undifferentiated) **Superficial Geology:** Not present **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Part Principal Aquifer, part Secondary A Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not designated
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off of 10.2 l/s/ha 4735 m^3 attenuation required for 480 minute winter storm (critical duration)
Potential SuDS	Attenuation likely to be more suitable: ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting.
Indicative costs	Pond construction costs in the order of £114,500

Mo4 Measham Road

Location	Moira
Site Reference	Mo4
Site Description	Land off Measham Road, Moira. An undulating Greenfield site. Pasture land with fields segregated by hawthorn hedges.
Size	6.35ha
Grid Reference	431743 315510
Current Use	Agriculture
Land Use Type	Greenfield
Proposed number of dwellings	191
Proposed development status	Site promoted by landowner and has been subject to pre application discussions.
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Existing STW drainage in adjacent highways
Nearest Watercourse	Hooborough Brook approximately 750m south west of site. Ashby de la Zouch canal approximately 50m south west of site.
Underlying Geology & Soils	**Bedrock Geology:** Pennine Upper Coal Measures Formation - Mudstone, Siltstone, Sandstone, Coal, Ironstone and Ferricrete **Superficial Geology:** Not present **Soils:** Slowly permeable seasonally wet acid loamy and clayey soils
Aquifer Status	**Bedrock Geology:** Secondary A Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not designated
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off 10.39 l/s/ha Attenuation of 2421m^3 needed for critical duration 480 minute winter storm
Potential SuDS	Attenuation likely to be more suitable: ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting.
Indicative costs	Pond construction costs in the order of £61,000

R7 Church Lane

Location	Ravenstone
Site Reference	R7
Site Description	Land off Church Lane. Relatively flat, arable site, immediately behind the hedge and some trees along the road boundary. The site is adjoined or faced on all sides by open agricultural land except to the south west where there is the end of a row of houses fronting Church Lane.
Size	0.7ha
Grid Reference	440372 314098
Current Use	Agriculture
Land Use Type	Greenfield
Proposed number of dwellings	20
Proposed development status	Strong market interest
Flood Zone	Flood Zone 1
FRA Requirements	FRA would not be required by the EA as site is less than 1 ha. However developer should aim to control surface water drainage to Greenfield rates (see Drainage Requirements section).
Existing Drainage	Sewerage in adjacent Ravenstone
Nearest Watercourse	Blowers Brook approximately 500m west of site.
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone and Sandstone **Superficial Geology:** Diamicton **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not designated
Source Protection Zone	Not designated
Infiltration Potential	Low based on soils description
Drainage Requirement	As site is less than 1 hectare, a drainage assessment would not be required by PPS25. However it is advised that the drainage is designed to limit run-off to the existing greenfield rate of 11.05 l/s/ha, 278m^3 of attenuation would be required for the critical storm of 480 minutes duration.
Potential SuDS	Attenuation likely to be more suitable: ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting.
Indicative costs	Pond construction costs less than £18,000

R8 Church Lane/Main Street

Location	Ravenstone
Site Reference	R8
Site Description	Church Lane / Main Street, Ravenstone
Size	0.75ha
Grid Reference	440348 313874
Current Use	Residential curtilage
Land Use Type	Greenfield, with change to PPS3
Proposed number of dwellings	23
Proposed development status	Strong market interest
Flood Zone	Flood Zone 1
FRA Requirements	FRA would not be required by the EA as site is less than 1 ha. However developer should aim to control surface water drainage to Greenfield rates (see Drainage Requirements section).
Existing Drainage	Sewerage in adjacent Ravenstone
Nearest Watercourse	Blowers Brook approximately 500m west of site.
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone and Sandstone **Superficial Geology:** Diamicton **Soils:** Slightly acid loamy and clayey soils with impeded drainage
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not designated
Source Protection Zone	Not designated
Infiltration Potential	Low based on soils description
Drainage Requirement	As site is less than 1 hectare, a drainage assessment would not be required by PPS25. However it is advised that the drainage is designed to limit run-off to the existing greenfield rate of 11.05 l/s/ha. 293m^3 of attenuation would be required for the critical storm of 480 minutes duration.
Potential SuDS	Attenuation likely to be more suitable: ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting.
Indicative costs	Pond construction costs less than £18,000

Wd1 Mount Pleasant

Location	Woodville
Site Reference	Wd1
Site Description	Woodville Woodlands Phase 5. Earth works underway on site which slopes gently up to the east and has a bank with densely planted trees along the north west boundary.
Size	5.8ha
Grid Reference	431610 318293
Current Use	Former Employment /Industrial Site and still being marketed for employment use.
Land Use Type	Brownfield
Proposed number of dwellings	173
Proposed development status	Strong market interest
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Private surface water sewers nearby may need to be considered for drainage
Nearest Watercourse	Hooborough Brook over 2.5km west of site. No obvious watercourses to discharge to.
Underlying Geology & Soils	**Bedrock Geology:** Pennine Upper Coal Measures Formation - Mudstone, Siltstone, Sandstone, Coal, Ironstone and Ferricrete **Superficial Geology:** Not present **Soils:** Slowly permeable seasonally wet acid loamy and clayey soils
Aquifer Status	**Bedrock Geology:** Part Principal Aquifer, part Secondary A Aquifer **Superficial Geology:** Not designated
Source Protection Zone	Not designated
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to brownfield run-off, 175.16 l/s/ha Attenuation of 1313 m^3 needed for 30 minute critical storm. However, limiting discharge may be significantly lower than calculated brownfield rate, if constrained by capacity of private sewers.
Potential SuDS	Attenuation likely to be more suitable: ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting.
Indicative costs	Pond construction costs between £18,000 and £61,000

AV1 Main Street/Occupation Road

Location	Albert Village
Site Reference	AV1
Site Description	Main Street / Occupation Lane. Significant coalmining influence in the area.
Size	14.84ha
Grid Reference	430564 318408
Current Use	Scrubland / storage and distribution
Land Use Type	Mixed
Proposed number of dwellings	300
Proposed development status	--
Flood Zone	Flood Zone 1
FRA Requirements	FRA required as site is greater than 1 ha to consider surface water drainage.
Existing Drainage	Combined sewers nearby. Drainage should be separated from combined system if possible
Nearest Watercourse	Hooborough Brook over 2.3km west of site. No obvious watercourses to discharge to.
Underlying Geology & Soils	**Bedrock Geology:** Pennine Middle Coal Measures Formation and South Wales Middle Coal Measures Formation (Undifferentiated) **Superficial Geology:** Not present **Soils:** Slowly permeable seasonally wet acid loamy and clayey soils
Aquifer Status	**Bedrock Geology:** Secondary A Aquifer **Superficial Geology:** Not designated
Source Protection Zone	Not designated
Infiltration Potential	Low based on soils description
Drainage Requirement	Limited to Greenfield run-off, 10.67 l/s/ha 5763 m^3 of attenuation required for critical duration storm of 480 minutes
Potential SuDS	Attenuation likely to be more suitable: ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting.
Indicative costs	Pond construction costs in the order of £114,500

Br1 Main Street

Location	Breedon on the Hill
Site Reference	Br1
Site Description	Land South of Main Street and East of The Crescent. The site forms part of site H32 and is within existing limits to development and in the Breedon Conservation Area. The site is undulating and is adjacent to a Brook to the north. There are low power lines running across the site and the boundaries comprise low fencing to the adjacent housing.
Size	0.49ha
Grid Reference	440462 322760
Current Use	Paddock
Land Use Type	Greenfield
Proposed number of dwellings	15
Proposed development status	--
Flood Zone	Flood Zone 1, but Flood Zone 3 mapped to north of site along Main Street
FRA Requirements	FRA would not be required by the EA as site is less than 1 ha. If application boundary includes area of Flood Zone 3, then an FRA would be required. Developer should aim to control surface water drainage to Greenfield rates (see Drainage Requirements section) and be aware of potential flood risk associated with small brook on site.
Existing Drainage	Foul sewer in village
Nearest Watercourse	Small brook immediately north of site, a tributary of Ramsey Brook (in the Lower Trent)
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Not present **Soils:** Freely draining slightly acid loamy soils
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not present
Infiltration Potential	Medium based on soils description
Drainage Requirement	As site is less than 1 hectare, a drainage assessment would not be required by PPS25. However it is advised that the drainage is designed to limit run-off to the existing greenfield rate of 10.52 l/s/ha. If developed as part of Br2, the site would be greater than 1 hectare and would require a drainage assessment/FRA. It has been assumed that the site would be developed at the same time. For attenuation requirements see Br2
Potential SuDS	See Br2
Indicative costs	See Br2

Br2 Brookside Paddock

Location	Breedon on the Hill
Site Reference	Br2
Site Description	Brookside Paddock, Breedon on the Hill. The site includes Br1 and is within existing limits to development and in the Breedon Conservation Area. The site is undulating and is adjacent to a Brook to the north. There are low power lines running across the site and the boundaries comprise low fencing to the adjacent housing.
Size	0.92ha
Grid Reference	440484 322765
Current Use	Paddock
Land Use Type	Brownfield/greenfield
Proposed number of dwellings	27
Proposed development status	Interest from Pegasus
Flood Zone	Flood Zone 1, but Flood Zone 3 mapped to north of site along Main Street
FRA Requirements	FRA would not be required by the EA as site is less than 1 ha. If application boundary includes area of Flood Zone 3, then an FRA would be required. Developer should aim to control surface water drainage to Greenfield rates (see Drainage Requirements section) and be aware of potential flood risk associated with small brook on site.
Existing Drainage	Foul sewer in village
Nearest Watercourse	Small brook immediately north of site, a tributary of Ramsey Brook (in the Lower Trent)
Underlying Geology & Soils	**Bedrock Geology:** Triassic Rocks (Undifferentiated) - Mudstone, Siltstone And Sandstone **Superficial Geology:** Not present **Soils:** Freely draining slightly acid loamy soils
Aquifer Status	**Bedrock Geology:** Secondary B Aquifer **Superficial Geology:** Not present
Source Protection Zone	Not present
Infiltration Potential	Medium based on soils description
Drainage Requirement	Limited to Greenfield run-off, 10.52 l/s/ha, to provide betterment, as attenuation requirements are not onerous 535 m^3 of attenuation is required to attenuate flows from this site **including Br1** to greenfield rates for the 1 in 100 year event, and for critical storm duration of 480 minutes. If infiltration is used, a volume of 340m^3 would be required for the 60 minute winter storm. It is suggested if both sites are developed that they use a combined SuDS system. Infiltration techniques should be used where possible, after carrying out on site soakaway tests.
Potential SuDS	Attenuation ponds, Swales, Filter drains, Wetlands, Green roofs, Rainwater harvesting. Infiltration could be used if on site soakaway tests demonstrate appropriate infiltration rates and groundwater levels: infiltration basins and trenches, soakaways, permeable paving
Indicative costs	Pond construction costs in the order of £18,000

Appendix E
Developer Guidance and Checklists

July 2012
Doc Reg No. 29438d038

Flood Risk Guidance and Checklist for Developers

	Action	Notes
Sites within Flood Zone 1		
1	Ensure FRA is prepared by suitably qualified persons, and where possible is undertaken early in the design process.	By considering flood risk and surface water management early in the process, SuDS can be more efficiently designed into landscaping / green infrastructure / rainwater harvesting requirements etc. and avoids retrofitting / last minute changed to layouts
2	Assess all forms of flood risk to the site	Assessment should consider all forms of flood risk such as surface water / groundwater / infrastructure failure as well as confirming site is in Flood Zone 1. Contact EA and Council to determine flood risks. Refer to Strategic Flood Risk Assessment http://www.nwleics.gov.uk/pages/evidence_base . .
3	Confirm existing surface water arrangements on site	Most sites are likely to be Greenfield. Identify surface water drains / channels. For Brownfield sites contact the sewerage provider to request drainage records.
4	Confirm development type in accordance with Table D.2 of Annex D in PPS25	Housing/residential development type is 'more vulnerable'
5	Determine how surface water will be managed.	The preferred hierarchy of managing surface water drainage from any development is: • infiltration measures • attenuation and discharge to watercourses • If these cannot be met, through discharge to surface water sewers
6	Identify where surface water can be discharged to.	In accordance to hierarchy above, discharge to surface water sewer should only be as a last resort. If discharge to sewer is the only option, contact Severn Trent Water / sewerage owner as early in the process as possible, to determine capacity and limiting discharge rate.
7	Determine limiting discharge rate	• For sites suitable for infiltration, undertake soakaway tests in accordance with BRE Digest 365. • For Greenfield sites discharging to watercourse or sewer, confirm run-off rate using Institute of Hydrology Report 124 for sites less than 200 ha, or Flood Estimation Handbook method for sites greater than 200ha[26] • For brownfield sites discharging to watercourses, confirm run-of rate using the Modified Rational Method. • For brownfield sites discharging to surface water sewer, confirm run-off rate by contacting sewerage provider from receiving pipe capacity and existing site run-off.
8	Devise indicative drainage strategy demonstrating that run-off will not be increased post development.	Use SuDS tables to guide appropriate SuDS types (Appendix D) Ensure sufficient land take for required attenuation Where possible tie in SuDS features with green infrastructure and water efficiency measures (e.g. swales, rainwater butts etc). Follow Developer Guidance (Figure x.1), and design drainage to 100 year storm event and include 30& rainfall increase for climate change. For infiltration SuDS, check aquifer status, groundwater levels and if Source Protection Zone is present, which may limit usage.

[26] Preliminary rainfall runoff management for developments, R&D Technical Report W5-074/A/TR/1 Revision C, Environment Agency 2007

	Action	Notes
9	Submit FRA report with information required as set out in Steps 1 to 8 above, to Council	Cross check all information is included in FRA against Steps 1 to 8 above and PPS25 Practice Guide Checklist (http://www.communities.gov.uk/publications/planningandbuilding/pps25guideupdate Appendix B)
Sites with Flood Zone 2 and/or Flood Zone 3 present		
10	Follow Steps 1 to 9 above. Under Step 2, identify which areas of site are designated as Flood Zone 2 or 3.	Use Environment Agency web map, and / or request the flood map specific to your site area.
11	Design site layout to avoid development in Flood Zone 2 and 3 where possible.	Follow Flood Risk Management Hierarchy and AVOID flood risk where possible by locating development in Flood Zone 1. Preference for more vulnerable (residential) development should be Flood Zone 1, then Flood Zone 2. Only where sites are not available in a lower flood risk zone should Flood Zone 3 be considered.
12	Undertake Sequential Approach to layout	Where development cannot be avoided in the higher flood risk zones, locate less vulnerable parts of the development within these zones, such as car parking etc.
13	Undertake Sequential Test and Exception Test	Where more vulnerable development is proposed in Flood Zone 3, demonstrate that no suitable alternative sites are available, that the development will be safe from flooding and will not increase flood risk elsewhere.
14	Submit FRA report with information required as set out in Steps 1 to 14 above, to Council	Cross check all information is included in FRA against Steps 1 to 14 above and PPS25 Practice Guide Checklist (http://www.communities.gov.uk/publications/planningandbuilding/pps25guideupdate Appendix B)

Water Efficiency Checklist for Developers

Action	Notes	CSH	EA
Design stage		☑	☑
Talk to the local planning authority and Severn Trent Water to ensure they can provide the water supply infrastructure and enough water for the lifetime of your development.	Discuss with the Local Authority whether your development has been taken account of in the North West Leicestershire water cycle study. Don't just assume Severn Trent Water can provide your development with the necessary water and supply infrastructure.		☐
Contact the local Environment Agency office for advice on our consents. You must contact the Environment Agency if you are likely to be: • abstracting water from surface or underground sources; • interrupting the flow or impounding water from a watercourse; • drilling any boreholes within 16m of any flood defence structure; • discharging to a watercourse or into the ground. You must obtain all necessary consents before you start work on the site.	Contact the Environment Agency for valuable information on water resources, water companies, water efficiency and specific supply and infrastructure issues. They can show you maps of Groundwater Source Protection Zones and explain possible restrictions on building in them.		☐
Design your development to at least meet the minimum level of the Code for Sustainable Homes. In North West Leicestershire this will be CSH level 3/4 (105 litres per person per day). Consider water and	Refer to section 2.1 for information on products that can deliver CSH level 3/4 for water. Additional information is available in the Water		☐

Action	Notes	CSH	EA
energy-efficient appliances and fittings in your development such as 'A-rated' washing machines and low or dual-flush toilets.	Technology List[27], and the AECB water standards[28].		
Complete the *Water Efficiency Calculator for New Dwellings*[29] internal potable water use for each dwelling which has a different specification.		☐	
Provide detailed documentary evidence showing the location, details and type of appliances/ fittings that use water in the dwelling including any specific *water reduction equipment* with the capacity / flow rate of equipment.		☐	
Provide a letter of instruction to a contractor/ supplier or a formal letter from the developer giving a specific undertaking, providing sufficient information to allow the water calculations to be completed.		☐	
If your development is large, consider leak-detection, rainwater-harvesting or even rainwater re-use systems. However you must understand their management and maintenance requirements.			☐

Action	Notes	CSH	EA
Post construction stage		☑	☑
For *post construction stage only assessments*, provide Water Efficiency Calculator for New Dwellings and detailed documentary evidence (as listed for design stage) representing the dwellings as built		☐	
OR			
Written confirmation from the developer that the appliances/fittings have been installed as specified in the design stage detailed documentary evidence		☐	
OR		☐	
Where only a letter of instruction is provided with calculations at design stage provide revised calculations and detailed documentary evidence (as listed for design stage) representing the dwellings as built			
OR			
Where different from design stage, provide revised Water Efficiency Calculator for New Dwellings and detailed documentary evidence (as listed for design stage) representing the dwellings as built		☐	
Provide water butts and use drought-resistant landscaping to keep your development looking good.			☐

[27] www.eca-water.gov.uk

[28] AECB Water Standards. Delivering buildings with excellent water and energy performance. Volume 1: The Water Standards. www.aecb.net

[29] The calculation procedures must be carried out in line with the Communities and Local Government (2009) Water Efficiency Calculator for New Dwellings: www.communities.gov.uk/publications/planningandbuilding/watercalculator

Developers should note that the Code for Sustainable Homes recognises only fixed fittings and fixtures such as low-flush WCs and flow restrictors. Devices that can be retrofitted to WCs, such as cistern displacement and flushing reduction, are not recognised by the Code. Such devices may provide reduced water use in existing dwellings, but can be easily removed. Where a building is developed with the intention of letting, and water efficiency requirements are embedded in tenancy agreements, but not physically installed in the building, the CSH level 3/4 credit will not be awarded, particularly where the efficiency savings are expected to come from better than typical practice white goods.

The CSH technical guide has an additional section for developers to demonstrate that rainwater or greywater reuse systems comply with the CSH requirements. However, for North West Leicestershire it is anticipated that most developments will aim to achieve level 3/4 by installing water efficient fixtures and fittings. Where developers intend to deliver water savings through rainwater/greywater systems it is recommended that they refer to the CSH technical guide for further information[30].

[30] Communities and Local Government (November 2010). *Code for Sustainable Homes. Technical Guide.* Available at: http://www.planningportal.gov.uk/uploads/code_for_sustainable_homes_techguide.pdf (Accessed: 8th June 2011).