Stoke-on-Trent City Council Water Cycle Study – Phase 2 Final Report

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City of Stoke-on-Trent

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Revision History

Revision Ref/Date	Amendments	Issued to
S3-P01 - 25/11/2021	Draft Report	Melanie Hughes (SOTCC) Jack Robinson (STW)
A1-C02 – 08/06/2022	Final Report	Melanie Hughes (SOTCC)
A1-C03 – 19/08/2022	Accessibility updates and minor corrections	Melanie Hughes (SOTCC)

Contract

This report describes work commissioned by Stoke-on-Trent City Council in July 2021. Patrick Eweh and Richard Pardoe of JBA Consulting carried out this work.

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Purpose

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Acknowledgements

JBA Consulting would like to thank Stoke-on-Trent City Council, the Environment Agency, and Severn Trent Water for their assistance in preparing this report.

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Executive summary

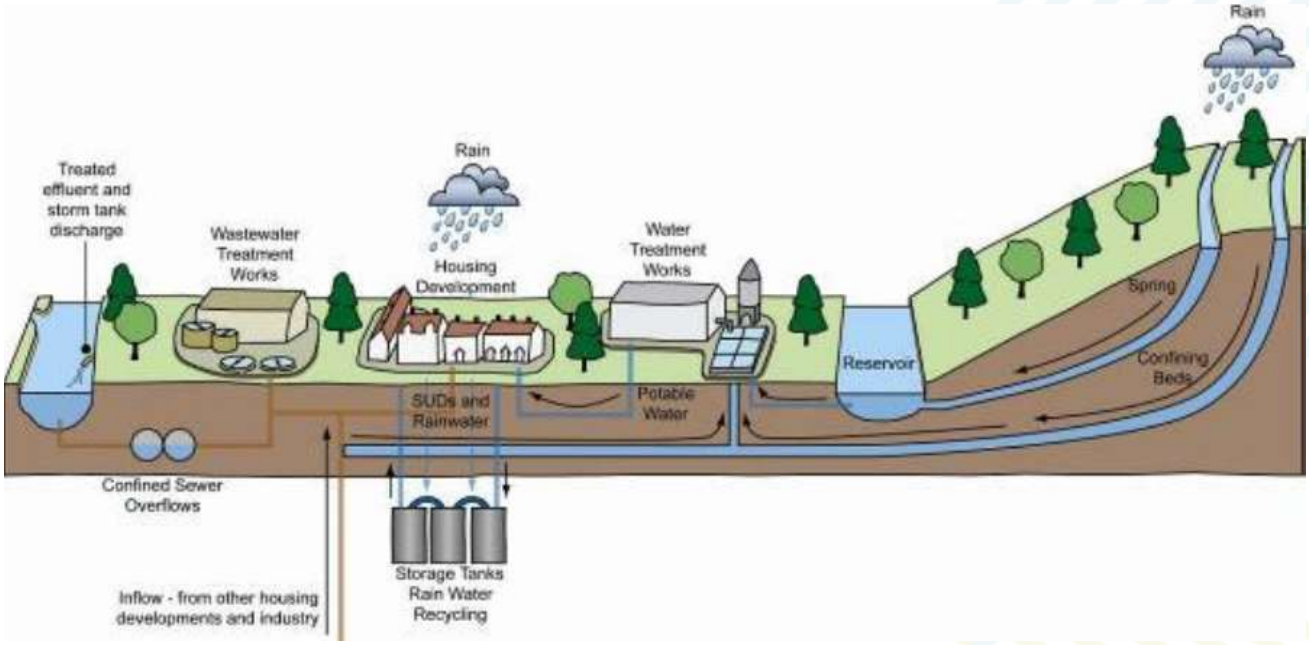
JBA Consulting was commissioned by Stoke-on-Trent City Council (SoTCC) to undertake a Phase 2 Outline Water Cycle Study (WCS) as part of the evidence base for their Local Plan. This builds on the Phase 1 Scoping Study completed in 2019 as a joint study for Newcastle Under Lyme Borough Council and SOTCC which informed the Joint Local Plan. Since the Scoping Study was completed, the decision has been made to produce a separate local plan for each administrative area.

This Phase 2 study is specific to SOTCC and will update the evidence provided in Phase 1 and consider the new plan period of the Stoke-on-Trent Local Plan (2020 – 2040).

New homes and employment land require the provision of clean water, safe disposal of wastewater and protection from flooding. The allocation of development in certain locations may result in the capacity of existing available infrastructure being exceeded, a situation that could potentially cause service failures to water and wastewater customers, adverse impacts to the environment, or high costs for the upgrade of water and wastewater assets being passed on to the bill payers.

In addition to increased demands from housing and employment development, future climate change presents further challenges to the existing water infrastructure network, including increased intensive rainfall events and a higher frequency of drought events. Sustainable planning for water must now take this into account. The water cycle can be seen in the figure below and shows how the natural and man-made processes and systems interact to collect, store or transport water in the environment.

The Water Cycle



Source of diagram: Environment Agency – Water Cycle Study Guidance

The Water Cycle Study has been carried out in co-operation with Severn Trent Water (STW), the Environment Agency, and the neighbouring Local Planning Authorities (LPAs).

Potential development sites were provided by the council and Wastewater Treatment Works (WwTW) likely to serve growth in the area were identified using the Environment Agency Consents database. Each development site was then allocated to a WwTW in order to understand the additional wastewater flow resulting from the planned growth. Available information was collated on water policy and legislation, water resources, water quality, and environmental designations within the study area.

Red / Amber /Green (RAG) assessments have been prepared at the settlement and site scale for the different aspects of the water cycle. It should be remembered that where a development is scored amber or red in a water supply or wastewater infrastructure assessment, it does not mean that development cannot or should not take place in that location, merely that significant infrastructure may be required to accommodate it. The decision on the suitability of sites is made up of a number of assessments outside the scope of this report.

Water Resources – Section 4

Severn Trent Water is responsible for supplying Stoke-on-Trent with water. For the purposes of water resources planning, the STW supply area is divided into 15 Water Resources Zones (WRZs) which vary greatly in scale and have unique water resource concerns. Stoke-on-Trent is covered principally by the North Staffordshire WRZ.

The scoping study presented a summary of the Draft Water Resources Management Plan (WRMP). The Final WRMP published in August 2019 was reviewed for the Phase 2 WCS and there were no significant changes that would impact the WCS.

In Phase 1 STW commented that they had adequate water resources for all proposed development sites. As the overall growth forecast for the area has not changed, this conclusion is still valid.

There is sufficient evidence to support the adoption of the tighter water efficiency target of 110l/p/d allowed for in building regulations. Policies to reduce water demand from new developments, or to go further and achieve water neutrality in certain areas, could be defined to reduce the potential environmental impact of additional water abstractions in Stoke-on-Trent, and also help to achieve reductions in carbon emissions.

Water supply infrastructure – Section 5

No further assessment of water supply infrastructure was undertaken in Phase 2. STW do not typically provide a site-by-site analysis as they do not have a team resourced to carry out such an assessment. They advise that as long as a site is within a water resource zone with sufficient water resources, then they "do not envisage a problem" with supply to that site. They also note that there are no new garden towns or villages proposed, which can prove more of a challenge to supply water to. Where a site is a long distance from the network,

a requisition may be required which is assessed at the time of contact with the developer. The following conclusions from the Phase 1 study are therefore still valid:

- Within the study area, there is enough water resource to supply all the potentially proposed development sites.
- No limitations on the provision of water supply infrastructure were identified by STW.
- A site-by-site assessment has not been completed as part of this study. Individual sites should be assessed as part of the planning process, and early engagement between developers and STW is recommended to ensure that the water supply network has sufficient capacity locally to accommodate the additional demand without detriment to existing customers.

Wastewater collection infrastructure – Section 6

Severn Trent Water provide wastewater services to Stoke-on-Trent. Sewerage Undertakers have a duty under Section 94 of the Water Industry Act 1991 to provide sewerage services and treat wastewater arising from new domestic development. Except where strategic upgrades are required to serve very large or multiple developments, infrastructure upgrades are usually only implemented following an application for a connection, adoption, or requisition from a developer.

Development in areas where there is limited wastewater network capacity will increase pressure on the network, increasing the risk of a detrimental impact on existing customers, and increasing the likelihood of storm overflow operation (where present). The results in section 6.4.1 and 6.4.2 show that for many of the proposed allocations, upgrades to the wastewater or surface water sewer network are required. Early engagement between SOTCC, developers and STW is required to ensure that development sites are aligned with provisions of upgrades to the wastewater network, and further modelling may be required as part of the planning process.

Stoke-on-Trent contains 80 storm overflows, eight of which are operating above the threshold for an investigation to take place. In areas where the current network is a combined sewer system, further separation of foul and surface water may be required as well as suitably designed SuDS.

Wastewater treatment capacity – Section 7

Severn Trent Water operate all of the WwTWs serving growth within Stoke-on-Trent, one of which is outside the study area. STW were provided with a forecast of growth during the plan period and provided an assessment of capacity at each WwTW. JBA also carried out an independent assessment of WwTW capacity based on a comparison of available headroom vs potential growth for each WwTW serving growth in the study area. Both WwTWs are expected to have capacity to accommodate this growth (alongside neighbouring authority growth).

In addition to hydraulic capacity, it is important to consider water quality considerations which are discussed in section 9 and 11.

Odour – Section 8

National Planning Policy Guidance recommends that plan-makers consider whether new development is appropriate near to sites used (or proposed) for water and wastewater infrastructure, due to the risk of odour nuisance. None of the potential allocations identified are close enough to a WwTW for nuisance odour to be a risk. Should further sites be identified, odour risk at these sites should be considered.

Water quality – Section 9

An increase in the discharge of effluent from Wastewater Treatment Works (WwTW) as a result of development and growth in the area in which they serve can lead to a negative impact on the quality of the receiving watercourse. Under the Water Framework Directive (WFD), a watercourse is not allowed to deteriorate from its current WFD classification (either as an overall watercourse or for individual elements assessed). It is Environment Agency (EA) policy to model the impact of increasing effluent volumes on the receiving watercourses.

Water quality modelling was undertaken using the Environment Agency's River Quality Planning (RQP) tool. Two tests were carried out, the first assessed whether increased discharge due to growth is predicted to cause either a 10% deterioration OR a change in WFD class (i.e., a significant deterioration) and a second test assessed whether should water quality upstream be improved in the future, whether growth alone could prevent the river achieving good ecological status under the water Framework Directive.

The modelling showed that growth is unlikely to lead to a significant deterioration in Ammonia, BOD and Phosphate during the plan period, and growth alone will not prevent good ecological status being prevented in the future should improvements in upstream water quality be made.

Flood risk from additional foul flow – Section 10

In catchments with a large, planned growth in population and which discharge effluent to a small watercourse, the increase in the discharged effluent might have a negative effect on the risk of flooding. An assessment has been carried out to quantify such an effect.

The 2020/21 Level 1 and Level 2 Strategic Flood Risk Assessment for Stoke-on-Trent contains a more detailed assessment of flood risk. At each of the estimated point of discharge for WwTWs, the additional flow from growth makes up less than 5% of the Q30 flow and less than 5% of the Q100 flow. The impact of increased effluent flows is not predicted to have a significant impact upon flood risk in any of the receiving watercourses.

Environmental constraints – Section 11

Development has the potential to cause an adverse impact on the environment through a number of routes such as worsening of air quality, pollution to the aquatic environment, or disturbance to wildlife. Of relevance in the context of a Water Cycle Study is the impact of development on the aquatic environment.

A source-pathway-receptor approach was taken to investigate the risk and identify where further assessment or action is required.

Four protected sites (SSSIs) two of which are also designated as SACs are downstream of the study area. Whilst these should be carefully considered in future plan making, the risk of a deterioration in water quality from an increase in wastewater discharge during the plan period is low.

Development sites within Stoke-on-Trent could also be sources of diffuse pollution from surface runoff. SuDS are required on all sites and their design must consider water quality as well as quantity. Runoff from these sites should be managed through implementation of a SuDS scheme with a focus on treating water quality of surface runoff from roads and development sites

Although primarily an urban area, opportunities exist to implement natural flood management techniques to achieve multiple benefits of flood risk, water quality and habitat creation.

Summary of key Water Cycle Study recommendations

Stoke-on-Trent City Council (SOTCC)

- Local Plan to adopt enhanced water efficiency standards (110l/p/d) permitted by National Planning Practice Guidance.
- The concept of water neutrality potentially has a lot of benefit in terms of resilience to climate change and enabling waterbodies to achieve good ecological status under the water framework directive.
- Provide a yearly profile of projected housing growth for use in water company planning.
- Early and continued engagement with Severn Trent Water is required in order to ensure that where upgrades to water supply or wastewater infrastructure is required, it can be planned in to ensure that it is in place prior to occupation of development sites.
- Odour risk should be considered when allocating sites close to WwTWs
- Incorporate water quality criterion into SuDS policy
- Work with developers to discourage connection of new developments into existing surface water and combined sewer networks.
- Opportunities for Natural Flood Management that includes schemes aimed at reducing / managing runoff should be considered to reduce nutrient and sediment pollution alongside reducing flood risk within Stoke-on-Trent.
- Take "no regrets" decisions in the design of developments which contribute to mitigation and adaptation to climate change

Severn Trent Water

- Continue to regularly review housing growth across supply region through WRMP Annual Update Reports, and where significant change is predicted, engage with local planning authorities.
- Take into account the full volume of growth (from SOTCC and neighbouring authorities) within the catchment when considering WINEP schemes or upgrades at WwTWs.
- Advise SOTCC of any strategic water resource infrastructure developments within the authority where safeguarding of land is required.
- Where appropriate, undertake network modelling to ensure adequate provision of water supply and wastewater services.
- Proposals to increase discharges to watercourse may require a flood risk activities environmental permit.

Developers

- Engage with SOTCC and Severn Trent Water early as part of pre-app and app consultations
- Work with STW and the Lead Local Flood Authority closely and early to develop an outline drainage strategy for sites
- Demonstrate to Lead Local Flood Authority and STW that surface water will be disposed of using a sustainable drainage system with connection to foul water sewers seen as a last option.
- Include the design of SuDS at an early stage to maximise the benefits of the scheme, including water quality, biodiversity and amenity benefits where appropriate
- Take "no regrets" decisions in the design of developments which will contribute to mitigation and adaptation to climate change impacts. For example, consider surface water exceedance pathways when designing the layout of developments

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Abbreviations / Glossary

ALS	Abstraction Licensing Strategy
AMP	Asset Management Plan
AMR	Automatic Meter Reading
AONB	Area of Outstanding Natural Beauty
AP	Assessment Point
ASNW	Ancient Semi-Natural Woodland
BIDS	Business, Industrial, distribution and Storage
BOD	Biochemical Oxygen Demand
BREEAM	Building Research Establishment Environmental Assessment Methodology
CAMS	Catchment Abstraction Management Strategies
CAPEX	Capital Expenditure
CED	Common End Date
CFMP	Catchment Flood Management Plan
CfSH	Code for Sustainable Homes
CSO	Combined Sewer Overflow
DCLG	Department of Communities and Local Government (Replaced by MHCLG)
DWF	Dry Weather Flow
DWI	Drinking Water Inspectorate
DWMP	Drainage and Wastewater Management Plan
EA	Environment Agency
EC	European Community
ECA	European Communities Act
EFI	Ecological Flow Indicator
EP	Environmental Permit
EU	European Union
FEH	Flood Estimation Handbook
FFT	Flow to Full Treatment
FWMA	Flood and Water Management Act
FZ	Flood Zone
GIS	Geographic Information Systems
GwR	Greywater Recycling
HOF	Hands-Off Flow
HOL	Hands-off Level
JBA	Jeremy Benn Associates
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority

l/p/d	Litres per person per day
Ml/d	Mega (Million) litres per day
MHCLG	Ministry of Housing Communities and Local Government
NH4	Ammonia
NMP	Nutrient Management Plan
NPPF	National Planning Policy Framework
NuL	Newcastle-Under-Lyme
OAN	Objectively Assessed Need
OfWAT	Water Service Regulation Authority
OPEX	Operational Expenditure
OS	Ordnance Survey
P	Phosphorous
RAG	Red / Amber / Green assessment
RBD	River Basin District
RBMP	River Basin Management Plan
ReFH	Revitalised Flood Hydrograph
RoFSW	Risk of Flooding from Surface Water (replaced uFMfSW)
RQP	River Quality Planning tool
RwH	Rainwater Harvesting
RZ	Resource Zone
SA	Sustainability Appraisals
SAC	Special Area of Conservation
SBP	Strategic Business Plan
SOTCC	Stoke-on-Trent City Council
SEA	Strategic Environmental Assessment
SfA	Sewers for Adoption
SFRA	Strategic Flood Risk Assessment
SHELAA	Strategic Housing and Economic Land Availability Assessment
SHMA	Strategic Housing Market Assessment
SPA	Special Protection Area
SPD	Supplementary Planning Document
SPZ	Source Protection Zone
SS	Suspended Solids
SSSI	Site of Special Scientific Interest
STW	Severn Trent Water
SU	Sewerage Undertaker
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan

UWWTD	Urban Waste Water Treatment Directive
WaSC	Water and Sewerage Company
WCS	Water Cycle Study
WFD	Water Framework Directive
WINEP	Water Industry National Environment Programme
WRMP	Water Resource Management Plan
WRZ	Water Resource Zone
WTW	Water Treatment Works
WwTW	Wastewater Treatment Works

1 Introduction

1.1 Terms of reference

JBA Consulting was commissioned by Stoke-on-Trent City Council (SOTCC) to undertake a Phase 2 Outline Water Cycle Study (WCS) as part of the evidence base for their Local Plan. This builds on the Phase 1 Scoping Study completed in 2019 as a joint study for Newcastle Under Lyme Borough Council and SOTCC.

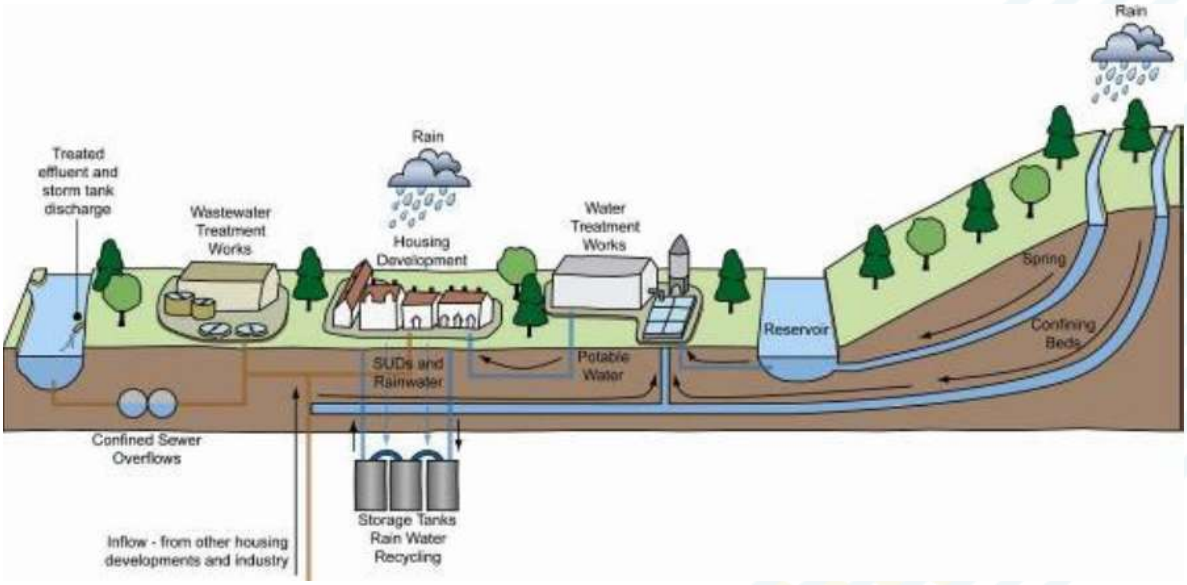
This Phase 2 study is specific to SOTCC and will update the evidence provided in Phase 1 for SOTCC only considering the local plan timeframe of 2020 - 2040.

Unmitigated future development and climate change can adversely affect the environment and water infrastructure capability. A WCS will provide the required evidence, together with an agreed strategy to ensure that planned growth occurs within environmental constraints, with the appropriate infrastructure in place in a timely manner so that planned allocations are deliverable.

1.2 The Water Cycle

Figure 1.1 below shows the main elements that compromise the Water Cycle and shows how the natural and man-made processes and systems interact to collect, store or transport water in the environment.

Figure 1.1 The Water Cycle



1.3 Impacts of Development on the Water Cycle

New homes require the provision of clean water, safe disposal of wastewater and protection from flooding. It is possible that allocating large numbers of new homes at some locations may result in the capacity of the existing available infrastructure being exceeded. This situation could potentially lead to service failures to water and wastewater customers, have adverse impacts on the environment or

cause the high cost of upgrading water and wastewater assets being passed on to bill payers. Climate change presents further challenges such as increased intensity and frequency of rainfall and a higher frequency of drought events that can be expected to put greater pressure on the existing infrastructure.

1.4 Study Area

The Local Planning Authority (LPA) area of Stoke-on-Trent is shown in Figure 1.2. The study area covers 94 km^2 in the West Midlands. Stoke-on-Trent is a polycentric city whereby it is made up of six towns; Tunstall, Burslem, Stoke, Hanley, Fenton and Longton. The River Trent flows from the north east to the south west through the centre of Stoke-on-Trent with two other tributaries forming Main Rivers (Fowlea Brook and Lyme Brook). The Lyme Brook originates in Newcastle-Under-Lyme.

Water supply and wastewater services for the whole study area are provided by Severn Trent Water (STW).

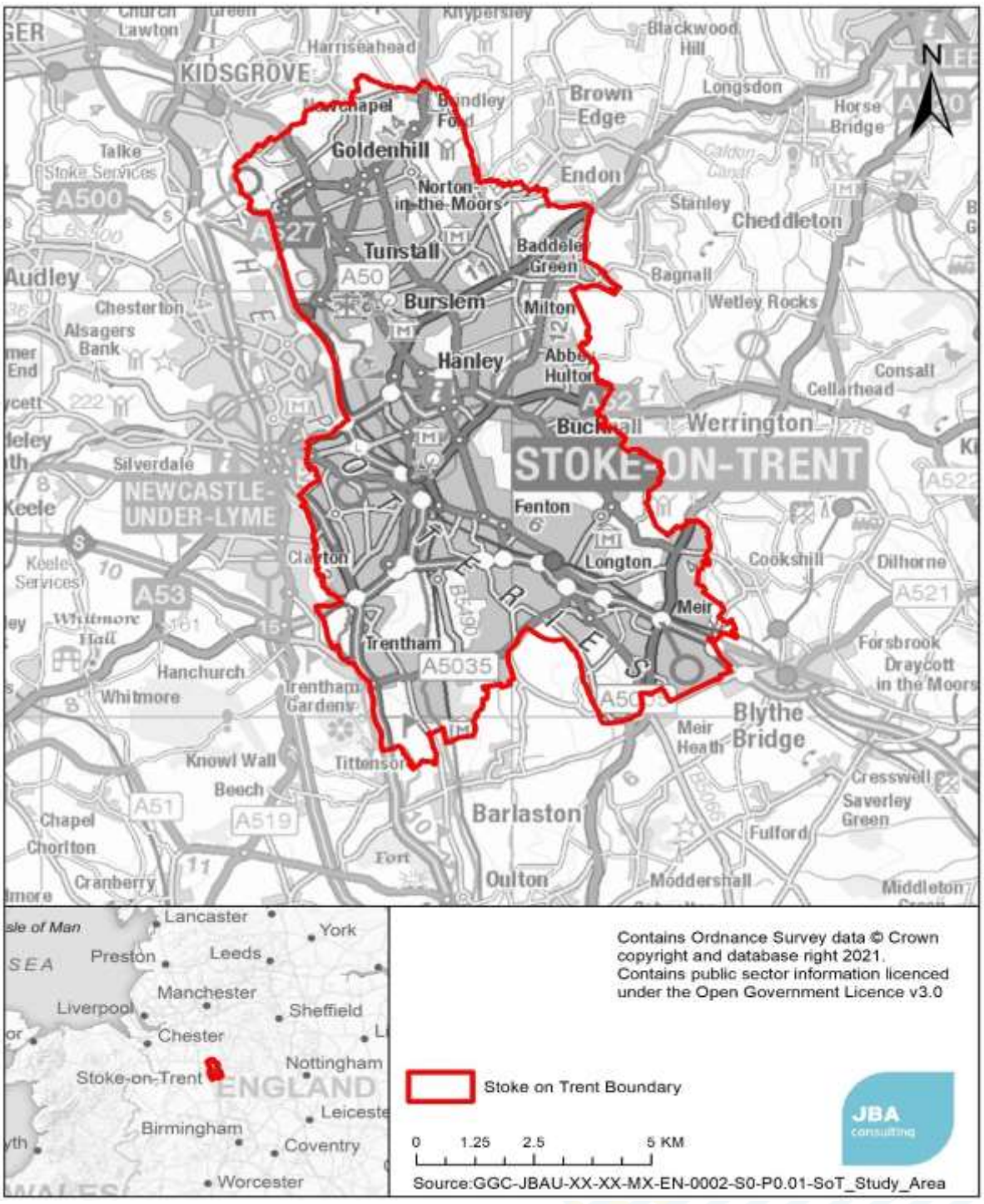


Figure 1.2 Stoke-on-Trent study area

1.5 Record of Engagement

1.5.1 Introduction

Preparation of a WCS requires significant engagement with stakeholders, within the Local Planning Authority area, with water and wastewater utilities, with the Environment Agency and Natural England, and where there may be cross-boundary issues, with neighbouring local authorities. This section forms a record of engagement for the WCS.

1.5.2 Engagement

An inception meeting was held with SOTCC to discuss the scope and data collection requirements. Severn Trent Water (STW) were contacted at the start of the project to discuss our data needs, and a data request was issued. Further discussions were held with STW as the project progressed and results emerged. The Environment Agency were consulted on the methodology for assessing the impact of growth on water quality and provided information on the targets for each river reach in the study area.

Neighbouring authorities that share wastewater infrastructure with SOTCC were contacted to obtain an estimate of growth in areas that would be served by those WwTWs. This allowed the full quantum of growth to be understood.

2 Future Growth in Stoke-on-Trent

2.1 Overview

The following section summarises how the councils are expected to grow during the plan period and allows a forecast to be created that can used to predict the volume of water and wastewater required in the future and the resulting pressure on water infrastructure.

This forecast consists of:

- Potential allocations - sites allocated, or planned to be allocated in the local plan (shown in Figure 2.1)
- Sites with extant planning permission – sites already in the planning system
- Recent completions – sites completed in the last year that may not yet appear in flow data provided by the water companies - for this study, 2019/20 data was used
- Windfall – sites that have not been specifically identified in the local plan. They normally comprise previously developed sites that have unexpectedly become available
- Neighbouring authority growth – growth served by infrastructure within or shared with the study area

Information on potential sites and expected growth during the plan period was provided by SOTCC and collated into a forecast for housing and employment floor space. Table 2.1 below contains a summary of this forecast.

Table 2.1: Overall Growth in SOTCC area

Type of Growth	Number of Houses	Indicative number of employees
Potential Allocation Sites	12,436	8,759
Commitments and recent completions	4,411	22,419
Windfall	3,376	N/A

* SOTCC provided an estimate of windfall during the plan period. In order to create a forecast of water demand, the windfall estimate was split between wastewater catchments based on the level of growth (from allocations and commitments) already forecast in each catchment.

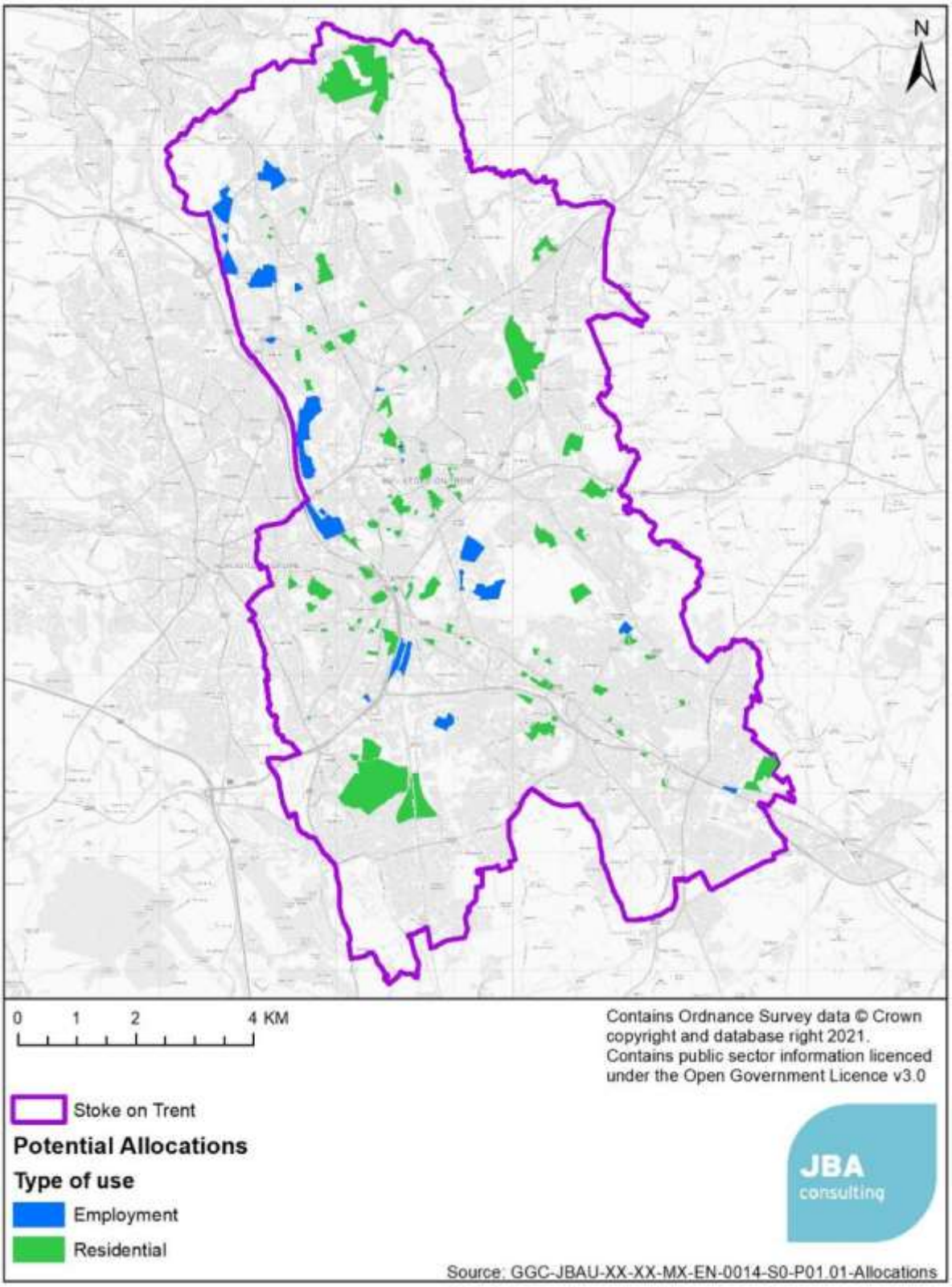


Figure 2.1 Potential allocations

2.2 Growth outside Stoke-on-Trent

2.2.1 Overview

There are three LPAs adjacent to the study area. Where growth within a neighbouring area may be served by infrastructure within or shared with Stoke-on-Trent, it is important to take this into account when considering infrastructure capacity or environmental impact. The wastewater catchments provided by STW were used to identify where infrastructure could be shared across boundaries, with all three sharing at least one of the WwTWs. Each neighbouring authority was therefore contacted in order to obtain their forecast for growth during the plan period, and a summary of this information is provided in Table 2.2.

A significant part of Newcastle under Lyme (NuL) is served by Strongford WwTW. NuL provided their latest housing and employment monitoring report, but they were unable to provide details of planned allocations as they are at an early stage in the local plan process. JBA therefore estimated the number of new houses within NuL that may be served by Strongford WwTW based on the published housing need in their 2020 Housing Needs Assessment, and the percentage of housing commitments expected to be served by Strongford WwTW. The housing figure also includes several university halls of residence containing with flats per site.

For the Housing Needs Assessment, click here to visit https://www.newcastle-staffs.gov.uk/downloads/file/726/housing-needs-assessment

Staffordshire Moorlands District Council and Stafford Borough Council areas are served in part by both Strongford and Checkley WwTWs, albeit to a lesser extent than NuL. Both LPAs provided their development sites in a GIS format and the wastewater catchments were used to identify which of these should be taken into account in this study.

Table 2.2 Neighbouring authority growth

Type of Growth	WwTW	Number of Houses	Employment floorspace (m^2)
Newcastle Under Lyme	Strongford	7,783*	201,346
Stafford Borough Council	Checkley	494	N/A
Stafford Borough Council	Strongford	830	N/A
Staffordshire Moorlands District Council	Checkley	1,954	1,341

Type of Growth	WwTW	Number of Houses	Employment floorspace (m^2)
Staffordshire Moorlands District Council	Strongford	213	546

3 Legislative and Policy Framework

3.1 Introduction

The following sections introduce several national, regional and local policies that must be considered by the LPA, water companies and developers during the planning stage. Key extracts from these policies relating to water consumption targets and mitigating the impacts on the water from the new development are summarised below.

3.2 National Policy

3.2.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF) was initially published on 27th March 2012, as part of reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth. A comprehensive revision was issued in July 2018. This was further revised in February 2019 and July 2021, but the changes were not significant from the July 2018 version for policy areas relevant to the WCS. The NPPF provides guidance to planning authorities to take account of flood risk and water and wastewater infrastructure delivery in their Local Plans. Key paragraphs include:

Paragraph 34:

"Plans should set out the contributions expected from development. This should include setting out the levels and types of affordable housing provision required, along with other infrastructure (such as that needed for education, health, transport, flood and water management, green and digital infrastructure). Such policies should not undermine the deliverability of the plan."

Paragraph 153:

"Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply..."

Paragraph 174 (e):

"…preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans".

In March 2014, the Planning Practice Guidance was issued by the Department for Communities and Local Government, with the intention of providing guidance on the application of the National Planning Policy Framework (NPPF) in England. The Department for Levelling Up Housing and Communities (DLUHC) is in the process of updating the Guidance to consider the necessary 2018 and 2019 updates of the NPPF.

Of the sections relevant to this study, only the Water Supply, Wastewater and Water Quality section has been updated.

- Flood Risk and Coastal Change
- Water Supply, Wastewater and Water Quality.
- Housing - Optional Technical Standards.

For the 2021 NPPF, click here to visit https://www.gov.uk/government/publications/national-planning-policy-framework--2

For the Flood Risk and Coastal Change Guidance, click here to visit https://www.gov.uk/guidance/flood-risk-and-coastal-change

For the Water Supply, Wastewater and Water Quality Guidance, click here to visit https://www.gov.uk/guidance/water-supply-wastewater-and-water-quality

For the Planning Practice Guidance: Housing – Optional Technical Standards, click here to visit https://www.gov.uk/guidance/housing-optional-technical-standards

3.2.2 Planning Practice Guidance: Water Supply, Wastewater and Water Quality

A summary of the specific guidance on how infrastructure, water supply, wastewater and water quality considerations should be accounted for in both plan-making and planning applications is summarised below in Figure 3.1.

Figure 3.1 PPG: Water supply, wastewater and water quality considerations for plan-making and planning applications

Topic	Plan-making	Planning applications
Infrastructure	Identification of suitable sites for new or enhanced infrastructure. Consider whether new development is appropriate near to water and wastewater infrastructure. Phasing new development so that water and wastewater infrastructure will be in place when needed.	Wastewater considerations include: First presumption is to provide a system for foul drainage discharging into a public sewer. Phasing of development and infrastructure, ensuring no occupation of properties until adequate infrastructure is in place. Circumstances where package sewage treatment plants or septic tanks are applicable.
Water supply	Not Specified	Planning for the necessary water supply would normally be addressed through the Local Plan, exceptions might include: Large developments not identified in Local Plans; Where a Local Plan requires enhanced water efficiency in new developments. This is recommended in all areas of water stress.
Water quality	How to help protect and enhance local surface water and groundwater in ways that allow new development to proceed and avoids costly assessment at the planning application stage. The type or location of new development where an assessment of the potential impacts on water bodies may be required.	Water quality is only likely to be a significant planning concern when a proposal would: Involve physical modifications to a water body; Indirectly affect water bodies, for example as a result of new development such as the redevelopment of land that may be affected by contamination etc. or through a lack of

	Expectations relating to sustainable drainage systems.	adequate infrastructure to deal with wastewater. Directly or indirectly result in a deterioration in water quality or a breach of environmental legislation as a result of adequate infrastructure in place to accommodate additional development pressures.
Wastewater	The sufficiency and capacity of wastewater infrastructure. The circumstances where wastewater from new development would not be expected to drain to a public sewer.	If there are concerns arising from a planning application about the capacity of wastewater infrastructure, applicants will be asked to provide evidence of initial liaison with STW with reference to plans to accommodate additional wastewater flows or provide information about how the proposed development will be drained and wastewater dealt with.
Cross-boundary concerns	Water supply and water quality concerns often cross local authority boundaries and can be best considered on a catchment basis. Recommends liaison from the outset.	No specific guidance (relevant to some developments).
SEA and Sustainability	Water supply and quality are considerations in strategic environmental assessment and sustainability appraisal. Sustainability appraisal objectives could include preventing deterioration of current water body status, taking climate change into account and	No specific guidance (should be considered in applications).

	seeking opportunities to improve water bodies.	

3.2.3 Planning Practice Guidance: Housing – Optional Technical Standards

This guidance, advises planning authorities on how to gather evidence to set optional requirements, including for water efficiency. It states that "all new homes already have to meet the mandatory national standard set out in the Building Regulations (of 125 litres/person/day). Where there is a clear local need, local planning authorities can set out Local Plan policies requiring new dwellings to meet the tighter Building Regulations optional requirement of 110 litres/person/day. Planning authorities are advised to consult with the EA and water companies to determine where there is a clear local need, and also to consider the impact of setting this optional standard on housing viability. A 2014 study into the cost of implementing sustainability measures in housing found that meeting a standard of 110 litres per person per day would cost only £9 for a four-bedroom house. The evidence for adopting the optional requirements is outlined in Section 4.7.8.

For the 2014 study, the Housing Standards Review: Cost Impacts, click here to visit https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/353387/021c_Cost_Report_11th_Sept_2014_FINAL.pdf

3.2.4 Building Regulations

The Building Regulations (2010) Part G was amended in early 2015 to require that all new dwellings must ensure that the potential water consumption must not exceed 125 litres/person/day, or 110 litres/person/day where required under planning conditions.

For The Building Regulations (2010) Part G – Sanitation, hot water safety and water efficiency, click here to visit https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/504207/BR_PDF_AD_G_2015_with_2016_amendments.pdf

3.2.5 BRE Standards

The Building Research Establishment (BRE) publish an internationally recognised environmental assessment methodology for assessing, rating and certifying the sustainability of a range of buildings.

New homes are most appropriately covered by the Home Quality Mark, and commercial, leisure, educational facilities and mixed-use buildings by the Building Research Establishment Environmental Assessment Methodology (BREEAM) UK New Construction Standard.

Using independent, licensed assessors, BREEAM/HQM assesses criteria covering a range of issues in categories that evaluate energy and water use, health and wellbeing, pollution, transport, materials, waste, ecology and management processes.

In the Homes Quality Mark, 400 credits are available across 11 categories and lead to a star rating. 18 credits are available for water

efficiency and water recycling. A greater number of credits are awarded for homes using water efficient fittings (with the highest score achieving 100l/p/d or less), and further credits are awarded for the percentage of water used in toilet flushing that is either sourced from rainwater or from grey water.

The BREEAM New Construction Standard awards credits across nine categories, four of which are related to water: water consumption, water monitoring, leak detection and water efficient equipment. This leads to a percentage score and a rating from "Pass" to "Outstanding".

The Councils have the opportunity to seek BREEAM or HQM status for all new, residential and non-residential buildings.

For the Home Quality Mark by BRE, click here to visit https://www.homequalitymark.com/professionals/standard/

For the BREEAM UK New Construction by BRE, click here to visit https://www.breeam.com/NC2018/

3.2.6 Sustainable Drainage Systems (SuDS)

From April 2015, Local Planning Authorities (LPA) have been given the responsibility for ensuring that sustainable drainage is implemented on developments of ten or more homes or other forms of major development through the planning system. Under the new arrangements, the key policy and standards relating to the application of SuDS to new developments are:

- The National Planning Policy Framework, which requires that development in areas already at risk of flooding should give priority to sustainable drainage systems.
- The House of Commons written statement setting out governments intentions that LPAs should "ensure that sustainable drainage systems for the management of run-off are put in place, unless demonstrated to be inappropriate" and "clear arrangements in place for ongoing maintenance over the lifetime of the development." This requirement is also now incorporated in the 2021 update of the NPPF (paragraph 169). In practice, this has been implemented by making Lead Local Flood Authorities (LLFAs) statutory consultees on the drainage arrangements of major developments.
- The Defra non-statutory technical standards for sustainable drainage systems. These set out the government's high-level requirements for managing peak flows and runoff volumes, flood risk from drainage systems and the structural integrity and construction of SuDS. This very short document is not a design manual and makes no reference to the other benefits of SuDS, for example water quality, habitat and amenity.
- Stoke-on-Trent City Council are a LLFA and play a key role in ensuring that the proposed drainage schemes for all new

developments comply with technical standards and policies in relation to SuDS. The Local "Sustainable Urban Drainage Systems (SuDS) Handbook" was published in February 2017 and contains guidance for the design and application of SuDS in Stoke-on-Trent.

- An updated version of the CIRIA SuDS Manual was published in 2015. The guidance covers the planning, design, construction and maintenance of SuDS for effective implementation within both new and existing developments. The guidance is relevant for a range of roles with the level of technical detail increasing throughout the manual. The guidance does not include detailed information on planning requirements, SuDS approval and adoption processes and standards, as these vary by region and should be checked early in the planning process.
- CIRIA also publish "Guidance on the Construction of SuDS" (C768), which contains detailed guidance on all aspects of SuDS construction, with specific information on each SuDS component available as a downloadable chapter.
- Severn Trent Water has a preferred method of surface water disposal of using a sustainable drainage system (SUDS) with connection to foul sewer seen as the last option. This is in line with the NPPF (Para 163).
- As of April 2020, the new Design and Construction Guidance (DCG) came into force in England. This contains details of the water sector's approach to the adoption of those SuDS which meet the legal definition of a sewer. The guidance replaces Sewers for Adoption 8. It differs from previous Sewers for Adoption guidance as compliance by water companies in England is now mandatory.

For the House of Commons written statement on SuDS, click here to visit http://www.parliament.uk/business/publications/written-questions-answers-statements/written-statement/Commons/2014-12-18/HCWS161/

For the Defra non-statutory technical standards for SuDS, click here to visit https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards

For the local SuDS handbook published by Staffordshire County Council, click here to visit https://www.staffordshire.gov.uk/environment/Flood-Risk-Management/Documents/SuDS-Handbook.pdf

For the CIRIA SuDS Manual, click here to visit https://www.ciria.org/ItemDetail?iProductcode=C768&Category=BOOK

For the Guidance on the Construction of SuDS published by CIRIA, click here to visit https://www.ciria.org/ItemDetail?iProductcode=C768&Category=BOOK%20

3.3 Regional Policy

3.3.1 Catchment Flood Management Plans

Catchment Flood Management Plans (CFMP) are high level policy documents covering large river basin catchments. They aim to set policies for sustainable flood risk management for the whole catchment covering the next 50 to 100 years. Stoke-on-Trent is within the River Trent CFMP area.

For the River Trent Catchment Flood Management Plan, click here to visit https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/289105/River_Trent_Catchment_Management_Plan.pdf

3.3.2 Surface Water Management Plans (SWMPs)

SWMPs outline the preferred surface water management strategy in a given location and establish a long-term action plan to manage surface water. SWMPs are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. A draft SWMP for Stoke-on-Trent was provided to the council in 2021.

3.4 Local Policy

3.4.1 Localism Act

The Localism Act (2011) changes the powers of local government, it re-distributes the balance of decision making from central government back to councils, communities and individuals. In relation to the planning of sustainable development, provision 110 of the Act places a duty to cooperate on Local Authorities. This duty requires Local Authorities to *"engage constructively, actively and on an ongoing basis in any process by means of which development plan documents are prepared so far as relating to a strategic matter"*.

The Localism Act also provides new rights to allow local communities to come together and shape the development and growth of their area by preparing Neighbourhood Development Plans, or Neighbourhood Development Orders, where the ambition of the neighbourhood is aligned with strategic needs and priorities for the area. This means that local people can decide where new homes and businesses should go and also what they should look like. As neighbourhoods draw up their proposals, Local Planning Authorities are required to provide technical advice and support.

For the Localism Act (2011), click here to visit http://www.legislation.gov.uk/ukpga/2011/20/section/110/enacted

3.5 International Environmental Policy

3.5.1 Ramsar

The Convention on Wetlands of International Importance, more commonly known as the Ramsar convention after the city where it was signed in 1971, aims to protect important wetland sites. Under the treaty, member counties commit to:

- Wise use of all their wetlands
- Designating sites for the Ramsar list of "Wetlands of International Importance" (Ramsar Sites) and their conservation
- Cooperating on transboundary wetlands and other shared interests.

"Wise use" of wetlands is defined under the convention as "the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development". A handbook on the wise use of wetlands is available from the Ramsar Convention Secretariat.

Ramsar Sites are designated by the National Administrative Authority, responsible for the Ramsar Convention in each country. In the case of the UK this is the Joint Nature Conservation Committee (JNCC).

In general, the designation of UK Ramsar sites is underpinned through prior notification of these areas as Sites of Special Scientific Interest (SSSIs) and as such receive statutory protection under the Wildlife and Countryside Act 1981 (as amended). More recently, Paragraph 176 of the NPPF states that Ramsar sites should be given the same protection in the planning process as sites designated under the EU Habitats Directive.

For the handbook on the wise use of wetlands, click here to visit https://www.ramsar.org/sites/default/files/documents/library/hbk4-01.pdf

3.6 European Environmental Policy

3.6.1 Urban Wastewater Treatment Directive (UWWTD)

The UWWTD is an EU Directive that concerns the collection, treatment and discharge of urban wastewater and the treatment and discharge of wastewater from certain industrial sectors. The objective of the Directive is to protect the environment from the adverse effects of wastewater discharges. More specifically Annex II A(a) sets out the requirements for discharges from urban wastewater treatment plants to sensitive areas which are subject to eutrophication. The Directive has been transposed into UK legislation through enactment of the Urban Waste Water Treatment (England and Wales) Regulations 1994 and 'The Urban Waste Water Treatment (England and Wales) (Amendments) Regulations 2003'.

For the UWWTD, click here to visit https://ec.europa.eu/environment/water/water-urbanwaste/index_en.html

3.6.2 Habitats Directive

The EU Habitats Directive aims to protect the wild plants, animals and habitats that make up our diverse natural environment. The directive created a network of protected areas around the European Union of national and international importance called Natura 2000 sites. These include:

- Special Areas of Conservation (SACs) - support rare, endangered or vulnerable natural habitats, plants and animals (other than birds).
- Special Protection Areas (SPAs) - support significant numbers of wild birds and habitats.

Special Protection Areas and Special Areas of Conservation are established under the EC Birds Directive and Habitats Directive respectively. The directive also protects over 1,000 animals and plant species and over 200 so called "habitat types" (e.g., special types of forests, meadows, wetlands, etc.), which are of European importance.

3.6.3 The Water Framework Directive

The Water Framework Directive (WFD) was first published in December 2000 and transposed into English and Welsh law in December 2003. It introduced a more rigorous concept of what "good status" should mean than the previous environmental quality measures.

River Basin Management Plans (RBMP) are required under the WFD and document the baseline classification of each waterbody in the plan area, the objectives, and a programme of measures to achieve those objectives. Stoke-on-Trent is entirely within the Humber River Basin District (RBD). Under the WFD, the RBMPs, which were originally published in December 2009, were reviewed and updated in December 2015. Consultation on the next update is due to end April 2022.

A primary WFD objective is to ensure 'no deterioration' in environmental status, therefore all water bodies must meet the class limits for their status class as declared in the Humber River Basin District RBMP. Another equally important objective requires all water bodies to achieve good ecological status. Future development needs to be planned carefully so that it helps towards achieving the WFD and does not result in further pressure on the water environment and compromise WFD objectives. The WFD objectives as outlined in the updated RBMPs are summarised below:

- Prevent deterioration of the status of surface waters and groundwater
- Achieve objectives and standards for protected areas

- Achieve good status for all water bodies or, for heavily modified water bodies and artificial water bodies, good ecological potential and good surface water chemical status
- Reverse any significant and sustained upward trends in pollutant concentrations in groundwater
- Stop discharges/emissions of priority hazardous substances into surface waters
- Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants

Local Planning Authorities (LPAs) must have regard to the Water Framework Directive and associated statutory objectives as implemented in the Environment Agency's River Basin Management Plans. It is of primary importance when assessing the impact of additional wastewater flow discharges on local river quality.

For the Humber river basin district river basin management plan, click here to visit https://www.gov.uk/government/publications/humber-river-basin-district-river-basin-management-plan

3.6.4 Protected Area Objectives

The WFD specifies that areas requiring special protection under other EC Directives, and waters used for the abstraction of drinking water, are identified as protected areas. These areas have their own objectives and standards.

Article 4 of the WFD required Member States to achieve compliance with the standards and objectives set for each protected area by 22 December 2015, unless otherwise specified in the Community legislation under which the protected area was established. Some areas may require special protection under more than one EC Directive or may have additional (surface water and/or groundwater) objectives. In these cases, all the objectives and standards must be met.

The types of protected areas are:

- Areas designated for the abstraction of water for human consumption (Drinking Water Protected Areas)
- Areas designated for the protection of economically significant aquatic species (Freshwater Fish and Shellfish)
- Bodies of water designated as recreational waters, including Bathing Waters
- Nutrient-sensitive areas, including areas identified as Nitrate Vulnerable Zones under the Nitrates Directive or areas designated as sensitive under Urban Waste Water Treatment Directive (UWWTD)
- Areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an

important factor in their protection including relevant Natura 2000 sites

Many WFD protected areas coincide with water bodies; these areas will need to achieve the water body status objectives in addition to the protected area objectives. Where water body boundaries overlap with protected areas the most stringent objective applies; that is the requirements of one EC Directive should not undermine the requirements of another. The objectives for Protected Areas relevant to this study are as follows:

Drinking Water Protected Areas

- Ensure that, under the water treatment regime applied, the drinking water produced meets the requirements of the Drinking Water Directive plus any UK requirements to make sure that drinking water is safe to drink
- Ensure the necessary protection to prevent deterioration in the water quality in the protected area in order to reduce the level of purification treatment required

Economically Significant Species (Freshwater Fish Waters)

- Protect or improve the quality of running or standing freshwater to enable them to support fish belonging to indigenous species offering a natural diversity; or species, the presence of which is judged desirable for water management purposes by the competent authorities of the Member States

Nutrient Sensitive Areas (Nitrate Vulnerable Zones)

- Reduce water pollution caused or induced by nitrates from agricultural sources
- Prevent further such pollution

Nutrient Sensitive Areas (Urban Waste Water Treatment Directive)

- Protect the environment from the adverse effects of urban wastewater discharges and wastewater discharges from certain industrial sectors

Natura 2000 Protected Areas (water dependent SACs and SPAs)

The objective for Natura 2000 Protected Areas identified in relation to relevant areas designated under the Habitats Directive or Birds Directive is to:

- Protect and, where necessary, improve the status of the water environment to the extent necessary to achieve the conservation objectives that have been established for the protection or improvement of the site's natural habitat types and species of importance

3.6.5 Groundwater Source Protection Zones

The Environment Agency has a Groundwater Protection Policy to help prevent groundwater pollution. In conjunction with this the Environment Agency have defined groundwater Source Protection Zones (SPZs) to help identify high risk areas and implement pollution prevention measures. The SPZs show the risk of contamination from activities that may cause pollution in the area, the closer the activity, the greater the risk. There are three main zones (inner, outer and total catchment) and a fourth zone of special interest which is occasionally applied.

Zone 1 (Inner protection zone)

This zone is designed to protect against the transmission of toxic chemicals and water-borne disease. It indicates the area in which pollution can travel to the borehole within 50 days from any point within the zone and applies at and below the water table. There is also a minimum 50 metre protection radius around the borehole.

Zone 2 (Outer protection zone)

This zone indicates the area in which pollution takes up to 400 days to travel to the borehole, or 25% of the total catchment area, whichever area is the largest. This is the minimum length of time the Environment Agency think pollutants need to become diluted or reduce in strength by the time they reach the borehole.

Zone 3 (Total catchment)

This is the total area needed to support removal of water from the borehole, and to support any discharge from the borehole.

Zone of Special Interest

This is defined on occasions, usually where local conditions mean that industrial sites and other polluters could affect the groundwater source even though they are outside the normal catchment.

The Environment Agency's approach to Groundwater protection sets out a series of position statements that detail how the Environment Agency delivers government policy on groundwater and protects the resources from contamination. The position statements that are relevant to this study with regard to discharges to groundwaters, include surface water drainage and the use of SuDS, discharges from contaminated surfaces (e.g. lorry parks) and from treated sewage effluent.

For the Environment Agency's approach to groundwater protection, click here to visit https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/598778/LIT_7660.pdf

3.6.6 European Derived Legislation and Brexit

Much of the legislation behind the regulation of the water environment derives from the UK enactment of European Union (EU) directives. The

UK government has signalled that "the UK will in future develop separate and independent policies in areas such as … the environment … maintaining high standards as we do so."

For the full article, click here to visit https://www.gov.uk/government/speeches/the-future-relationship-between-the-uk-and-the-eu

As the details of future changes to environmental regulation are not yet known, this study has used existing, European Union derived environmental legislation, most significantly the Water Framework Directive, to assess the environmental impacts of planned development during the plan period for the Local Plan. Should this situation change, a review of this Water Cycle Study may be required considering any new emerging regulatory regime.

3.7 UK Environmental Policy

3.7.1 Environment Act 2021

The Environment Act came into UK law in November 2021 with the aim of protecting and enhancing the environment. The Act has objectives to improve air and water quality, biodiversity, waste reduction and resource efficiency. The implementation of the policies within the Environment Act has begun and legally binding environmental targets are being developed. This will be enforced by the newly created Office for Environmental Protection (OEP).

The Environment Act (Part 5) contains policies concerning improvements to the water environment. These policies have the following aims:

- Effective collaboration between water companies through statutory water management plans
- Minimise damage water abstraction may cause on environment
- Modernise the process for modifying water and sewerage company licence conditions

Further to this, there is specific legislation regarding storm overflows aiming to reduce the discharge of untreated sewage into waterways. This plan includes requirements for water companies to:

- report on the discharges from storm overflows,
- monitor the quality of water potentially affected by discharges,
- progressively reduce the harm caused by storm overflows,
- report on elimination of discharges from storm overflows.

For the Environment Act 2021, click here to visit https://www.legislation.gov.uk/ukpga/2021/30/part/5/enacted

For the website of the Office for Environmental Protection, click here to visit https://www.theoep.org.uk/office-environmental-protection

3.7.2 Conservation of Habitats and Species Regulations 2017 (as amended)

The Conservation of Habitats and Species Regulations 2010 (commonly referred to as the Habitats Regulations) consolidated the Conservation (Natural Habitats, &c.) Regulations 1994, and transposed the EU Habitats Directive in England and Wales. This was further amended in 2017.

The Habitats Regulations define the requirement for a Habitats Regulations Assessment (HRA) to be carried out. The purpose of this is to determine if a plan or project may affect the protected features of a "habitats site". These include:

- A special area of conservation (SAC)
- A site of Community Importance
- A site hosting a priority natural habitat type or priority species protected in accordance with Article 5(4) of the Habitats Directive
- A Special Protection Area (SPA)
- A potential SPA

All plans and projects (including planning applications) which are not directly connected with, or necessary for the conservation management of a habitat site require consideration of whether the plan or project is likely to have significant effects on that site.

This is referred to as the "Habitats Regulations Assessment screening" and should take into account the potential effects of both the plan/project itself and in combination with other plans or projects.

Part 6 of the conservation of Habitats and Species Regulations 2017 states that where the potential for likely significant effects cannot be excluded, a competent authority must make an appropriate assessment of the implications of the plan or project for that site, in view of the site's conservation objectives.

The competent authority may agree to the plan or project only after having ruled out adverse effects on the integrity of the habitats site.

If adverse effects cannot be ruled out, and where there are no alternative solutions, the plan or project can only proceed if there are imperative reasons of over-riding public interest and if the necessary compensatory measures can be secured.

The "People over Wind" ECJ ruling (C-323/17) clarifies that when making screening decisions for the purposes of deciding whether an appropriate assessment is required, competent authorities cannot take into account any mitigation measures. This must be part of the appropriate assessment itself.

3.7.3 Wildlife and Countryside Act 1981

Sites of Special Scientific Interest (SSSI) are designated and legally protected under the Wildlife and Countryside Act 1981, Section 28G places a duty to take reasonable steps, consistent with the proper exercise of the authority's functions, to "further to the conservation and enhancement of the flora, fauna or geological or physiographical features by reason of which the site is of special scientific interest."

The Government's 25-year Environment Plan has a target of "restoring 75% of our one million hectares of terrestrial and freshwater protected sites to favourable condition, securing their wildlife value for the long term." In line with this, and the Wildlife and Countryside Act 1981, Local Authorities should look to put forward options that contribute to conservation or restoration of favourable condition, and at the very least must not introduce policies that hinder the restoration of favourable conditions by increasing existing issues.

A site is said to be in "favourable condition" when the designated feature(s) within a unit are being adequately conserved and the results from monitoring demonstrate that the feature(s) in the unit are meeting all the mandatory site-specific monitoring targets set out in the favourable condition targets (FCT).

For the Wildlife and Countryside Act 1981, click here to visit http://www.legislation.gov.uk/ukpga/1981/69

For the Government's 25-year Environment Plan, click here to visit https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf

3.7.4 The Natural Environment Rural Communities Act (NERC)

The Natural Environment and Rural Communities Act 2006 (commonly referred to the as the NERC Act), was intended to implement key aspects of the Government's Rural Strategy published in 2004 and established Natural England as a new independent body responsible for conserving, enhancing and managing England's natural environment.

Section 40 of the NERC Act places a duty to conserve biodiversity on public authorities, including Local Planning Authorities and water companies. "The public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity."

Section 41 requires the Secretary of State to publish and maintain a list of species and types of habitat which in the Secretary of State's opinion (in consultation with Natural England) are of "principal importance for the purpose of conserving biodiversity."

For the Natural Environment and Rural Communities Act 2006, click here to visit http://www.legislation.gov.uk/ukpga/2006/16/section/40

3.8 Water Industry Policy

3.8.1 The Water Industry in England

Water and sewerage services in England and Wales are provided by 10 Water and Sewerage Companies (WaSCs) and 12 'water-only' companies. The central legislation relating to the industry is the Water Industry Act 1991. The companies operate as regulated monopolies within their supply regions, although very large water users and developments are able to obtain water and/or wastewater services from alternative suppliers - known as inset agreements.

The Water Act 2014 aims to reform the water industry to make it more innovative and to increase resilience to droughts and floods. Key measures could influence the future provision of water and wastewater services include:

- Non-domestic customers will be able to switch their water supplier and/or sewerage undertaker (from April 2017)
- New businesses will be able to enter the market to supply these services
- Measures to promote a national water supply network
- Enabling developers to make connections to water and sewerage systems

3.8.2 Regulations of the Water Industry

The water industry is primarily regulated by three regulatory bodies:

- The Water Services Regulation Authority (OfWAT) – economic/ customer service regulation
- Environment Agency - environmental regulation
- Drinking Water Inspectorate (DWI) - drinking water quality

Every five years the industry submits a Business Plan to OfWAT for a Price Review (PR). These plans set out the companies' operational expenditure (OPEX) and capital expenditure (CAPEX) required to maintain service standards, enhance service (for example where sewer flooding occurs), to accommodate growth and to meet environmental objectives defined by the Environment Agency. OfWAT assesses and compares the plans with the objective of ensuring what are effectively supply monopolies and operating efficiently. The industry is currently in Asset Management Plan 7 (AMP7) which runs from 2020 to April 2025.

When considering investment requirements to accommodate growing demand, water companies are required to ensure a high degree of certainty that additional assets will be required before funding them. Longer term growth is, however, considered by the companies in their internal asset planning processes and in their 25-year Strategic Direction Statements and WRMPs.

3.8.3 Water Resource Management Plans

Water Resource Management Plans (WRMPs) are 25-year strategies that water companies are required to prepare, with updates every five years. In reality, water companies prepare internal updates more regularly. WRMPs are required to assess:

- Future demand (due to population and economic growth)
- Future water availability (including the impact of sustainability reductions)
- Demand management and supply-side measures (e.g., water efficiency and leakage reduction, water transfers and new resource development)
- How the company will address changes to abstraction licences
- How the impacts of climate change will be mitigated

Where necessary, they set out the requirements for developing additional water resources to meet growing demand and describe how the balance between water supply and demand will be balanced over the period 2015 to 2040.

- Using cost-effective demand management, transfer, trading and resource development schemes to meet growth in demand from new development and to restore abstraction to sustainable levels.
- In the medium to long term, ensuring that sufficient water continues to be available for growth and that the supply systems are flexible enough to adapt to climate change.

The WRMP covering Stoke-on-Trent is reviewed in section 4.

3.8.4 Regional Water Resource Planning

Water resource planning is taking an increasingly regional focus, recognising the need for collaboration between water companies and sectors in order to address the challenges of climate change, increasing demand for water and protecting the water environment. Five regional groupings having been formed, including the Water Resource West (WRW) group which covers Stoke-on-Trent. WRW is a group of abstractors, their representatives, and their regulators, with a core group consisting of the Severn Trent Water, United Utilities, South Staffs Water, Welsh Water and the Environment Agency. Their associate members include the National Farmers Union and Energy UK (among many others). Their aim is to provide strategic oversight and co-ordination of water resources matters across the river catchments of the West of England and the cross-border river systems with Wales. This will ensure the sustainability of water resources in these catchments. It will also support activity aimed at enabling water resource resilience across England and Wales, including promoting the development of a long-term strategic plan for water transfers into East and South East England.

WRW is starting to prepare a regional water resource plan for publication in 2023, which in turn will inform the next round of company WRMPs to be published in 2024. As part of this process, they have published an initial water resource position statement which sets out the water resources challenges and opportunities within the region.

For the Initial Resource Position by Water Resources West, click here to visit https://static1.squarespace.com/static/5e67889204d86850e1fdcece/t/5e6f544fa53943154ad85b60/1584354387330/WRW+Initial+Resource+Position.pdf

3.8.5 Drainage and Wastewater Management Plans

The UK Water Industry Research (UKWIR) "21st Century Drainage" programme has brought together water companies, governments, regulators, local authorities, academics and environmental groups to consider how planning can help to address the challenges of managing drainage in the future. These challenges include climate change, population growth, urban creep and meeting the Water Framework Directive.

The group recognised that great progress has been made by the water industry in its drainage and wastewater planning over the last few decades, but that, in the future, there needs to be greater transparency and consistency of long-term planning. The Drainage and Wastewater Management Plan (DWMP) framework sets out how the industry intends to approach these goals, with the objective of the water companies publishing plans by the end of 2022, in order to inform their business plans for the 2024 Price Review.

DWMPs will be prepared for wastewater catchments or groups of catchments and will encompass surface water sewers within those areas which do not drain to a treatment works. The framework defines drainage to include all organisations and all assets which have a role to play in drainage, although, as the plans will be water company led, it does not seek to address broader surface water management within catchments.

LPAs and LLFAs are recognised as key stakeholders and will be invited to join, alongside other stakeholders, the Strategic Planning Groups (SPGs) organised broadly along river basin district catchments.

There is limited opportunity for DWMPs to inform this study, as the process is still at an early stage. In the future, however, DWMPs will provide more transparent and consistent information on sewer flooding risks and the capacity of sewerage networks and treatment works, and this should be taken into account in SFRAs, Water Cycle Studies, as well as in site-specific FRAs and Drainage Strategies.

Severn Trent Water published their draft initial findings at the start of 2018.

For the Drainage and Wastewater Management Plan framework, click here to visit https://www.water.org.uk/wp-content/uploads/2018/12/Water-UK-DWMP-Framework-Report-Main-Document.pdf

For the Draft Initial Findings of the Drainage and Wastewater Management Plan by Severn Trent Water, click here to visit https://www.stwater.co.uk/content/dam/stw/about_us/pr19-documents/sve_appendix_a9_drainage_and_wastewater_management_plan.pdf

3.8.6 Developer Contributions and Utility Companies

Developments with planning permission have a right to connect to the public sewerage systems, however, there is no guarantee that the capacity exists to serve a development.

Developers may requisition a water supply connection or sewerage system or self-build the assets and offer these for adoption by the water company or sewerage undertaker. Self-build and adoption are usually practiced for assets within the site boundary, whereas requisitions are normally used where an extension of upgrading the infrastructure requires construction on third party land. The cost of requisitions is shared between the water company and developer as defined in the Water Industry Act 1991.

Where a water company is concerned that a new development may impact upon their service to customers or the environment (for example by causing foul sewer flooding or pollution) they may request the LPA to impose a Grampian condition, whereby the planning permission cannot be implemented until a third-party secures the necessary upgrading or contributions.

The above arrangements are third party transactions because the Town and Country Planning Act Section 106 agreements and Community Infrastructure Levy agreements may not be used to obtain funding for water or wastewater infrastructure.

3.8.7 Changes to Charging Rules for New Connections

OfWAT, the water industry's economic regulator, has published new rules covering how water and wastewater companies may charge customers for new connections. These rules apply to all companies in England and commenced on 1st April 2018. The key changes included:

- More charges will be fixed and published on water company websites. This will provide greater transparency to developers and will also allow alternative connection providers to offer competitive quotations more easily
- There will be a fixed infrastructure charge for water and one for wastewater

- The costs of network reinforcement will no longer be charged directly to the developer in their connection charges. Instead, the combined costs of all of the works required on a company's networks, over a five-year rolling period, will be covered by the infrastructure charges payed for all new connections.
- The definition of network reinforcement has changed and will now apply only to works required as a direct consequence of the increased demand due to a development. Where the water company has not been notified of a specific development, for example when developing long-term strategic growth schemes, the expenditure cannot be recovered through infrastructure charges.
- Severn Trent Water have published their 2021/22 charges for connections. An environmental discount scheme is offered which rewards developers with a reduction in the connection charge if certain conditions are met:
    - Up to £353 off the clean water infrastructure charge could be applied if it can be demonstrated that the property has been built to consume no more than 110 litres per person per day
    - A discount of £124 is available if there is no surface water connection made to a public sewer, or £93 if the connection is made to a public sewer via Sustainable Drainage System (SuDS).

For the charging rules for new connection services https://www.stwater.co.uk/content/dam/stw/stw_buildinganddeveloping/new-connections/2021-charges/new-connections-charging-arranging-document-21-22.pdf

For the Charging Arrangements for Development Services and New Connections by Severn Trent Water, click here to visit https://www.stwater.co.uk/content/dam/stw/stw_buildinganddeveloping/new-connections/2021-charges/new-connections-charging-arranging-document-21-22.pdf

For the Environmental Discount Scheme https://www.stwater.co.uk/building-and-developing/regulations-and-forms/application-forms-and-guidance/infrastructure-charges/

3.8.8 Design and Construction Guidance (DCG)

The Design and Construction Guidance contains details of the water sector's approach to the adoption of SuDS, which meet the legal definition of a sewer. This subsumed the work which would have fed into Sewers for Adoption 8 as the government made the decision not to implement Schedule 3 of the Flood and Water Management Act 2010. The new guidance came into force in April 2020 and differs from

previous sewers for adoption guidance as compliance by water companies in England will be mandatory.

The standards, up to and including Sewers for Adoption version 7, have included a narrow definition of sewers to mean below-ground systems comprising of gravity sewers and manholes, pumping stations and rising mains. This has essentially excluded the adoption of SuDS by water companies, with the exception of below-ground storage comprising of oversized pipes or chambers.

The new guidance provides a mechanism for water companies to secure the adoption of a wide range of SuDS components which are now compliant with the legal definition of a sewer. There are however several non- adoptable components such as green roofs, pervious pavements and filter strips. These components may still form part of a drainage design so long as they remain upstream of the adoptable components.

The Design and Construction Guidance states that the drainage layout of a new development should be considered at the earliest stages of design. It is hoped that the new guidance will lead to better managed and more integrated surface water systems which incorporate amenity, biodiversity and water quality benefits.

4 Water Resources

4.1 Introduction

4.1.1 Objectives

The aim of the water resources assessment is to ensure that sufficient water is available in the region to serve the proposed level of growth, and that it can be abstracted without a detrimental impact on the environment, both during the plan period and into the future. The report will characterise the study area, identifying the key surface water and groundwater bodies, and local geology. It will highlight the pressures on water resources in the region, and what constraints are present on abstract and provide evidence for adopting a tighter water efficiency target allowed under building regulations.

4.1.2 Conclusion from Phase 1 Scoping study

The Phase 1 WCS concluded that the WRMP showed a supply-demand deficit from 2024 if no action were taken but went on to define a number of actions that would address the deficit. Severn Trent Water commented that they would have adequate water resource for all proposed development sites.

On the basis that the WRMP contains an approved plan to address the supply-demand deficit, and sufficient time to adapt the long-term plan to include emerging trends in population, no further assessment was recommended as part of a Phase 2 Outline study.

4.1.3 Requirement for Phase 2 Outline Study

The scoping study assessed the impact of Stoke-on-Trent's housing need on water resources. Since the scoping study STW have published their Water Resource Management Plan, which was previously at the draft stage, and one of the Abstraction Licencing Strategies for the study area has also been amended.

The Phase 2 assessment will therefore consist of:

- Summary of the Surface water and geology of the Stoke-on-Trent area
- Presentation of Groundwater body status not included in Phase 1
- Update to the Abstraction Licencing Strategy
- Summary of changes to the STW WRMP
- Restatement of STW's position

4.2 Surface Waters

Figure 4.1 shows the main watercourses within the study. The River Trent flows through Stoke-on-Trent; the river becomes 'Main River' as it enters the boundary near Norton Green. The Trent then flows south-westerly through the city and exits north of Trentham. The Fowlea

Brook flows south along the western boundary, of Stoke-on-Trent, becoming a Main River in Middleport. It forms a tributary to the River Trent in Stoke-on-Trent. Further south, the Lyme Brook also flows along the western boundary of Stoke (bordering Newcastle-Under-Lyme). The Lyme Brook is classified as a Main River near Knutton and later forms a tributary to the Trent, within the Stoke-on-Trent boundary, near Hanford.

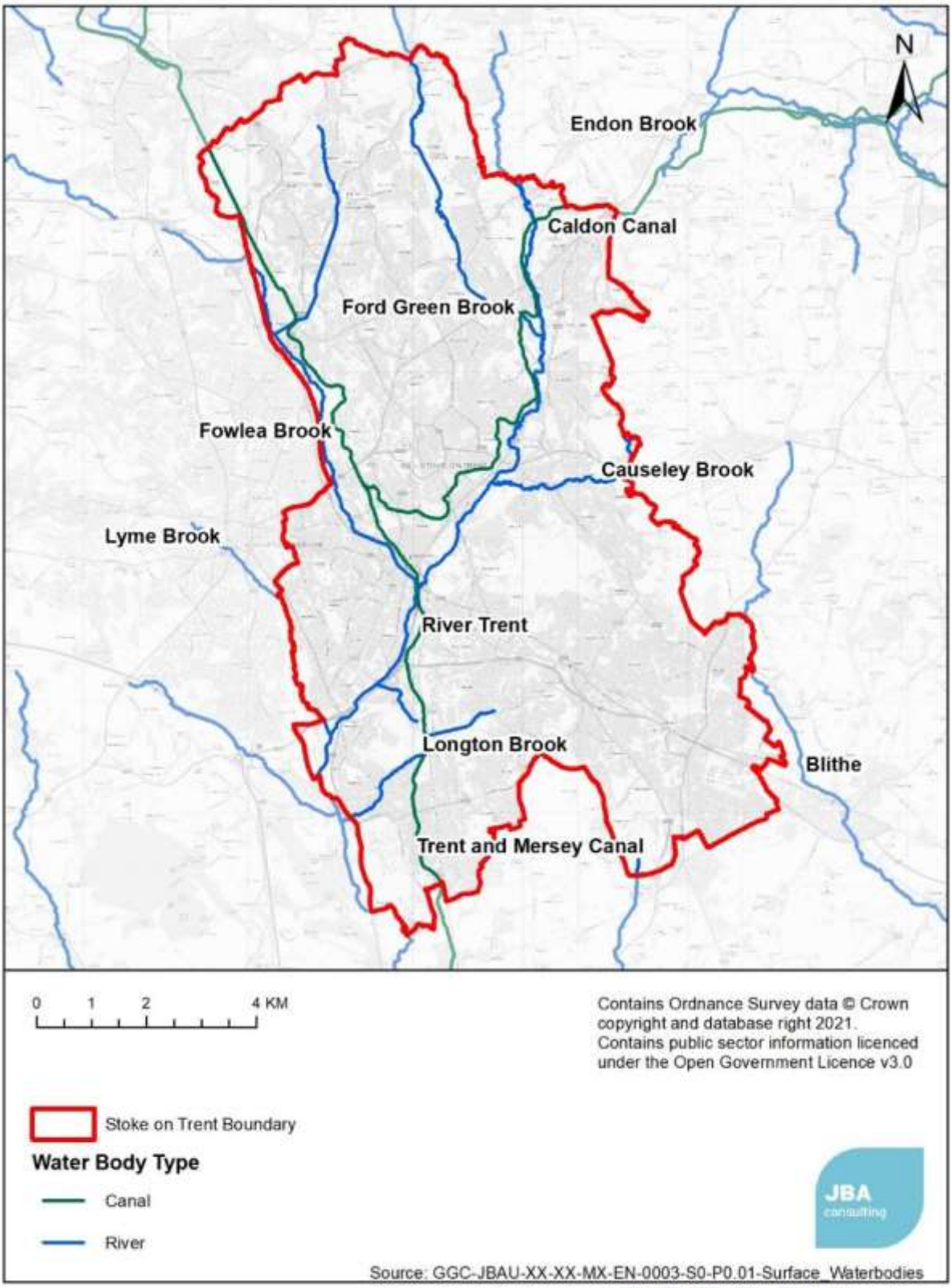


Figure 4.1 Surface waterbodies in Stoke-on-Trent

4.3 Geology

Stoke-on-Trent has a mixture of geologies. Figure 4.2 shows that Stoke-on-Trent has three distinct geological bands whereby the west is

Warwickshire Group; the centre is Pennine Upper Coal Measures formation, and the east is Pennine Middle Coal Measures formation. In the south east, there is a small area of undifferentiated Triassic rocks.

Stoke-on-Trent is underlain by various types of superficial deposits, shown in Figure 4.3. The southern and south-eastern areas of Stoke-on-Trent are underlain by glacial till, as well as smaller areas in the north. These deposits are also found along the northern boundary of Newcastle-Under-Lyme. Through the centre of Stoke-on-Trent (west-east) there is a band of alluvium and small areas of undifferentiated river deposits.

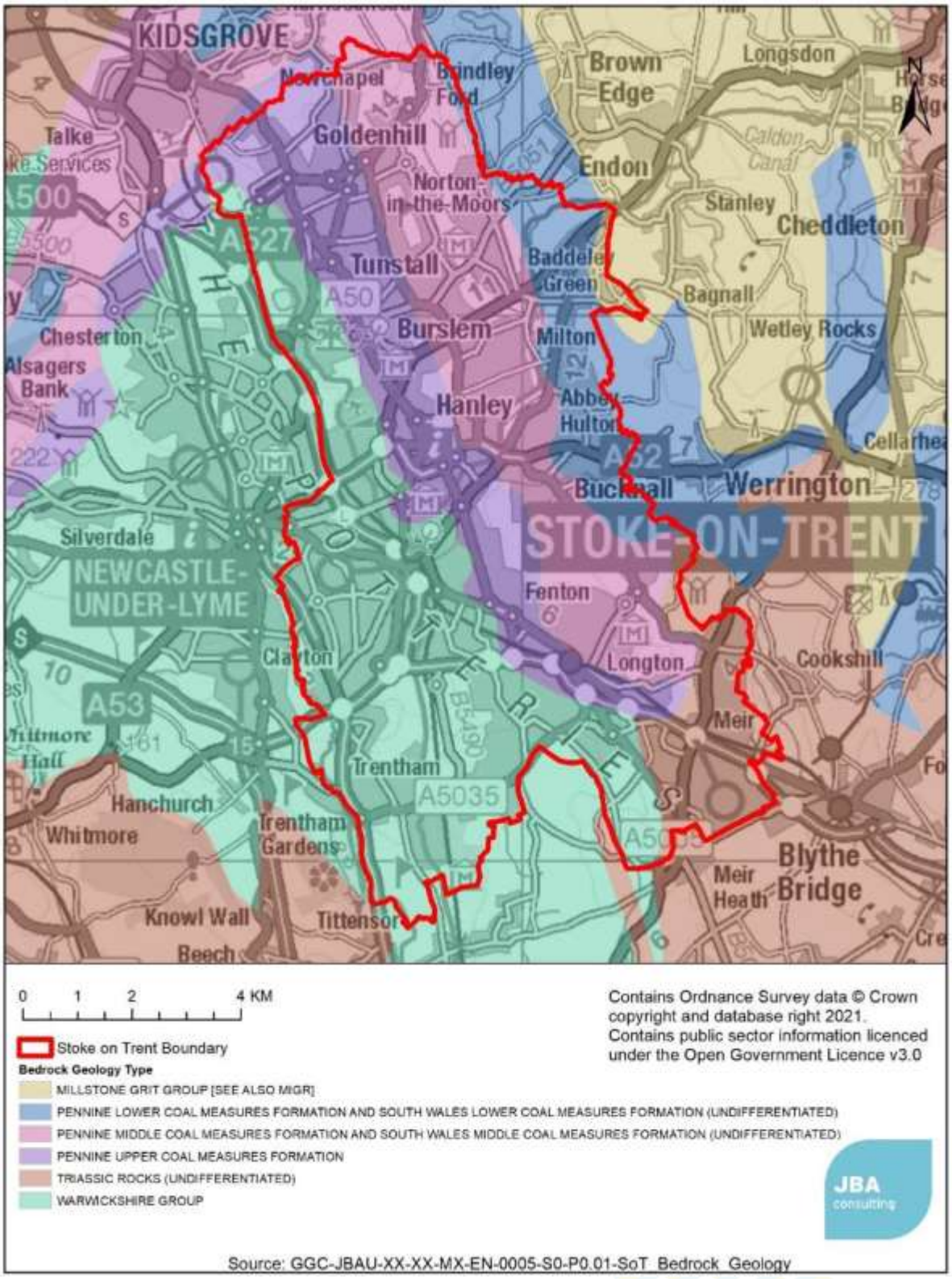


Figure 4.2 Bedrock geology of Stoke-on-Trent

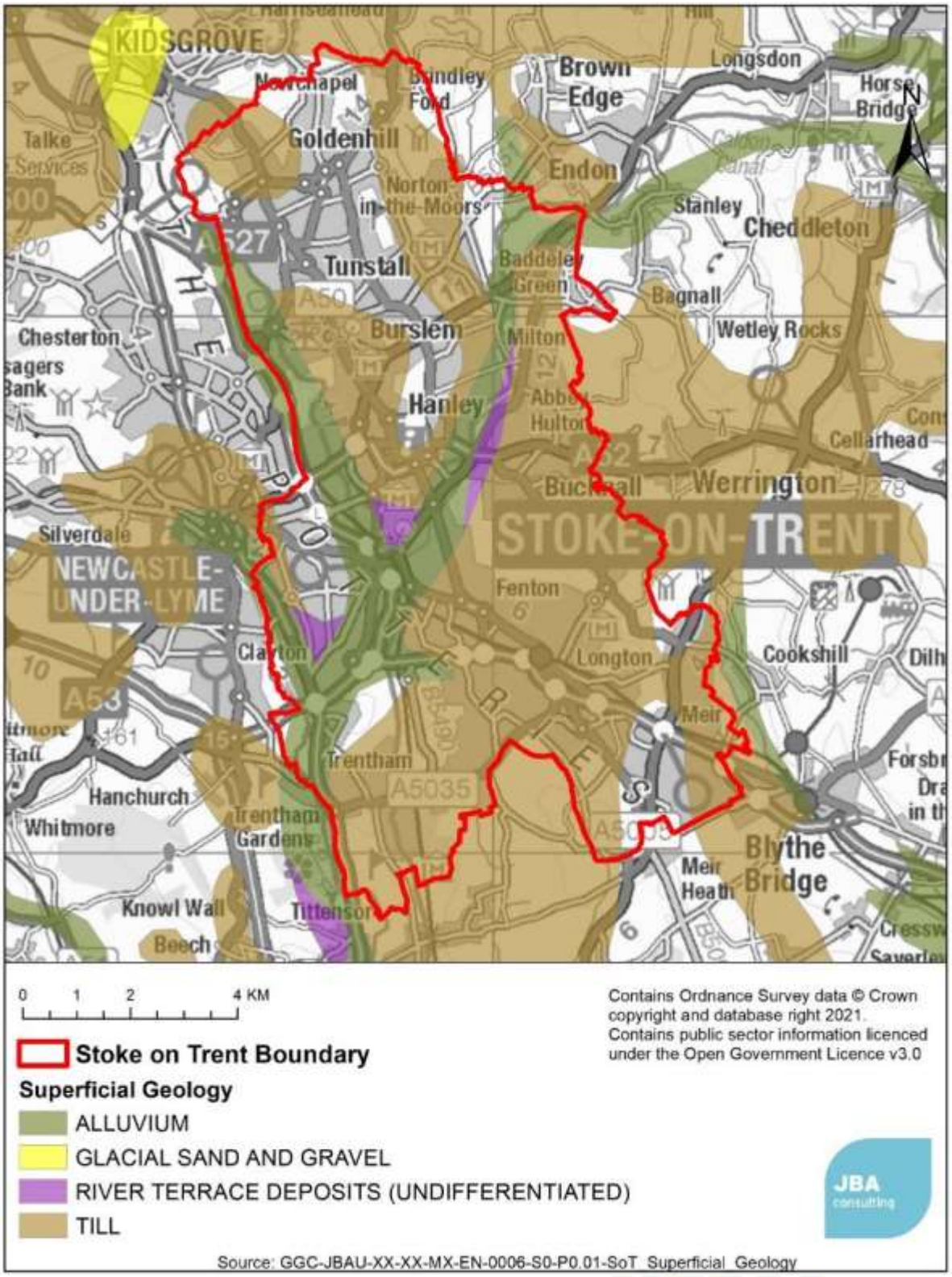


Figure 4.3 Superficial geology of Stoke-on-Trent

4.4 Groundwaters

Groundwater bodies within and encompassing the study are shown in Figure 4.4 and their corresponding WFD classification is summarised in reported in Table 4.1.

Table 4.1 WFD status of groundwater bodies

Groundwater Bodies	Quantitative Status	Chemical Status	Overall Status
Dove - Millstone Grit/Coal Measure	Good	Good	Good
Manchester and East Cheshire	Good	Poor	Poor
Staffordshire Trent Valley – Coal Measures Stoke	Good	Good	Good
Staffordshire Trent Valley – Merica Mudstone East & Coal Measures	Good	Good	Good
Staffordshire Trent Valley – PT Sandstone Staffordshire	Poor	Good	Poor

Poor chemical status is associated with agricultural, rural and urban land management point and diffuse sources of pollution. Quantitative status of poor means that the water bodies failed the quantitative groundwater balance test, indicating the total existing abstraction may not be sustainable in the long term. This failure is currently associated with abstraction for agricultural and rural land management, and water industry abstraction.

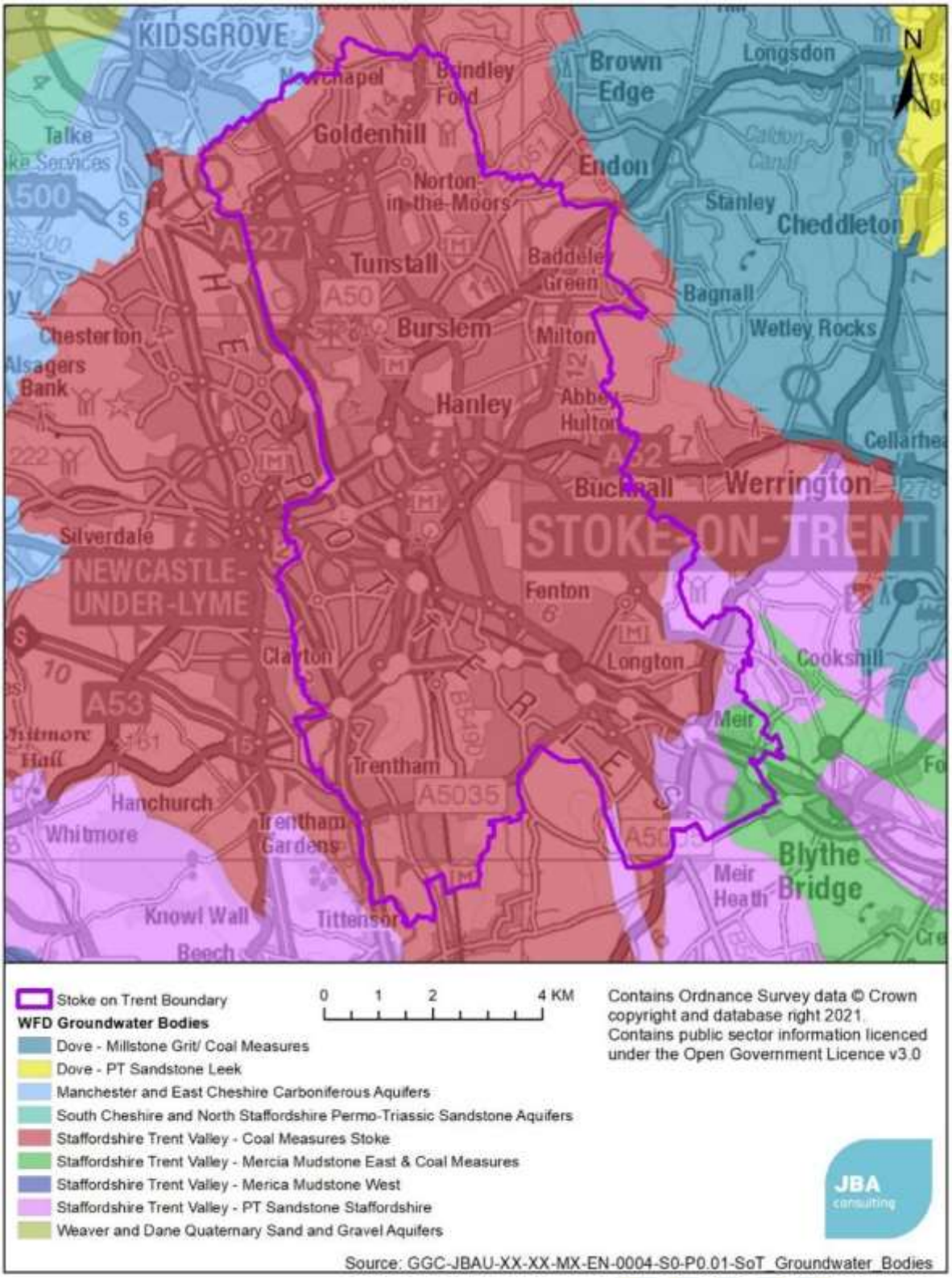


Figure 4.4: Groundwater Bodies

4.5 Availability of Water Resources

4.5.1 Abstraction Licencing Strategy

The Environment Agency (EA), working through their Resource Assessment Methodology (which replaces the former Catchment Abstraction Management Strategy (CAMS) process), prepare an Abstraction Licensing Strategy (ALS) for each sub-catchment within a river basin. A description of documents and how they are used can be found in Section 4.1.3 of the scoping study.

Stoke-on-Trent is covered by one ALS area: Staffordshire Trent Valley, as shown in Figure 4.5 below.

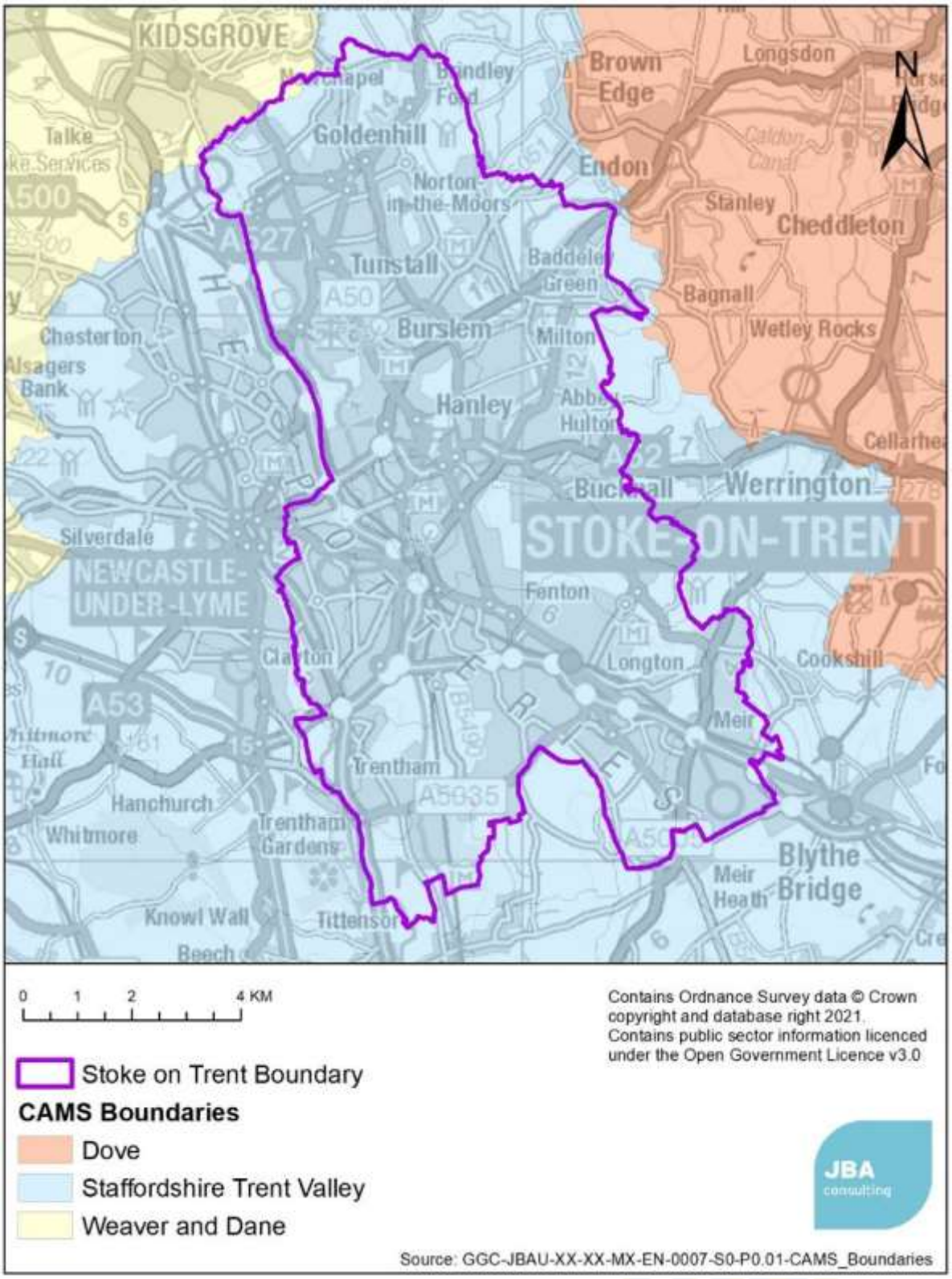


Figure 4.5: ALS (formerly CAMS) Boundaries covering Stoke-on-Trent

4.5.2 Resource Availability Assessment

In order to abstract surface water, it is important to understand what water resources are available within a catchment and where abstraction for consumptive purposes will not pose a risk to resources or the environment. The Environment Agency has developed a classification system which shows:

- The relative balance between the environmental requirements for water and how much has been licensed for abstraction
- whether there is more water available for abstraction in the area
- areas where abstraction may need to be reduced.

The availability of water for abstraction is determined by the relationship between the fully licensed (all abstraction licences being used to full capacity) and recent actual flows (amount of water abstracted in the last six years) in relation to the Environmental Flow Indicator (EFI). Results are displayed using different water resource availability colours, further explained in Table 4.2. In some cases, water may be scarce at low flows, but available for abstraction at higher flows. Licences can be granted that protect low flows, this usually takes the form of a "Hands-off Flow" (HOF) or Hands-off Level (HOL) condition on a licence, which mean abstractions have to stop when the river flow or level falls below a particular value. This value is known as the HOF or HOL and ensures there is always a minimum flow in the river. Surface Water Flows can be assessed at Assessment Points (APs) which are significant points on the river, often where two main rivers join or at a gauging station.

Groundwater availability as a water resource is assessed similarly, unless better information on principle aquifers is available or if there are local issues that need to be taken into account.

Table 4.2 Implications of Surface Water Resource Availability Colours

Water Resource Availability Colour	Implications for Licensing
BLUE - High hydrological regime	There is more water than required to meet the needs of the environment. Due to the need to maintain the near pristine nature of the water body, further abstraction is severely restricted.
GREEN - Water available for licensing	There is more water than required to meet the needs of the environment. Licences can be considered depending on local/downstream impacts.

Water Resource Availability Colour	Implications for Licensing
YELLOW - Restricted water available for licensing	Fully Licensed flows fall below the Environmental Flow Indicator (EFI). If all licensed water is abstracted there will not be enough water left for the needs of the environment. No new consumptive licences would be granted. It may also be appropriate to investigate the possibilities for reducing fully licensed risks. Water may be available via licence trading.
RED - Water not available for licensing	Recent Actual flows are below the Environmental Flow Indicator (EFI). This scenario highlights water bodies where flows are below the indicative flow requirement to help support Good Ecological Status. No further licences will be granted. Water may be available via licence trading.
GREY - HMWBs (and /or discharge rich water bodies)	These water bodies have a modified flow that is influenced by reservoir compensation releases or they have flows that are augmented. There may be water available for abstraction in discharge rich catchments.

Water resource availability is assessed under four different flow conditions:

- Q95 – very low flows which are exceeded 95% of the time
- Q70 – low flows which are exceeded 70% of the time
- Q50 – median flows which are exceeded 50% of the time
- Q30 – high flows which are exceeded 30% of the time

The resource availability for Staffordshire Trent Valley ALS is summarised in below, and for completeness the Water resource availability in all the ALSs within the study area is presented graphically in Figure 4.6.

4.5.3 Staffordshire Trent Valley ALS Abstraction Licensing Strategy

The Staffordshire Trent Valley ALS includes the River Trent, from its source on Biddulph Moor (north of Stoke-on-Trent) to the downstream confluence with the Tame. It also includes its tributaries. This ALS contains the entirety of Stoke-on-Trent and eastern areas of Newcastle-under-Lyme. The only principal aquifer in the ALS consists of Sherwood

Sandstone geology and provides a large quantity of water for abstraction.

There are ten assessment points (AP) across the ALS, of which two are relevant to the study area. AP1 is the Trent up to & including Strongford STW and it has water available for licensing, but new licenses are subject to certain conditions already discussed in the phase 1 study. AP7 is the Upper River Blithe and has no water available for licensing due to over-licensing and abstraction, this means that no new licenses will be issued and there is no impact on existing licence holders.

There are four groundwater management units which are within the study area which are Tittensor, Hatton, Forsbrook and Spot. All of these units are classified as not having water available for licensing due to previous over-abstraction. In total, there are ten management units across the ALS, of which three have water available for licensing.

For the Staffordshire Trent Valley abstraction licensing strategy, click here to visit https://www.gov.uk/government/publications/cams-staffordshire-trent-valley-abstraction-licensing-strategy

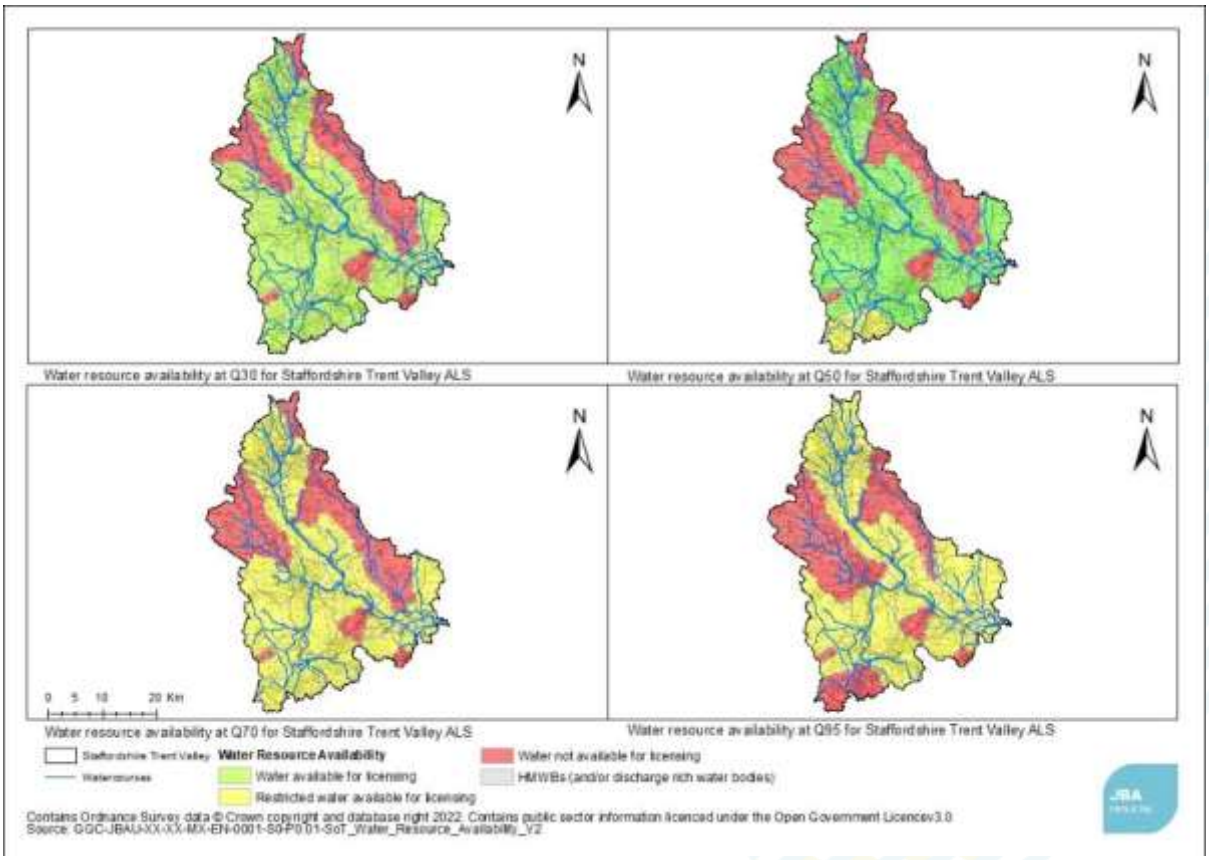


Figure 4.6 Water resource availability

4.6 Water Company Update

4.6.1 Water Resource Management Plan

The scoping study presented a summary of the Draft WRMP. The Final WRMP published in August 2019 was reviewed for the Phase 2 WCS and there were no significant changes that would impact the WCS.

For the Water resources management plan by Severn Trent Water, click here to visit https://www.severntrent.com/content/dam/stw-plc/our-plans/severn-trent-water-resource-management-plan.pdf

4.6.2 Severn Trent Water

Severn Trent Water is responsible for supplying Stoke-on-Trent with water. For the purposes of water resources planning, the STW supply area is divided into 15 Water Resources Zones (WRZs) which vary greatly in scale and have unique water resource concerns. Stoke-on-Trent is covered principally by the North Staffordshire WRZ.

In Phase 1 STW commented that they had adequate water resources for all proposed development sites. As the overall growth forecast for the area has not changed, this conclusion is still valid.

4.7 Water efficiency and water neutrality

4.7.1 Introduction

It is widely recognised that the climate is changing and in response, Stoke-on-Trent declared a climate emergency in 2019. Climate change is predicted to increase pressure on water resources, increasing the potential for a supply-demand deficit in the future, and making environmental damage from over abstraction of water resources more likely. Furthermore, the delivery of water and wastewater services and the heating of water in the home require high energy inputs, and therefore contribute directly to emissions of greenhouse gases. Water efficiency therefore reduces energy use and carbon emissions. It is important therefore that new development does not result in an unsustainable increase in water abstraction. This can be done in a number of ways from reducing the water demand from new houses through to achieving "water neutrality" in a region by offsetting a new developments water demand by improving efficiency in existing buildings.

Severn Trent Water STW launched a 4-month trial scheme called the Severn Trent NHH Water Efficiency Incentive in May 2021. The scheme will provide incentive payment to Non-household (NHH) customers through the retailer for reduction in volume of water consumed. The scheme will help STW identify the best approach in realizing better water efficiency in the area. The results of this trial have not yet been published.

For the Severn Trent NHH Water Efficiency Incentive Scheme Trial Terms and Conditions, click here to visit https://www.stwater.co.uk/content/dam/stw_businesses/retailers/water-efficiency-incentive-scheme-trial-terms-and-conditions.pdf

4.7.2 Required evidence

It is for Local Authorities to establish a clear need to adopt the tighter water efficiency target through the building regulations. This should be based on:

- Existing sources of evidence such as:
  - The Environment Agency classification of water stress
  - Water resource management plans produced by water companies
  - River Basin Management Plans which describe the river basin district and the pressure that the water environment faces. These include information on where water resources are contributing to a water body being classified as 'at risk' or 'probably at risk' of failing to achieve good ecological status, due to low flows or reduced water availability.
- Consultations with the local water and sewerage company, the Environment Agency and catchment partnerships
- Consideration of the impact on viability and housing supply of such a requirement

4.7.3 Water Stress

Water stress is a measure of the level of demand for water (from domestic, business and agricultural users) compared to the available freshwater resources, whether surface or groundwater. Water stress causes deterioration of the water environment in both the quality and quantity of water, and consequently restricts the ability of a waterbody to achieve a "Good" status under the WFD.

The Environment Agency has undertaken an assessment of water stress across the UK. This defines a water stressed area as where:

- "The current household demand for water is a high proportion of the current effective rainfall which is available to meet that demand; or
- The future household demand for water is likely to be a high proportion of the effective rainfall available to meet that demand."

In the Phase 1 study it was reported that STW's North Staffordshire WRZ (which covers all of Stoke-on-Trent) was classified as an area of "moderate" water stress in the 2013 Environment Agency and Natural Resources Wales water stress assessment. An updated water stress classification is being developed by the EA and was recently published for consultation. In this assessment the classification for the North

Staffordshire WRZ had changed from "moderate" to "serious", although it should be noted that this is provisional at the time of writing this WCS.

For the 2013 Environment Agency assessment on water stressed areas, click here to visit https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/244333/water-stressed-classification-2013.pdf

For the updated Environment Agency assessment on water stressed areas click here to visit https://www.gov.uk/government/consultations/determining-areas-of-water-stress-in-england

4.7.4 River Basin Management Plans

Consultation on the latest version of the River Basin Management Plans (RBMPs) is open and due to complete in April 2022. The draft of the Humber RBMP was not available at the time of writing this WCS and so the current RBMP published in 2015 was reviewed.

One of the challenges identified in the RBMP is "changes to natural flow and levels of water". The management recommendations from the RBMP are listed below:

- **All sectors** take up or encourage water efficiency measures, including water industry work on metering, leakage, audits, providing water efficient products, promoting water efficiency and education.
- **Local Government** sets out local plan policies requiring new homes to meet the tighter water efficiency standard of 110 litres per person per day as described in Part G of Schedule 1 to the Building Regulations 2010.
- **Industry manufacturing and other business** implement tighter levels of water efficiency, as proposed by changes to the Building Regulations.
- **Agriculture and rural land management** manage demand for water and use water more efficiently to have a sustainable water supply for the future.
- **Local government** commissions water cycle studies to inform spatial planning decisions around local water resources.

The RBMP goes on to state that "dealing with unsustainable abstraction and implementing water efficiency measures is essential to prepare and be able to adapt to climate change and increased water demand in the future."

For the 2015 Humber river basin district river basin management plan, click here to visit https://assets.publishing.service.gov.uk/government/uploads/system/up

loads/attachment_data/file/718328/Humber_RBD_Part_1_river_basin_management_plan.pdf

4.7.5 National Water Resources Framework

A new National Framework for Water Resources was published by the Government in March 2020. This outlines the water resources challenges facing England and sets out the strategic direction for the work being carried out by regional water resource groups.

A range of options were explored, and the most ambitious scenarios rely on policy change to introduce mandatory labelling of water using fittings and associated standards. The Government is currently reviewing policy on water efficiency following a recent consultation. The framework proposes that regional groups plan to help customers reduce their water use to around 110 l/p/d. This is achievable without policy interventions.

This aligns with the tighter standard of 110 l/p/d per day as described in building regulations. A water efficiency target higher than 110 l/p/d would make the overall target for the UK harder to achieve.

4.7.6 Regional Water Resources

Stoke-on-Trent is within the Water Resources West (WRW) regional water resource group and WRW are developing a long-term plan for water resources in the northwest of England, the Midlands and the cross-border catchments with Wales. As part of this work, and in order to support Local Authorities, an evidence paper was published to support the adoption of the optional water efficiency standard. WRW strongly recommend LPAs adopt the 110l/p/d target for water efficiency using the suggested policy wording below:

"All new residential development must achieve as a minimum the optional requirement set through Building Regulations for water efficiency that requires an estimated water use of no more than 110 litres per person per day".

For the evidence paper on Water Efficiency in New Homes by Water Resources West, click here to visit https://static1.squarespace.com/static/5e67889204d86850e1fdcece/t/61dda1b541f91757dd22a16c/1641914806785/WRW+evidence+to+support+water+efficiency+optional+standard+for+new+homes+%28updated+October21%29.pdf

4.7.7 Impact on viability

As outlined in section 3.2.3 the cost of installing water-efficient fittings to target a per capita consumption of 110l/d has been estimated as a one-off cost of £9 for a four-bedroom house. Research undertaken for the devolved Scottish and Welsh governments indicated potential annual savings on water and energy bills for householders of £24-£64 per year as a result of such water efficiency measures. Water efficiency is

therefore not only viable but of positive economic benefit to both private homeowners and tenants.

For the full article on water efficiency and savings, click here to visit https://waterwise.org.uk/wp-content/uploads/2019/10/Advice-on-water-efficient-homes-for-England061118.pdf

4.7.8 Summary of evidence for tighter efficiency standard

The strategic direction in the UK set out in the new National Water Resources Framework is to attain an average household water efficiency of 110 l/p/d by 2050. This also aligns with the recommendation in the River Basin Management Plan aimed at reducing the impact of abstraction. There would also be a positive economic impact for residents in terms of reduced energy and water bills.

It is therefore recommended that the tighter water efficiency standard of 110 litres per person per day as described in Part G of Schedule 1 to the Building Regulations 2010 is adopted for Stoke-on-Trent.

4.7.9 Water neutrality concept

Water neutrality is a relatively new concept for managing water resources, but one that is receiving increased interest as deficits in future water supply/demand are identified. The definition adopted by the Government and the Environment Agency is:

"For every development, total water use in the wider area after the development must be equal to or less than total water use in the wider area before development".

It is useful to also refer to the refined definition developed by Ashton:

"For every new significant development, the predicted increase in total water demand in the region due to the development should be offset by reducing demand in the existing community, where practical to do so, and these water savings must be sustained over time" (V Ashton, 2014).

For the full quotation, click here to visit https://www.wiley.com/en-gb/Water+Resources+in+the+Built+Environment:+Management+Issues+and+Solutions-p-9780470670910

This definition states the need to sustain water saving measures over time, and the wording "predicted increase in total water demand" reflects the need for water neutrality to be designed in at the planning stage.

Both definitions refer to water use in the region or "wider area", and the extent of this area should be appropriate to local authority boundaries, water resource zones, or water abstraction boundaries depending on what is appropriate for that particular location. For instance, if a development site is in an area of water stress relating to a particular abstraction source, offsetting water use in a neighbouring town that is

served by a different water source will not help to achieve water neutrality.

In essence water neutrality is about accommodating growth in a region without increasing overall water demand.

Water neutrality can be achieved in a number of ways:

- Reducing leakage from the water supply networks
- Making new developments more water-efficient
- "Offsetting" new demand by retrofitting existing homes with water-efficient devices
- Encouraging existing commercial premises to use less water
- Implementing metering and tariffs to encourage the wise use of water
- Education and awareness-raising amongst individuals

Suggestions for water-efficiency measures are listed in Table 4.3 below.

For the full article on the definition of water neutrality by the Environment Agency, click here to visit https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291675/scho1009bqzr-e-e.pdf

4.7.10 Consumer water efficiency measures

Table 4.3 Consumer water-efficiency measures

Type of measure	Examples
Education and promotional campaigns	• Encourage community establishments (e.g., schools, hospitals) to carry out self-audits on their water use • Deliver water conservation message to schools and provide visual material for schools • Building awareness with homeowners/tenants
Water-efficient measures for toilets	• Cistern displacement devices to reduce volume of water in cistern • Retro-fit or replacement dual flush devices • Retro-fit interuptable flush devices • Replacement low-flush toilets
Water-efficient measures for taps	• Tap inserts, such as aerators • Low flow restrictors • Push taps • Infrared taps

Type of measure	Examples
Water-efficient measures for showers and baths	• Low-flow shower heads • Aerated shower heads • Low-flow restrictors • Shower timers • Reduced volume baths (e.g. 60 litres) • Bath measures
Rainwater harvesting and water reuse	• Large-scale rainwater harvesting • Small-scale rainwater harvesting for example with a water butt, or rainwater tank for toilet flushing • Grey water recycling
Water-efficient measures addressing outdoor use	• Hosepipe flow restrictors • Hosepipe siphons • Hose guns (trigger hoses) • Drip irrigation systems • Mulches and composting
Commercial properties	• Commercial water audits • Rainwater recycling • Grey water recycling • Optimising processes • Provide water efficiency information to all newly metered businesses
Metering	• Promote water companies free meter option • Compulsory metering (in water stressed areas) • Smart metering (to engage customer with their consumption) • Provide interactive websites that allow customers to estimate the savings associated with metering (environmental and financial) • Innovative tariffs (seasonal, peak, rising block) • Customer supply pipe leakage - supply pope repair and replacement
Other	• Household water audits, including DIY or with help of plumber

Type of measure	Examples
	• Seek-and-fix internal leaks and/or dripping taps • Water efficient white goods, included washing machines and dishwashers • Ask customers to spot and report leaks

(Table adapted from Booth and Charleswell 2014.)

Many interventions are designed to reduce water use if operated in a particular way, and so rely on the user being aware and engaged with their water use. The educational aspect is therefore important to ensure that homeowners are aware of their role in improving water efficiency.

4.7.11 Rainwater Harvesting and Greywater Recycling

Rainwater harvesting

Rainwater recycling or rainwater harvesting (RwH) is the capture of water falling on buildings, roads or pathways that would normally be drained via a surface water sewer, infiltrate into the ground or evaporate. In the UK this water cannot currently be used as a drinking water supply as there are strict guidelines on potable water, but it can be used in other systems within domestic or commercial premises.

Systems for collection of rainwater can be simple water butts attached to a drainpipe on a house, or it could be a complex underground storage system, with pumps to supply water for use in toilet flushing and washing machines. By utilising rainwater in this way there is a reduced dependence on mains water supply for a large proportion of the water use in a domestic property.

Benefits of RwH

- RwH reduces the dependence on mains water supply – reducing bills for homeowners and businesses
- Less water needs to be abstracted from river, lakes and groundwater
- Stormwater is stored in a RwH system reducing the peak runoff leaving a site providing a flood risk benefit (for smaller storms)
- By reducing surface water flow, RwH can reduce the first flush effect whereby polluted materials adhering to pavement surfaces during dry periods are removed by the first flush of water from a storm and can cause pollution in receiving watercourses.

Challenges of RwH

- Dependency on rainfall can limit availability of harvested rainwater during drought and hot weather events.

- Increased capital (construction) costs to build rainwater harvesting infrastructure into new housing (£2,674 for a 3/4bed detached home)
- Payback periods are long as the cost of water is low so there is little incentive for homeowners to invest. For further information click here to visit: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/353387/021c_Cost_Report_11th_Sept_2014_FINAL.pdf

Greywater Recycling

Greywater refers to water that has been "used" in the home in appliances such as washing machines, showers and hand basins. Greywater recycling (GwR) is the treatment and re-use of this water in other systems such as for toilet flushing. By their nature, GwR systems require more treatment and are more complex than RwH systems, and there are limited examples of their use in the UK.

Greywater re-use refers to systems where wastewater is taken from source and used without further treatment. An example of this would be water from a bath or shower being used on plants in the garden. This sort of system is easy to install and maintain, however as mentioned above the lack of treatment to remove organic matter means the water cannot be stored for extended periods.

Greywater recycling refers to systems where wastewater undergoes some treatment before it is used again. These systems are complex and require a much higher level of maintenance than RwH or greywater re-use systems.

Domestic water demand can be significantly reduced by using GwR, and unlike with a RwH system where the availability of water is dependent on the weather, the source of water is usually constant (for instance if it is from bathing and showering). However, the payback period for a GwR system is usually long, as the initial outlay is large, and the cost of water relatively low. Viability of greywater systems for domestic applications is therefore currently limited. Communal systems may offer more opportunities where the cost can be shared between multiple households.

4.7.12 Energy and water use

According to EU statistics (Eurostat 2017), 17% of the UK's domestic energy usage is for water heating. If less water was being used within the home, for instance through more water efficient showers, less water would need to be heated, and overall domestic energy usage would be reduced.

The Government is currently analysing the results of a 2019 consultation on a Future Homes Standard that will involve changes to Part L (conservation of fuel and power) of the Building Regulations for new

dwellings. Whilst there is no direct mention of water efficiency in this consultation, there is an important link between water use and energy use, and therefore between water use and carbon footprint.

4.7.13 Funding for water neutrality

Water neutrality is unlikely to be achieved by just one type of measure, and likewise it is unlikely to be achieved by just one funding source. Funding mechanisms that may be available could be divided into the following categories:

- Infrastructure-related funding (generally from developer payments)
- Fiscal incentives at a national or local level to influence buying decisions of households and businesses
- Water company activities, either directly funded by the five-year price review or as a consequence of competition and individual company strategies
- Joint funding through energy efficiency schemes (and possibly to integrate with the heat and energy saving strategy).

Currently in the UK, the main funding resource for the delivery of water efficiency measures is the water companies, with some discretionary spending by property owners or landlords. For water neutrality to be achieved, policy shifts may be required in order to increase investment in water efficiency. Possible measures could include:

- Further incentivisation of water companies to reduce leakage and work with customers to reduce demand
- Require water efficient design in new development
- Developer funding to contribute towards encouraging water efficiency measures
- Require water efficient design in refurbishments when a planning application is made
- Tighter standards on water using fittings and appliances.

4.8 Conclusions

- Additional information was provided on the status of ground waterbodies present in Stoke-on-Trent that wasn't included in Phase 1 and updated to the Abstraction Licencing System were presented.
- No significant changes to the Severn Trent Water WRMP were identified.
- STW's position from Phase 1 was restated and therefore the conclusion from Phase 1 that there is adequate water resource to serve growth in Stoke-on-Trent is still valid.

- There is sufficient evidence to support the adoption of the tighter water efficiency target of 110 l/p/d allowed for in building regulations.
- Policies to reduce water demand from new developments, or to go further and achieve water neutrality in certain areas, could be defined to reduce the potential environmental impact of additional water abstractions in Stoke-on-Trent, and also help to achieve reductions in carbon emissions.

4.9 Recommendations

The recommendations for water resources are provided in Table 4.4 below.

Table 4.4 Recommendations on water resources

Action	Responsibility	Timescale
Continue to regularly review forecast and actual household growth across the supply region through WRMP Annual Update reports, and where significant change is predicted, engage with Local Planning Authorities.	STW	Ongoing
Provide yearly profiles of projected housing growth to water companies to inform the WRMP update.	SOTCC	Ongoing
Use planning policy to require the 110l/person/day water consumption target permitted by National Planning Policy Guidance in water-stressed areas.	SOTCC	In Local Plan
The concept of water neutrality has potentially a lot of benefit in terms of resilience to climate change and enabling all waterbodies to be brought up to Good status. Explore further with STW and the Environment Agency how the Council's planning and climate change policies can encourage this approach.	SOTCC, EA, STW	In the Local Plan and Climate Change Action Plan
Water companies should advise SOTCC of any strategic water resource infrastructure developments within the Authority, where these may require safeguarding of land to prevent other type of development occurring.	STW, SOTCC	In the Local Plan

5 Water Supply Infrastructure

5.1 Introduction

An increase in water demand due to growth can exceed the hydraulic capacity of the existing supply infrastructure. This is likely to manifest itself as low pressure at times of high demand. An assessment is required to identify whether the existing infrastructure is adequate or whether upgrades will be required. The time required to plan, obtain funding, and construct major pipeline works can be considerable and therefore water companies and planners need to work closely together to ensure that the infrastructure is able to meet growing demand.

Water supply companies make a distinction between supply infrastructure, the major pipelines, reservoirs, and pumps that transfer water around a WRZ, and distribution systems, smaller scale assets which convey water around settlements to customers. This outline study is focused on the supply infrastructure. It is expected that developers should fund water company impact assessments and modelling of the distribution systems to determine requirements for local capacity upgrades to the distribution systems.

In addition to the work undertaken by water companies, there are opportunities for the local authority and other stakeholders to relieve pressure on the existing water supply system by increasing water efficiency in existing properties. This can contribute to reducing water consumption targets and help to deliver wider aims of achieving water neutrality.

A cost-effective solution can be for local authorities to co-ordinate with water supply companies and "piggyback" on planned leakage or metering schemes, to survey and retrofit water efficient fittings into homes. This is particularly feasible within property owned or managed by the local authorities, such as social housing.

For more on water efficiency retrofitting, click here to visit http://www.waterwise.org.uk/wp-content/uploads/2018/01/Waterwise-2009_Water-efficiency-Retrofitting_Best-practice.pdf

5.1.1 Conclusion from Phase 1

STW do not typically provide a site-by-site analysis as they do not have a team resourced to carry out such an assessment. They advise that as long as a site is within a water resource zone with sufficient water resources, then they "do not envisage a problem" with supply to that site. They also note that there are no new garden towns or villages proposed, which can prove more of a challenge to supply water to. Where a site is a long distance from the network, a requisition may be required which is assessed at the time of contact with the developer. The following conclusions from the Phase 1 study are therefore still valid:

- Within the study area, there is enough water resource to supply all the proposed developments.
- No limitations on the provision of water supply infrastructure were identified by STW.
- A site-by-site assessment has not been completed as part of this study. Individual sites should be assessed as part of the planning process, and early engagement between developers and STW is recommended to ensure that the water supply network has sufficient capacity locally to accommodate the additional demand without detriment to existing customers.

5.1.2 Recommendations

Table 5.1 Recommendations for water supply infrastructure

Action	Responsibility	Timescale
Undertake network modelling where appropriate to ensure adequate provision of water supply is feasible	STW	As part of the planning process
SOTCC and Developers should engage early with STW to ensure infrastructure is in place prior to occupation.	SOTCC, STW, Developers	Ongoing

6 Wastewater Collection

6.1 Sewerage undertakers

Severn Trent Water is the Sewerage Undertaker (SU) for the study area. The role of the sewerage undertaker includes the collection and treatment of wastewater from domestic and commercial premises, and in some areas, it also includes the drainage of surface water from building curtilages to combined or surface water sewers. It excludes, unless adopted by the SU, systems that do not connect directly to the wastewater network, e.g., Sustainable Drainage Systems (SuDS) or highway drainage.

Increased wastewater flows into collection systems due to growth in populations or per-capita consumption can lead to an overloading of the infrastructure, increasing the risk of sewer flooding and, where present, increasing the frequency of discharges from Combined Sewer Overflows (CSOs).

Likewise, headroom at Wastewater Treatment Works (WwTW) can be eroded by growth in population or per-capita consumption, requiring investment in additional treatment capacity. As the volumes of treated effluent rises, even if the effluent quality is maintained, the pollutant load discharged to the receiving watercourse will increase. In such circumstances the Environment Agency as the environmental regulator, may tighten the permit limits of effluent consents to achieve a "load standstill", i.e., ensuring that as effluent volume increases, the pollutant discharged does not increase. Again, this would require investment by the water company to improve the quality of the treated effluent.

In combined sewerage systems, or foul systems with surface water misconnections, there is potential to create headroom in the system, thus enabling additional growth, by the removal of surface water connections. This can most readily be achieved during the redevelopment of brownfield sites which have combined sewerage systems, where there is potential to discharge surface waters via sustainable drainage systems (SuDS) to groundwater, watercourses or surface water sewers. In some areas of Stoke-on-Trent, there are known issues of surface water causing localised flooding. Strategic schemes to provide improved local surface water drainage may be required in such areas, rather than solely relying upon on-site soakaways on brownfield or infill plots.

STW are supportive of the use of SuDS and SuDS principles to manage surface water run-off. They recommend that the Drainage Hierarchy is used to direct surface water to natural outfall routes such as infiltration to the ground or into watercourses, before utilising sewers, as supported by paragraph 80 of the NPPF. Surface water should also not be permitted to connect to a foul sewer.

Another issue when considering sewer capacity is the volume of groundwater infiltration. This is where groundwater enters the public

and private sewerage systems through cracks, holes, or faulty joints. In catchments where there is significant groundwater infiltration, capacity in the sewer is used up in the same way as the presence of a surface water misconnection. Under storm conditions this increases the likelihood of sewer flooding or sewage overflows into watercourses. In some catchments prone to significant groundwater infiltration into sewers, there are 'unavoidable discharges', where water is allowed to flow from, or is pumped from foul sewers overloaded with infiltration, in order to prevent flooding. These are being managed through Infiltration Management Plans, in line with Environment Agency policy.

6.2 Sewerage System Capacity Assessment

New residential developments and new employment land add pressure to the existing sewerage systems. An assessment is required to identify the available capacity within the existing systems, and the potential to upgrade overloaded systems to accommodate future growth. The scale and cost of upgrading works may vary significantly depending upon the location of the development in relation to the network itself and the receiving WwTW.

It may be the case that an existing sewerage system is already working at its full capacity and further investigations have to be carried out to define which solution is necessary to implement an increase in its capacity. New infrastructure may be required if, for example, a site is not served by an existing system. Such new infrastructure will normally be secured through private third-party agreements between the developer and utility provider.

Sewerage Undertakers must consider the growth in demand for wastewater services when preparing their five-yearly Strategic Business Plans (SBPs) which set out investment for the next Asset Management Plan (AMP) period. Typically, investment is committed to provide new or upgraded sewerage capacity to support allocated growth with a high certainty of being delivered. Additional sewerage capacity to service windfall sites, smaller infill development or to connect a site to the sewerage network across third party land is normally funded via developer contributions, as third-party arrangements between the developer and utility provider.

6.3 Methodology

Severn Trent Water were provided a list of the potential allocations and asked to assess each site based on the impact on the wastewater network. The following red/amber/green definition was used by STW to score each site:

LOW - GREEN	MEDIUM - AMBER	HIGH - RED
Network improvements unlikely to be required	Network improvements may be required	Network improvements likely to be required

The assessment was divided into foul sewer network and surface water sewer assessments.

A red RAG score given by the water companies reflects the presence of sewer flooding, CSO spills or pollution events in the vicinity of the site, on the assumption that an increase in wastewater flows from development would make those occurrences more likely in the future. It also takes into account the size of the site, with larger sites more likely to exacerbate existing issues in the network.

For surface water, a red RAG score indicates that the potential site has limited options for a sustainable surface water discharge point, i.e., the developer may have no option other than to make a connection into the combined sewerage system. STW "would encourage the LPA to consider surface water within site selection. If a "red" site were progressed to an allocation in the Local Plan, STW recommend that they should be accompanied by site specific policy requesting extra vigour around proving adherence to the drainage hierarchy before considering surface water discharge into the combined network". STW advise that "site specific policy, master planning or onsite reinforcements are all steps the LPA could consider utilising to help accommodate these sites as sustainably as possible".

A red assessment does not reflect a "showstopper" and it should be remembered that the water companies have a statutory duty to serve new development under the Water Industry Act 1991 – but the rating shows where the most amount of new infrastructure or network reinforcement will be required.

An amber assessment indicates where further modelling may be required to understand local capacity in the network, and a green assessment indicates that no constraints have been identified.

It should be noted that this assessment does not replace appropriate assessments or modelling as part of developer engagement with the sewerage undertaker, evidence of which should be demonstrated to the LPA as an application progresses through the planning process.

6.4 Results

6.4.1 Foul sewer network assessment

For the avoidance of doubt, this assessment refers to wastewater flows in both foul and combined sewer systems. 62 sites were given a "green" assessment by Severn Trent Water, however as these tend to be smaller sites, they only deliver 2,829 houses.

Three housing sites (0369, 0417 and 0442) and two employment sites (ST31 and ST32) were given a "red" assessment reflecting potential issues due to existing flooding and pollution issues in downstream networks.

The remaining sites were given an "amber" assessment indicating that some upgrades to infrastructure may be required in order to accommodate these sites. STW advise that infrastructure capacity work can often be avoided or reduced should a sustainable discharge mechanism for surface water be found. It is essential that Severn Trent Water is engaged early so upgrade work can be planned and completed prior to occupation of new developments. In the case of some sites significant investment may be required in order to pump wastewater to the nearest sewer, provide a bespoke treatment solution, undertake capacity upgrades, and undertake hydraulic modelling to better understand the flooding on site and the cumulative impacts of multiple sites within a catchment.

The assessments completed in this WCS by Severn Trent are desktop studies. More detailed network modelling may be required during the planning process in order to better understand the impact on the foul sewer network. This is usually best conducted once there is greater certainty on the delivery of development sites.

Table 6.1: RAG ratings for Foul Sewerage Network Capacity

Type of growth	**Red** - High	**Amber** - Medium	**Green** - Low
Number of residential sites	2	40	52
Number of houses	775	8,830	2,829
Number of employment sites	3	10	14
Indicative Number of employees	1,149	1,900	5710

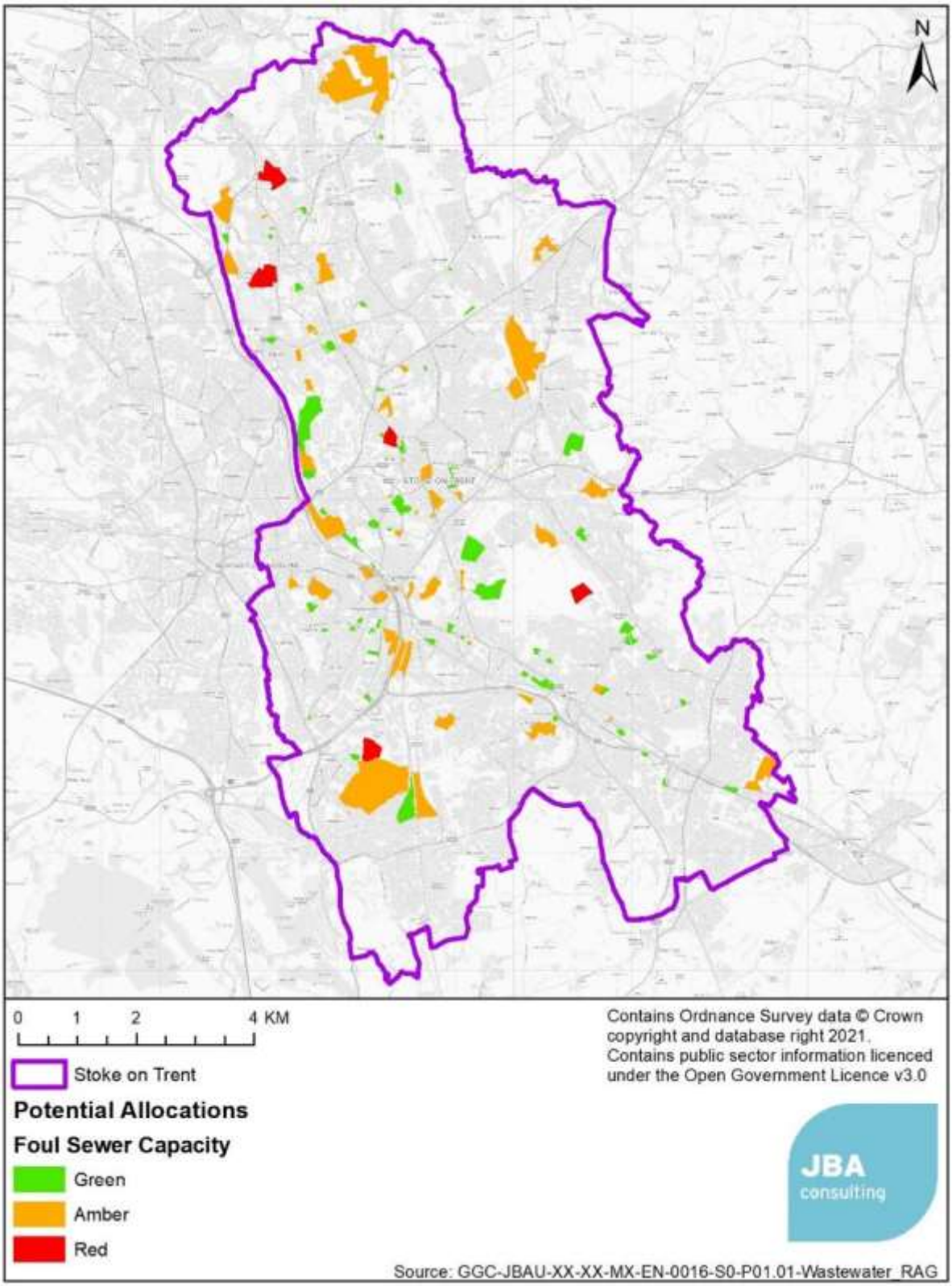


Figure 6.1 Foul sewer network RAG assessment

Note: This map contains potential allocations that are already in the planning system or under construction.

6.4.2 Surface Water sewerage capacity

53 residential sites and 25 employment sites were given a "green" assessment by Severn Trent Water, making up 10,134 of the total 12,499 houses (from potential allocations). Many of the larger residential and employment sites with a red RAG score for foul network capacity have been allocated a green RAG score for surface water network capacity.

One site (442) was given a "red" RAG score by Severn Trent Water on the basis that the current storm network near this development connects into a combined sewer. Significant infrastructure may be required in order to provide a new surface water connection. This should be investigated as part of a drainage strategy for the site and early engagement with STW is essential to ensure a solution is possible that does not increase the risk of sewer flooding or storm overflow operation.

The remaining sites were given an "amber" assessment indicating that some upgrades to infrastructure may be required in order to accommodate these sites. As with the water supply assessment, where upgrades are required it is essential that Severn Trent Water is engaged early so upgrade work can be planned and completed prior to occupation of new developments.

It is recommended that SuDS are utilised on all sites to manage surface water. However, it should be noted that SuDS alone do not protect the public sewerage system and that the drainage hierarchy still applies. SuDS connection of surface water into the combined sewerage system is still detrimental to its performance and may exacerbate existing flood risk issues or spills from combined sewer overflows.

The assessments completed in this WCS by the Severn Trent are desktop studies. More detailed network modelling may be required during the planning process in order to better understand the impact on the surface water network. This is usually best conducted once there is greater certainty on the delivery of development sites.

Table 6.2 RAG ratings for Surface Water Sewerage Network

Type of growth	Red - High	Amber - Medium	Green - Low
Number of residential sites	1	18	76
Number of houses	356	2,009	10,069
Number of employment sites	0	2	24

Type of growth	Red - High	Amber - Medium	Green - Low
Indicative Number of employees	0	3,367	5,392

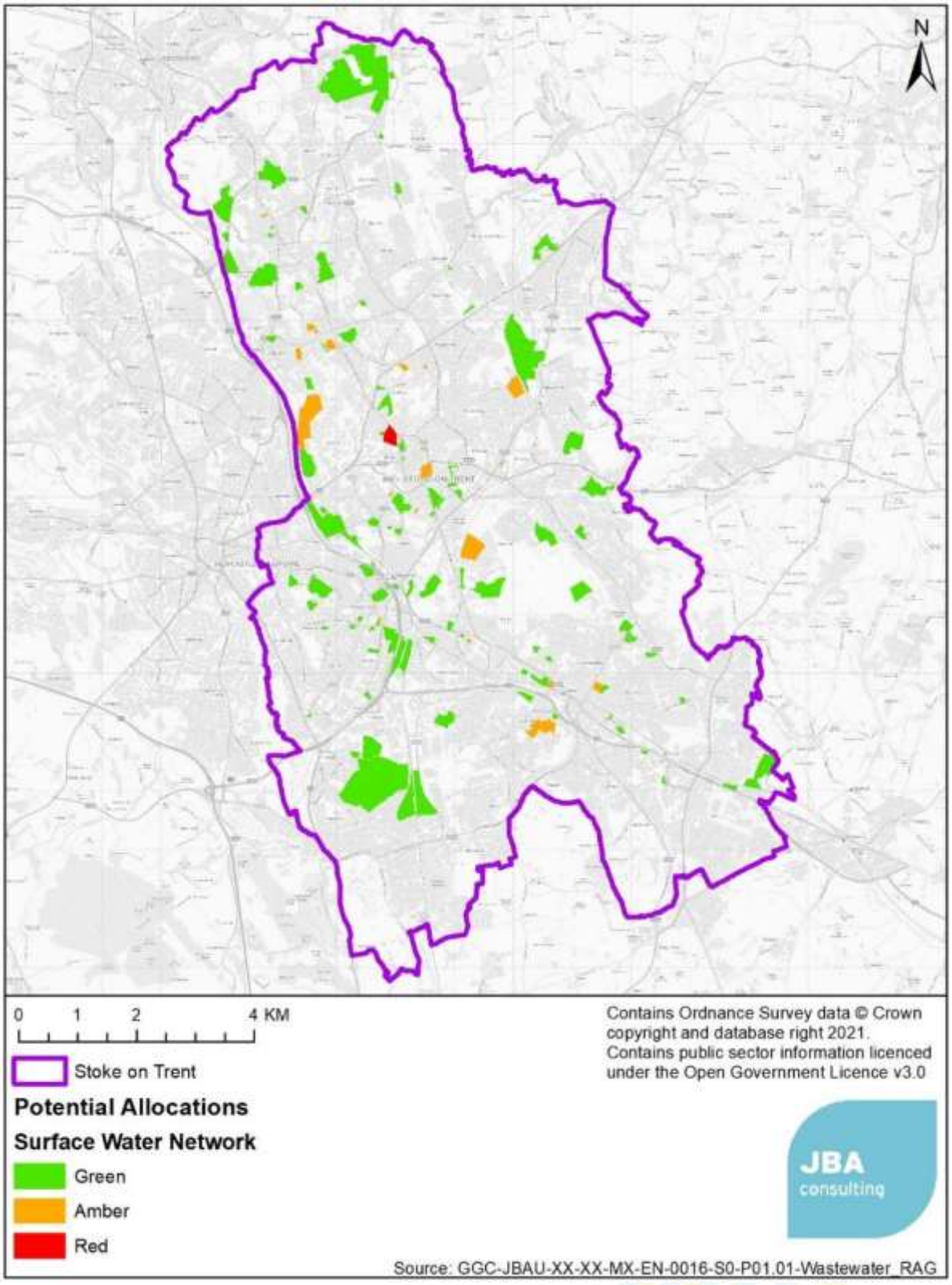


Figure 6.2 Surface water sewer network RAG assessment

6.4.3 Severn Trent Water comments

STW provided the following general comments:

"The purpose of these desktop-based assessments is to indicate where proposed development MAY have a detrimental impact on the performance of the existing public sewerage network taking into account the size of the development proposals.

For most new development provided the surface water in managed sustainably through use of a SuDS the additional foul only flows will have a negligible impact on existing sewer performance but where there are pre-existing capacity constraints additional capacity improvements may be required.

Where subsequent detailed modelling indicates capacity improvements are required such work will be phased to align with development occupancy with capacity improvement works will be funded by Severn Trent Water. However, whilst Severn Trent have a duty to provide additional capacity to accommodate planned development, we also have a requirement to manage our assets efficiently to minimise our customers' bills. Consequently, to avoid potential inefficient investment we generally do not provide additional capacity until there is certainty that the development is due to commence. Where development proposals are likely to require additional capacity upgrades to accommodate new development flows it is highly recommended that potential developers contact Severn Trent as early as possible to confirm flow rates and intended connection points. This will ensure provision of additional capacity can be planned into our investment programme to ensure development is not delayed."

6.5 Storm overflows

There are many storm overflows present in Stoke-on-Trent, the location of these is shown in Figure 6.3 below. The Storm Overflow Taskforce (made up of Defra, the Environment Agency, Ofwat, Consmer Council for Water, blueprint for Water and Water UK) has agreed a long-term goal to end the damaging pollution caused by the operation of storm overflows. An important component of this is the monitoring of overflows, and a target has been set to monitor the frequency and duration of operation at all storm overflows by 2023. This is called Event Duration Monitoring (EDM). The EDM dataset (based on the 12,000 storm overflows monitored in 2020) has been used to provide information on storm overflows in Stoke-on-Trent.

The EA have set a threshold of 60 operations per year above which a storm overflow should be investigated. 80 storm overflows were identified within the study area, and it can be seen in Table 6.3 that at eight of these operated more than 60 times in 2020. Storm overflows operating between 40 and 60 times have also been included in the table.

For the targets on overflow monitoring, click here to visit https://environmentagency.blog.gov.uk/2021/03/31/event-duration-monitoring-lifting-the-lid-on-storm-overflows/

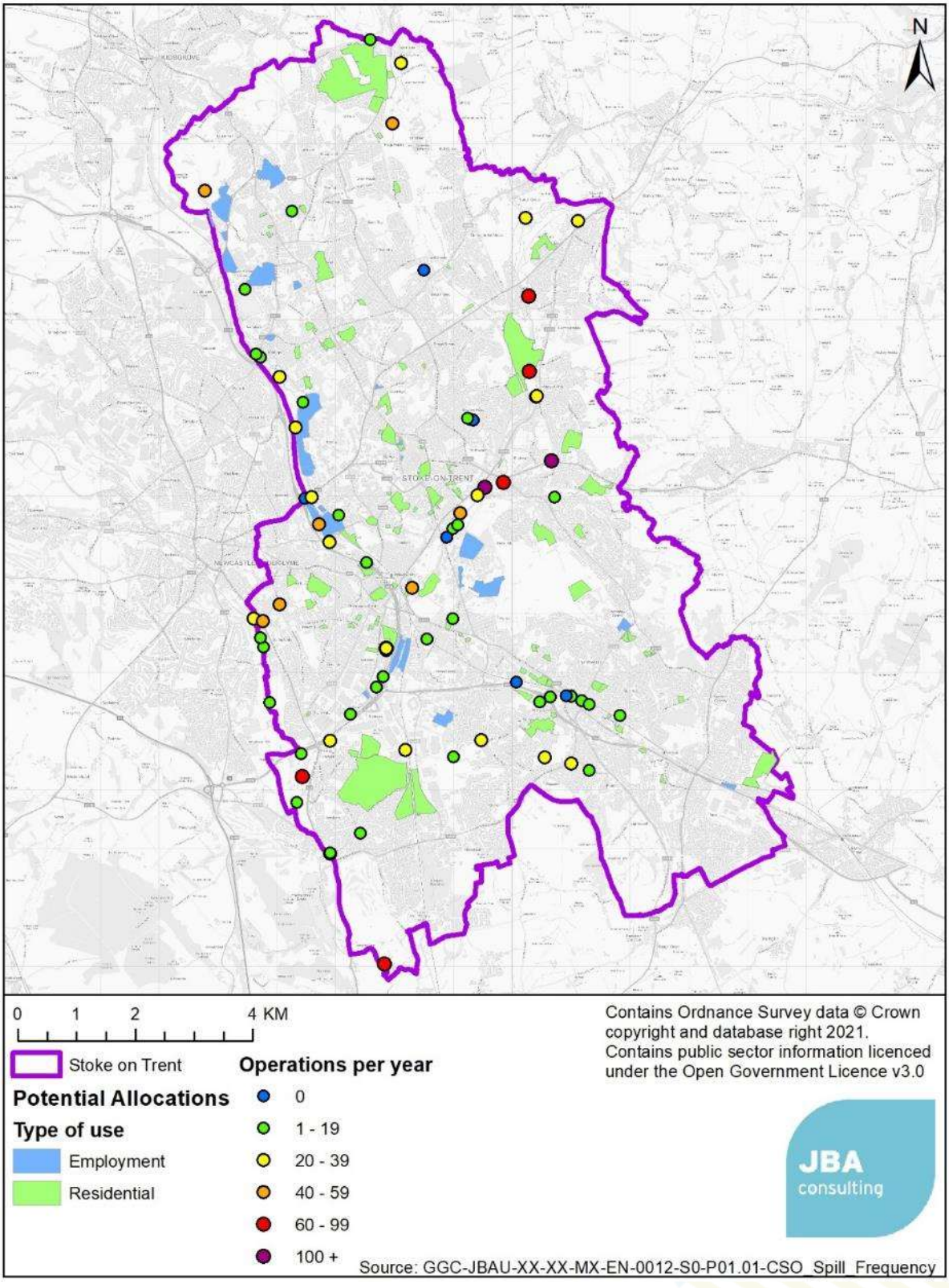


Figure 6.3 Storm overflow location, frequency and duration of operation

Table 6.3 Storm overflow operations (>40/yr)

Storm overflow	Permit Ref	Duration in 2020 (hours)	% of year overflow operated	Number of operations in 2020
BUCKNALL - WERRINGTON ROAD (CSO)	T/01/35719/O	3748	42.8%	195
TRENT VALE PS (CSO)	T/01/36007/O	965	11.0%	81
HANLEY - LEEK ROAD (CSO)	T/01/36022/O	1324	15.1%	135
PENKHULL-PENKHULL NEW ROAD (CSO)	T/01/21322/O	50	0.6%	62
MILTON - GAYTON AVENUE (CSO)	T/01/36406/O	52	0.6%	66
BOATHORSE ROAD CSO (TUNSTALL - BOATHORSE ROAD (CSO))	T/01/35893/O	746	8.5%	47
HANLEY - CAULDON ROAD (CSO)	T/01/21319/O	56	0.6%	48
HANLEY - LEEK RD/BOTTESLOW ST (CSO)	T/01/35967/O	11	0.1%	40
STRONGFORD SEWAGE TREATMENT WORKS (STRONGFORD (SEWAGE TREATMENT WORKS))	T/01/36052/R	1044	11.9%	96
GREAT CHELL - CUMBERBATCH AVENUE (CSO)	T/01/35798/O	47	0.5%	42
HARTSHILL - HILTON ROAD (CSO)	T/01/36238/O	31	0.4%	41

Storm overflow	Permit Ref	Duration in 2020 (hours)	% of year overflow operated	Number of operations in 2020
BUCKNALL - DIVIDY RD/JOINERS SQ (CSO)	T/01/35986/O	58	0.7%	73
ABBEY HULTON - BIRCHES HEAD ROAD (SST)	T/01/35770/O	293	3.3%	95
HARTSHILL - RISELEY ROAD (CSO)	T/01/35715/O	35	0.4%	55
GARNER STREET ETRURIA (ETRURIA - GARNER STREET (CSO))	T/01/21052/O	280	3.2%	47

Growth in areas where there is already a high level of storm overflow operation, could exacerbate the issue by increasing flows in the sewer network – both directly from wastewater and through runoff from surface water. When developing a site, surface water drainage must be designed to prevent surface water discharging to the combined sewerage system. This is particularly applicable to brownfield development sites with previously combined drainage systems. Infiltration of groundwater through the fabric of sewers and drains also increases the frequency and duration of storm overflow operation.

STW provided a comment specifically on the overflow with the highest spill count in 2020: "With regards to Werrington Road CSO itself, we recognise the high spill count within the EDM data and would point out that the exercise is not exempt from data quality issue associated with monitoring sewer flows. The monitors and equipment used require a degree of calibration and maintenance and as such can return incorrect data where this is lacking. If you review our published data, there's actually a comment on this site disclosing that there have been maintenance issues with the monitor. We continue to review and enhance our EDM monitors to build longer term datasets and encourage others to view full period data for a wider timeframe and not just a single annual submission which may contain errors. Ultimately it comes back to our goal of protecting water quality and that being more important than the number of spills, we are heavily regulated around this, and environmental damage can result in large penalties both financially and reputationally."

STW provided further comments on storm overflows: "we have an ongoing water quality project under the Environment Agencies WINEP programme (Water Industry National Environment Programme) looking at numerous overflows within the catchment. This project however focuses on the output of waterbody Water Framework Directive classification as opposed to the frequency of spill operations. Our focus is on ensuring overflow operations do not result in environmental damage to local watercourses, not how many times they spill."

6.6 Conclusions

Development in areas where there is limited wastewater network capacity will increase pressure on the network, increasing the risk of a detrimental impact on existing customers, and increasing the likelihood of storm overflow operation (where present). The results in section 6.4.1 and 6.4.2 show that for many of the proposed allocations, upgrades to the wastewater or surface water sewer network are required. Early engagement between SOTCC, developers and STW is required to ensure that development sites are aligned with provisions of upgrades to the wastewater network, and further modelling may be required as part of the planning process.

Stoke-on-Trent contains 80 storm overflows, eight of which are operating above the threshold for an investigation to take place. In areas where the current network is a combined sewer system, further separation of foul and surface water may be required as well as suitably designed SuDS.

6.7 Recommendations

Table 6.4 Recommendations from wastewater network assessment

Action	Responsibility	Timescale
Early engagement between Developers, SOTCC and STW is required to ensure that where upgrades to infrastructure is required, it can be planned in by STW.	SOTCC, Developers, STW	Ongoing
Take into account wastewater infrastructure constraints in phasing development in partnership with the sewerage undertaker	SOTCC, STW	Ongoing
Developers will be expected to work with the sewerage undertaker closely and early in the planning promotion process to develop an outline foul Drainage Strategy for sites to the satisfaction of the LPA	STW and Developers	Ongoing

Action	Responsibility	Timescale
that the development will not increase sewer flooding or the frequency or duration of storm overflow operation. The Outline Foul Drainage strategy should set out the following: What – What is required to serve the site Where – Where are the assets / upgrades to be located When – When are the assets to be delivered (phasing) Which – Which delivery route is the developer going to use s104 s98 s106 etc. The Outline Drainage Strategy should be submitted as part of the planning application submission, and where required, used as a basis for a drainage planning condition to be set.		
Developers will be expected to demonstrate to the Lead Local Flood Authority (LLFA) that surface water from a site will be disposed using a sustainable drainage system (SuDS) with connection to foul sewers seen as the last option. New connections for surface water to foul sewers will be resisted by the LLFA and the discharge rate should also be agreed with the LLFA. Where a surface water connection is proposed to the public sewerage network, it should be demonstrated to Severn Trent Water that there is no other technically feasible option by selecting options as high as possible within the surface water hierarchy.	Developers, LLFA, STW	Ongoing

7 Wastewater Treatment

7.1 Wastewater Treatment Works in Stoke-on-Trent

Two WwTWs are expected to serve growth in Stoke-on-Trent, Strongford and Checkley WwTWs and their location is shown in Figure 7.1 below. Both these WwTWs are operated by Severn Trent Water.

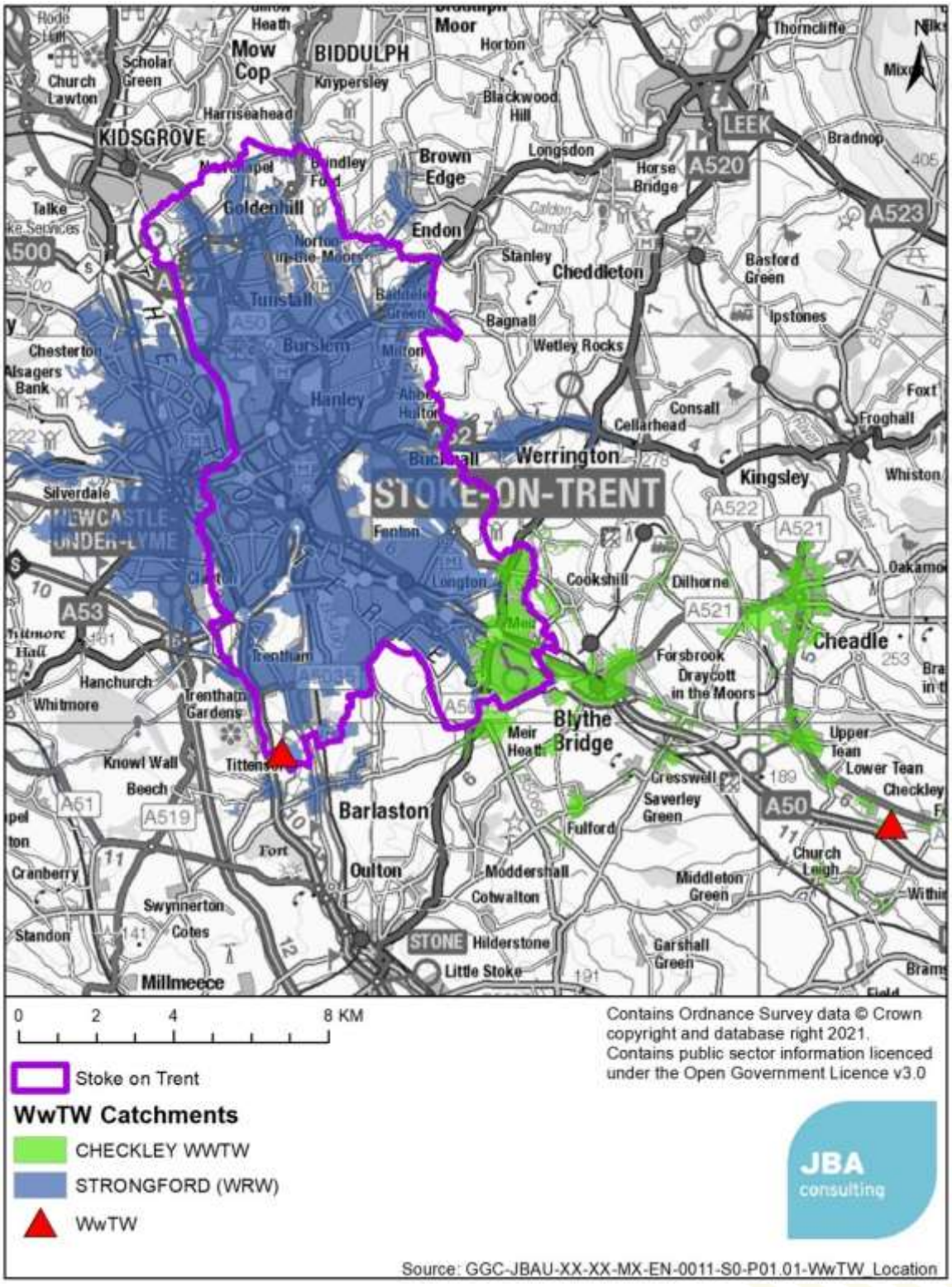


Figure 7.1 Location of WwTWs in and around Stoke-on-Trent

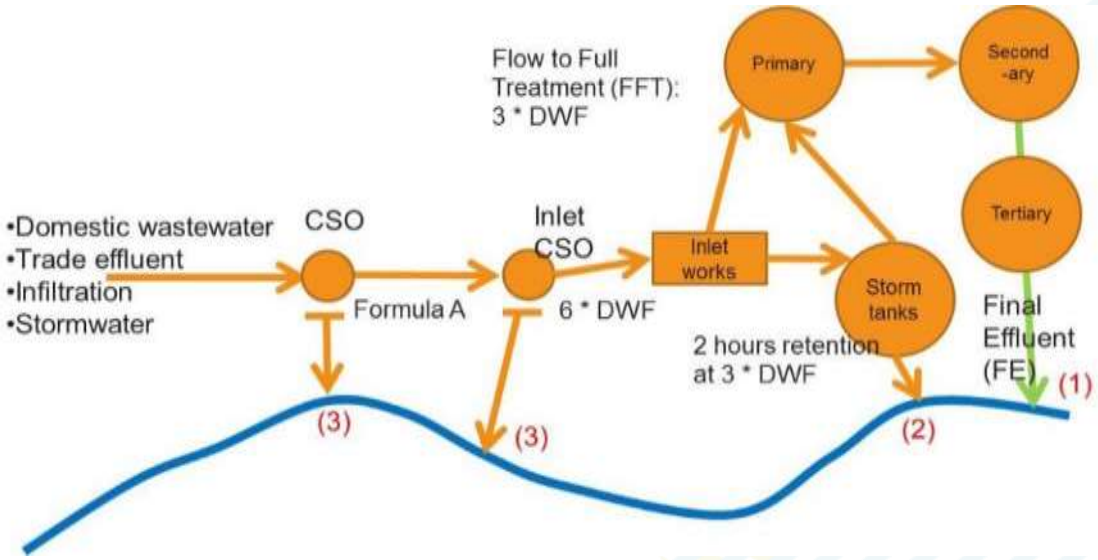
7.2 Wastewater Treatment Works Flow Permit Assessment

7.2.1 Introduction

The Environment Agency is responsible for regulating sewage discharge releases via a system of Environmental Permits (EPs). Monitoring for compliance with these permits is the responsibility of both the EA and the plant operators. Figure 7.2 summarises the different types of wastewater releases that might take place, although precise details vary from works to works depending on the design.

During dry weather, the final effluent from the WwTW should be the only discharge (1). With rainfall, the storm tanks fill and eventually start discharging to the watercourse (2) and where present, Combined Sewer Overflows (CSOs) upstream of the storm tanks start to operate (3). The discharge of storm sewage from treatment works is allowed only under conditions of heavy rain or snow melt, and therefore the flow capacity of treatment systems is required to be sufficient to treat all flows arising in dry weather and the increased flow from smaller rainfall events. After rainfall, storm tanks should be emptied back to full treatment, freeing their capacity for the next rainfall event.

Figure 7.2 Overview of typical combined sewerage system and WwTW discharges



Environmental permits control the pollutant load discharged from a water recycling centre to a receiving watercourse and set out the concentration of substances and the volume for each effluent. Sewage flow rates must be monitored for all WwTWs where the permitted discharge rate is greater than 50 m^3/day in dry weather.

Permitted discharges use a statistic known as the Dry Weather Flow (DWF). As well as being used in the setting and enforcement of effluent discharge permits, the DWF is used for WwTW design, as a means of estimating the 'base flow' in sewerage modelling and for determining the

flow at which discharges to storm tanks will be permitted by the permit (Flow to Full Treatment, FFT).

WwTW Environmental Permits consent for maximum concentrations of pollutants, in most cases Suspended Solids (SS), Biochemical Oxygen Demand (BOD) and Ammonia (NH4). These may be expressed as annual average concentrations or 95 percentiles etc depending on the substance. Some works (usually the larger works) also have permits for Phosphorous (P). These are determined by the Environment Agency with the objective of ensuring that the receiving watercourse is not prevented from meeting its environmental objectives, with specific regard to the physico-chemical Status element of the Water Framework Directive (WFD) classification.

Increased domestic population and/or employment activity can lead to increased wastewater flows arriving at a WwTW. Where there is insufficient headroom at the works to treat these flows, this could lead to failures in flow consents.

7.3 Methodology

An assessment of WwTW capacity was carried out by JBA using measured flow data supplied by the water companies. The process was as follows:

- STW provided their Dry Weather Flow (DWF) statistics, and from this the 20th percentile (80% exceedance flow) for 2017-2020 was calculated. The flow data was processed to remove zero values and low outlier values which would artificially reduce the measured DWF.
- Potential allocations, windfall and existing commitments were assigned to a WwTW using the sewerage drainage area boundaries provided by STW.
- For each residential site, the future DWF was calculated using the occupancy rates and per-capita consumption values obtained from the Water Resource Management Plans (Table 7.1), and the assumption that 95% of water used is returned to sewer. Permitted headroom was used as a substitute for actual designed hydraulic capacity for each WwTW being assessed.
- For employment sites, the net floorspace provided by SOTCC was used to estimate the number of employees using the employment use class, and standard densities from the Employment Density Guide 3rd Edition (Homes & Communities Agency, 2015). A standard figure of 0.1m^3/employee/day was then used to estimate water demand on each site.
- For this study it is assumed that every development site identified in a wastewater catchment is developed. This represents a "worse-case" scenario for capacity at each WwTW.

Table 7.1 Per capita consumption values used in water demand calculations

Water Company	Water Resource Zone	Occupancy rate (persons per dwelling)	Per capita consumption (m^3/person/day)
Severn Trent Water	North Staffordshire	2.2	0.109

- The current and estimated future flow was then compared to the permitted flow obtained from the Environment Agency "Consented Discharges to Controlled Waters with Conditions" database.
- Headroom (expressed the number of homes that could be accommodated before the permit is exceeded) was estimated by calculating the difference between the current and permitted flow and using the occupancy and per capita consumption for the WRZ the sewer catchment is in to provide an estimate for the number of houses.
- A red/amber/green score was then assigned to each WwTW based on whether it was likely to exceed its permitted flow.
- Severn Trent Water were also asked to comment on specific issues in any of the WwTWs.

The following red/amber/green traffic light definition was used by STW to score each WwTW:

GREEN / LOW - Not expected to be an issue / No land or other constraints preventing expansion	AMBER / MEDIUM - Marginal concern subject to size of development / limited potential to provide additional capacity	RED / HIGH - Probable issue / no scope to provide additional capacity

7.4 Results

Severn Trent Water provided an assessment of each WwTW based on the estimated spare hydraulic capacity and the risk of additional flow from growth causing hydraulic headroom to be used up. A further assessment on the environmental capacity of receiving watercourse was also provided and is presented in Section 9.

JBA carried out an independent assessment of WwTW capacity and the results are shown alongside the STW assessment in Table 7.2. Both WwTWs expected to serve growth have sufficient hydraulic headroom during the plan period. It does not take into account the impact on downstream water quality of using available headroom.

Table 7.2 WwTW capacity assessment results

WwTW	STW Assessment	JBA Assessment	Estimated spare hydraulic capacity (STW)
Strongford	LOW	LOW	60,680
Checkley	LOW	LOW	8,666

Where a WwTW has sufficient headroom to accommodate all of the potential growth during the plan period it has been given a "Green" RAG rating indicating that the WwTW is likely to operate within its permit.

7.5 Conclusions

There are two WwTWs that may serve growth during the plan period in Stoke-on-Trent. Both of these are expected to have capacity to accommodate this growth (alongside neighbouring authority growth).

In addition to hydraulic capacity, it is important to consider water quality considerations which are discussed in Section 9 and 11.

7.6 Recommendations

Table 7.3 Recommendations for wastewater treatment

Action	Responsibility	Timescale
Consider the available WwTW capacity when phasing development going to the same WwTW.	SOTCC STW	Ongoing
Provide Annual Monitoring Reports to STW detailing projected housing growth.	SOTCC	Ongoing
STW to assess growth demands as part of their wastewater asset planning activities and feedback to the Council if concerns arise.	STW SOTCC	Ongoing

8 Odour Assessment

8.1 Introduction

Where new developments are in close proximity to an existing Wastewater Treatment Works (WwTW), odour from that site may become a cause for nuisance and complaints from residents. Managing odour at WwTWs can add considerable capital and operational costs, particularly when retro fitted to existing WwTWs. National Planning Policy Guidance recommends that plan-makers consider whether new development is appropriate near to sites used (or proposed) for water and wastewater infrastructure, due to the risk of odour nuisance. Sewerage undertakers recommend that an odour assessment may be required if the site of a proposed development is close to a WwTW and is encroaching closer to the WwTW than existing urban areas. The general principle is that allocated sites should not be located where a suitable standard of amenity cannot be achieved, or the continuous operation of an existing WwTW would be prejudiced.

8.2 Methodology

An assessment was carried out based on the Anglian Water Asset Encroachment Risk Assessment Methodology. Although this method was developed by Anglian Water, it is applicable to any catchment and allows the size of a WwTW to be taken into account when considering the odour risk.

The closest WwTW to each site is determined, along with the distance and direction of the WwTW to that site. The actual odour experienced is dependent on the size of the works, the type of treatment processes present, and the age and condition of the site. There is also significant variation due to current weather conditions.

To take into account the size of the works, the dry weather flow (DWF) was used to calculate an approximate population served by each WwTW and this was used to assign a "trigger" distance. Where the distance between the site and the WwTW is less than the trigger distance, an odour assessment is recommended. The trigger distances used are outlined in Table 8.1.

This is an adaptation of the Anglian Water asset encroachment methodology and uses the same categorisation by population served to identify sites that may be at risk. Application of the full methodology involves knowledge of the treatment processes at individual WwTWs and is best performed by Severn Trent Water on a site-by-site basis.

Table 8.1 Trigger distance assignment

Population served by WwTW	Trigger distance (m)
0-1,000	0
1,001-2,500	50
2,501-5,000	100
5,001-10,000	150
10,001-50,000	300
50,001-100,000	400
>100,000	800

A red/amber/green assessment was applied by JBA:

GREEN - Site is unlikely to be impacted by odour from WwTW	AMBER - Site location is such that an odour impact assessment is recommended	RED - Site is in an area with confirmed WwTW odour issues

For further information on the Anglian Water Asset Encroachment Risk Assessment Methodology, click here to visit https://www.anglianwater.co.uk/siteassets/developers/development-services/asset-encroachment-risk-assessment-methodology.pdf

8.3 Results

There are no potential allocations identified within 800m of a WwTW that may require an odour assessment.

8.4 Conclusions

None of the potential allocations identified are close enough to a WwTW for nuisance odour to be a risk. Should further sites be identified, odour risk at these sites should be considered.

8.5 Recommendations

Table 8.2 Recommendations from the odour assessment

Action	Responsibility	Timescale
Consider odour risk when identifying new sites in the future	SOTCC	Ongoing

9 Water Quality

9.1 Introduction

An increase in the discharge of effluent from Wastewater Treatment Works (WwTW) as a result of development and growth in the area in which they serve can lead to a negative impact on the quality of the receiving watercourse. Under the Water Framework Directive (WFD), a watercourse is not allowed to deteriorate from its current WFD classification (either as an overall watercourse or for individual elements assessed).

It is Environment Agency (EA) policy to model the impact of increasing effluent volumes on the receiving watercourses. Where the scale of development is such that a deterioration is predicted, a variation to the Environmental Permit (EP) may be required for the WwTW to improve the quality of the final effluent, so that the increased pollution load will not result in a deterioration in the water quality of the watercourse. This is known as "no deterioration" or "load standstill". The need to meet river quality targets is also taken into consideration when setting or varying a permit.

The Environment Agency operational instructions on water quality planning and no-deterioration are currently being reviewed. Previous operational instructions (withdrawn, for further information click here http://www.fwr.org/WQreg/Appendices/No_deterioration_and_the_WFD_50_12.pdf) set out a hierarchy for how the no-deterioration requirements of the WFD should be implemented on inland waters. This approach has been discussed and agreed with the EA as part of this study. The potential impact of development should be assessed in relation to the following objectives:

- **Could the development cause a greater than 10% deterioration in water quality?** This objective is to ensure that all the environmental capacity is not taken up by one stage of development and there is sufficient capacity for future growth.
- **Could the development cause a deterioration in WFD class of any element assessed?** This is a requirement of the Water Framework Directive to prevent a deterioration in class of individual contaminants. The "Weser Ruling" by the European Court of Justice in 2015 specified that individual projects should not be permitted where they may cause a deterioration of the status of a water body. If a water body is already at the lowest status ("bad"), any impairment of a quality element was considered to be a deterioration. Emerging practice is that a 3% limit of deterioration is applied.

For further information on the Weser Ruling, click here https://curia.europa.eu/jcms/upload/docs/application/pdf/2015-07/cp150074en.pdf

The overall WFD classification of a water body is based on a wide range of ecological and chemical classifications. This assessment focuses on three physico-chemical quality elements; Biochemical Oxygen Demand (BOD), Ammonia, and Phosphate as set out in the Environment Agency guidance.

For further information on the Environment Agency guidance, click here https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/489146/H1_annex_D2.pdf

BOD – Biochemical Oxygen Demand

BOD is a measure of how much organic material – sewage, sewage effluent or industrial effluent – is present in a river. It is defined as the amount of oxygen taken up by micro-organisms (principally bacteria) in decomposing the organic material in a water sample stored in darkness for 5 days at 20°C. Water with a high BOD has a low level of dissolved oxygen. A low oxygen content can have an adverse impact on aquatic life.

Ammonia

Nitrogen is an essential nutrient required by all plants and animals for the formation of amino acids. In its molecular form nitrogen cannot be used by most aquatic plants, and so it is converted into other forms. One such form is ammonia (NH_3). This may then be oxidized by bacteria into nitrate (NO_3) or nitrite (NO_2). Ammonia may be present in water in either the unionized form NH_3 or the ionized form NH_4. Taken together these forms care called Total Ammonia Nitrogen.

Although ammonia is a nutrient, in high concentrations it can be toxic to aquatic life, in particular fish, affecting hatching and growth rates.

The main sources in rivers include agricultural sources, (fertilizer and livestock waste), residential sources (ammonia containing cleaning products and septic tank leakages), industrial processes and WwTWs.

Phosphate

Phosphorus is a plant nutrient and elevated concentrations in rivers can lead to accelerated plant growth of algae and other plants. Its impact on the composition and abundance of plant species can have adverse implications for other aspects of water quality, such as oxygen levels. These changes can cause undesirable disturbances to other aquatic life such as invertebrates and fish.

Phosphorus (P) occurs in rivers mainly as Phosphate (PO_4), which are divided into Orthophosphates (reactive phosphates), and organic Phosphates.

Orthophosphates are the main constituent in fertilizers used in agriculture and domestic gardens and provide a good estimation of the amount of phosphorus available for algae and plant growth and is the form of phosphorus that is most readily utilized by plants.

Organic phosphates are formed primarily by biological processes and enter sewage via human waste and food residues. Organic phosphates can be formed from orthophosphates in biological treatment processes or by receiving water biota.

Although it is phosphorus in the form of phosphates that is measured as a pollutant, the term phosphorus is often used in water quality work to represent the total phosphorus containing pollutants.

9.2 Methodology

9.2.1 General Approach

The methodology for modelling water quality was discussed with the Environment Agency and the EA's RQP (River Quality Planning) tool selected as the most appropriate tool to assess water quality in Stoke-on-Trent.

RQP uses a Monte Carlo mass balance statistical approach predict the concentration of pollutants at the point of discharge for a WwTW. It is used by the Environment Agency to identify where permit changes are needed to prevent deterioration or improve water quality as well as supporting decision making to guide development to locations where environmental deterioration will be reduced.

The tool is first used to predict a baseline water quality based on the current discharge from the WwTW. A "future" scenario is then run where wastewater discharge is increased to account for growth. It is assumed in this case the quality of the discharge remains the same. Should deterioration in any of the modelled determinands exceed 10% or result in a change in WFD class, a further test is carried where the WwTW is set to its technically achievable limit (TAL) assessed to determine if deterioration could be prevented.

Lastly, a third test investigates whether, if improvements in water quality were made elsewhere in the catchment to improve the water body's condition to good ecological status (GES), growth alone could prevent GES being achieved downstream.

9.2.2 Data

In order to calculate downstream water quality, RQP requires an upstream river flow, an upstream river water quality, a WwTW discharge flow and a WwTW discharge quality.

For Strongford WwTW upstream river flow for the last 5 years was taken from gauged daily flow data for the River Trent (Station ID 28083). For Checkley WwTW, there was no suitable gauge and so Low Flows 2 software was used to create an estimate of flow for the River Tean close to the point of discharge.

Upstream water quality, and discharge quality from the last 5 years was taken from the EA Water Quality data archive using sampling point MD-

36785080 (Non-Tidal R Trent – Strongford) for Strongford WwTW and MD-55725750 (River Tean (Checkley) for Checkley WwTW. Where data did not exist for BOD the mid-point of good ecological status was assumed.

Discharge data for the last three years for Strongford and Checkley WwTWs was provided by STW.

The EA advised that the following permit values are achievable using treatment at TAL, and that these values should be used for modelling all WwTW potential capacity irrespective of the existing treatment technology and size of the works:

- Ammonia (90%ile): 1 mg/l
- BOD (90%ile): 5 mg/l
- Phosphorus (mean): 0.25 mg/l

This assessment did not take into consideration whether it is feasible to upgrade each existing WwTW to TAL due to constraints of costs, timing, space, carbon costs etc.

9.2.3 Water quality statistics

In water quality monitoring, sometimes the laboratory tests cannot distinguish between a very low concentration and complete absence of a particular substance. In these cases, the data point may be marked with a "qualifier" indicating the true result is less than the measurable limit of the laboratory test. EA guidance recommends that, in these cases, two calculations should be performed, one with the qualified values set to zero, the second with the qualified value set to its face value to give a range in which the true result lies.

For further information on the Environment Agency guidance, click here http://www.fwr.org/WQreg/Appendices/Codes_of_practice_for_data_handling_111_07_SD02%5B1%5D.pdf

9.3 Results

9.3.1 Water Framework Directive Overview

Figure 9.1 shows the Cycle 2 Water Framework Directive ecological status classifications for watercourses in the study area, and the location of the two WwTWs serving growth.

The RBMP for the Humber River Basin estimates that pollution from wastewater affects 38% of water bodies within this river basin district, and in the water bodies that contain a WwTW serving growth, sewage discharge was cited as one of the reasons for not achieving good status.

To access the RBMP for the Humber River Basin, click here https://www.gov.uk/government/publications/humber-river-basin-district-river-basin-management-plan

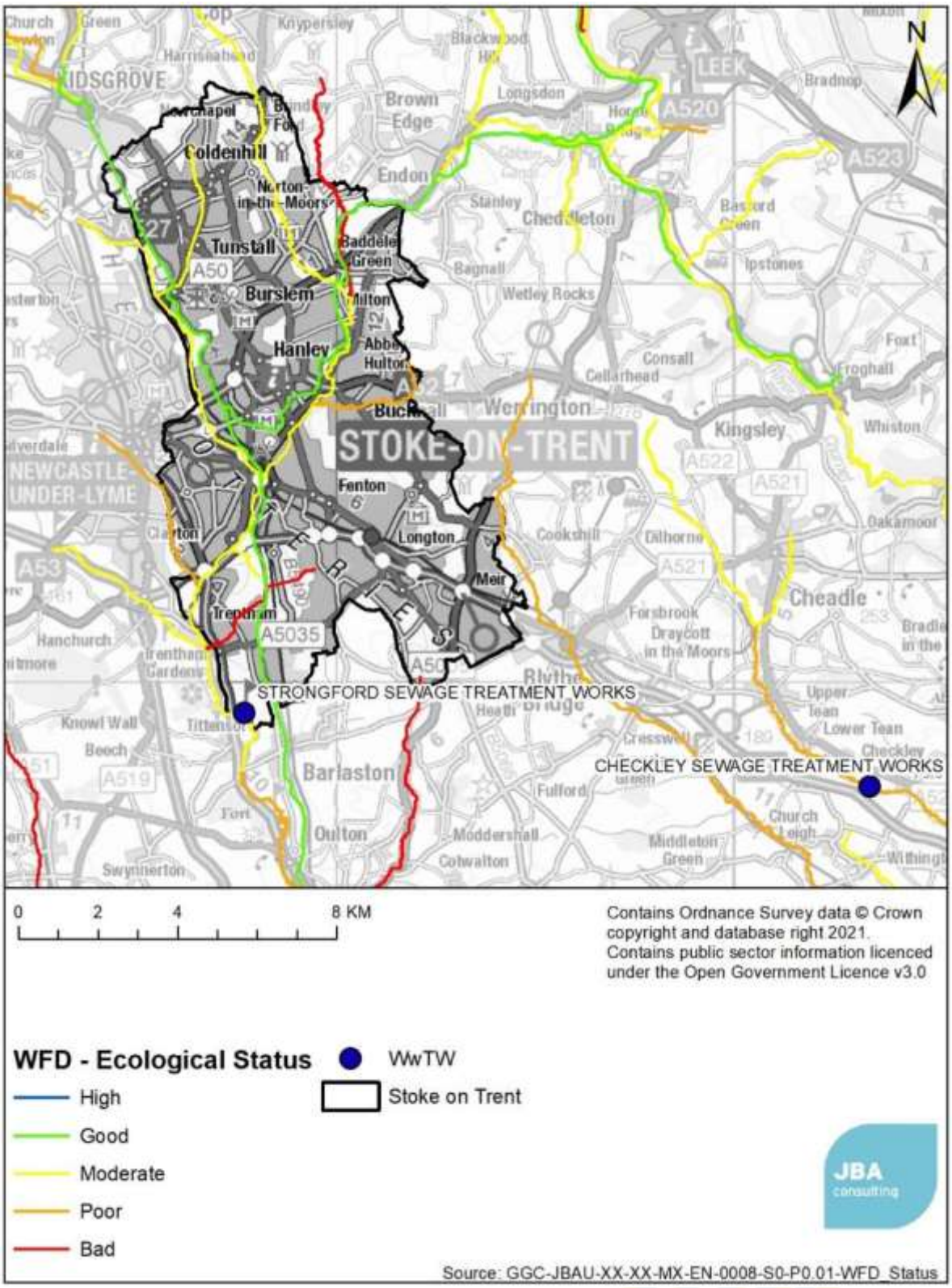


Figure 9.1 WFD Cycle 2 2016 status of waterbodies in Stoke-on-Trent

9.3.2 Strongford WwTW

Strongford WwTW is located in the southwest of Stoke-on-Trent and discharges into a small channel which is a tributary to the Trent (from Fowlea Brook to Tittensor). The watercourse has an overall "moderate" status, and the reasons for not achieving good status for phosphate are stated as sewage discharge, and diffuse pollution from urbanisation and agriculture. The draft STW DWMP notes that Stoke-on-Trent is situated close to the source of the River Trent and its tributaries which means that the watercourses in the area are generally smaller and more sensitive than you would normally find in a large urban conurbation. An investigation is ongoing into the impact of storm overflow operations in this catchment on achieving WFD river water quality standards which has shown that work is required to reduce the spill frequency and volume from a selection of storm overflows.

A quality upgrade project is planned to meet new Phosphorus and BOD limits by December 2024, costing around £7m.

Table 9.1 WFD classifications for River Trent

Trent (Fowlea Brook to Tittensor)	Overall Water Body	BOD	Ammonia	Phosphate
2016 WFD Cycle 2 Classification	Moderate	Not assessed	Good	Moderate
Objectives	Good by 2027	N/A	Good by 2015	Good by 2027

Table 9.2 summarises the growth that may be served by Strongford WwTW over the plan period. The majority of the growth will come from Stoke-on-Trent with additional growth from Newcastle Under Lyme, Staffordshire Moorlands and Stafford.

Table 9.2 Growth identified impacting Strongford WwTW

Type of growth	Estimated growth during plan period
Housing growth within SOTCC	20,321 houses
Housing growth within neighbouring LPAs	8,826 houses
Total housing growth	29,147 houses
Employment growth within SOTCC	495,172 square meters
Employment growth within neighbouring LPAs	201,891 square meters
Total employment growth	697,063 square meters

9.3.3 Checkley WwTW

Checkley WwTW is outside of the study area, to the southeast of Stoke-on-Trent. It discharges to the River Tean which has an overall status of "poor" in Cycle 2 of the Water Framework Directive (2016). The reasons for not achieving good status for ammonia and phosphate were stated as livestock.

Table 9.3 WFD classifications for River Tean

River Tean	Overall Water Body	BOD	Ammonia	Phosphate
2016 WFD Cycle 2 Classification	Poor	Not assessed	Poor	Poor
Objectives	Good by 2027	N/A	Good by 2021	Good by 2027

Table 9.4 summarises the growth that may be served by Checkley WwTW over the plan period. Only part of the growth will originate within Stoke-on-Trent, with the majority associated with Staffordshire Moorlands District.

Table 9.4 Growth identified impacting Checkley WwTW

Type of growth	Estimated growth during plan period
Housing growth within SOTCC	973 houses
Housing growth within neighbouring LPAs	2,448 houses
Total housing growth	3,421 houses
Employment growth within SOTCC	38,377 square meters
Employment growth within neighbouring LPAs	1,341 square meters
Total employment growth	39,718 square meters

9.4 Severn Trent Water assessment

In addition to the RAG assessment applied to each WwTW based on hydraulic headroom, STW also provided an assessment of the environmental capacity of the receiving waterbody. Both Strongford and Checkley WwTWs were rated "Medium risk". This is assessment is based on a comparison of the current environmental permit, and the performance that could be achieved by the Best Available Technology Not Exceeding Excessive Costs (BATNEEC).

STW also advised that both WwTWs are included in the Water Industry National Environment Programme (WINEP) for AMP7 (2020-25). At

Checkley this involves a significant tightening of the Ammonia permit from 5mg/l May to October and 10mg/l November to April to 1.5mg/l year-round. At Strongford WwTW the permit will be tightened from 12mg/l to 10mg/l for BOD and from 1mg/l to 0.4mg/l for Phosphate.

9.5 Modelling Results

9.5.1 Strongford WwTW

RQP predicts the concentration at the point of mixing (i.e., where the WwTW discharges to the river) so does not always match the stated WFD status for that waterbody which may be based on observed values further downstream.

At Strongford WwTW the increase in wastewater discharge during the plan period is unlikely to cause a significant deterioration in water quality, and no change in WFD class for the determinands assessed.

Good ecological status for Ammonia is not currently being achieved (at the point of mixing). The permit limit required in order to achieve GES should upstream water quality be improved is 0.70 – 0.77 mg/l which is less than the technically achievable limit (1 mg/l). In this case growth alone is unlikely to prevent GES being achieved in the future.

The modelling shows no deterioration in concentration of BOD during the plan period. BOD is not currently part of the WFD assessment for that waterbody, although the value predicted by RQP is in the range for good status. For this reason, the GES test was not applied to this determinand.

The deterioration in Phosphate during the plan period is predicted to be between 0 and 3%, with no change in WFD class. Following improvements to upstream water quality, GES is unlikely to be achieved before or after growth with a permit limit of 0.1 mg/l required in order to achieve GES in comparison to a technically achievable limit of 0.25 mg/l. The predicted concentration of phosphate is in the range for Poor WFD class. A further test was carried out to see if moderate ecological status could be achieved. The permit limit required would be 0.41 mg/l based on current flows and 0.40 mg/l after growth indicating that achieving moderate status would be possible and would not be made significantly harder by growth.

Table 9.5 RQP results for Strongford WwTW

Determinand	Upstream Conc. (mg/l)	Modelled downstream Conc. (mg/l)	Deterioration	Change in WFD class
Ammonia (90th %ile)	0.43 – 0.49	0.42 – 0.49	0%	None
BOD (90th %ile)	2.92 – 3.01	2.92 – 3.01	0%	None
Phosphate (Mean)	0.35 – 0.69	0.36 – 0.69	0 - 3%	None

9.5.2 Checkley WwTW

As above, at Checkley WwTW the increase in wastewater discharge during the plan period is unlikely to cause a significant deterioration in water quality, and no change in WFD class for any of the determinands assessed.

Good ecological status for Ammonia is not currently being achieved (at the point of mixing). The permit limit required in order to achieve GES should upstream water quality be improved is 0.74 – 0.81 mg/l which is less than the technically achievable limit (1 mg/l). In this case growth alone is unlikely to prevent GES being achieved in the future.

The modelling predicts a very small (0 to 1%) deterioration in concentration of BOD during the plan period. BOD is not currently part of the WFD assessment for that waterbody, although the value predicted by RQP is in the range for good status. For this reason, the GES test was not applied to this determinand.

Phosphate is predicted to deteriorate by 8% with no change in WFD class. Following improvements to upstream water quality, GES is unlikely to be achieved before or after growth with a permit limit of 0.09 mg/l required in order to achieve GES in comparison to a technically achievable limit of 0.25 mg/l. The predicted concentration of phosphate is in the range for Moderate WFD class.

Table 9.6 RQP results for Checkley WwTW

Determinand	Upstream Conc. (mg/l)	Modelled downstream Conc. (mg/l)	Deterioration	Change in WFD class
Ammonia (90th %ile)	0.50 – 0.60	0.51 – 0.61	2%	None
BOD (90th %ile)	3.53 – 3.65	3.55 – 3.65	0 to 1%	None
Phosphate (Mean)	0.13	0.14	8%	None

9.5.3 Priority substances

As well as the physio-chemical water quality elements (BOD, Ammonia, Phosphate etc.) addressed above, a watercourse can fail to achieve Good Ecological Status due to exceeding permissible concentrations of hazardous substances. Currently 33 substances are defined as hazardous or priority hazardous substances, with others under review. Such substances may pose risks both to humans (when contained in drinking water) and to aquatic life and animals feeding in aquatic life. These substances are managed by a range of different approaches, including EU and international bans on manufacturing and use, targeted bans, selection of safer alternatives and end-of-pipe treatment solutions. There is considerable concern within the UK water industry that regulation of these substances by setting permit values which require their removal at Water Recycling Centres will place a huge cost burden upon the industry and its customers, and that this approach would be out of keeping with the "polluter pays" principle.

We also consider how the planning system might be used to manage priority substances:

- Industrial sources – whilst this report covers potential employment sites, it doesn't consider the type of industry and therefore likely sources of priority substances are unknown. It is recommended that developers should discuss potential uses which may be sources of priority substances from planned industrial facilities at an early stage with the EA and, where they are seeking a trade effluent consent, with the sewerage undertaker.
- Agricultural sources - There is limited scope for the planning system to change or regulate agricultural practices. UK water companies are involved in a range of "Catchment-based Approach" schemes aimed at reducing diffuse sources of pollutants, including agricultural pesticides.
- Surface water runoff sources - some priority substances e.g., heavy metals, are present in urban surface water runoff. It is recommended that future developments would manage these sources by using SuDS that provide water quality treatment, designed following the CIRIA SuDS Manual. This is covered in more detail in section 11.6.2.
- Domestic wastewater sources - some priority substances are found in domestic wastewater as a result of domestic cleaning chemicals, detergents, pharmaceuticals, pesticides or materials used within the home. Whilst an increase in the population due to housing growth could increase the total volumes of such substances being discharged to the environment, it would be more appropriate to manage these substances through regulation at source, rather than through restricting housing growth through the planning system.

No further analysis of priority substances will be undertaken as part of this study.

9.6 Conclusions

- The Environment Agency's RQP tool was used to predict the impact on water quality of increased discharge from WwTWs due to growth during the plan period.
- Growth is unlikely to lead to a significant deterioration in Ammonia, BOD and Phosphate during the plan period, and growth alone will not prevent good ecological status being prevented in the future should improvements in upstream water quality be made.

9.7 Recommendations

Table 9.7 Table of recommendations for water quality

Action	Responsibility	Timescale
Provide annual monitoring reports to STW detailing projected housing growth in the Local Authority	SOTCC	Ongoing
Take into account the full volume of growth (from SOTCC and neighbouring authorities) within the catchment when considering WINEP schemes or upgrades at WwTW.	STW	Ongoing

10 Flood Risk Management

10.1 Assessment of additional flood risk from increased WwTW discharges

In catchments with a large, planned growth in population and which discharge effluent to a small watercourse, the increase in the discharged effluent might have a negative effect on the risk of flooding. An assessment has been carried out to quantify such an effect.

10.2 Methodology

The following process has been used to assess the potential increased risk of flooding due to the extra flow reaching a specific WwTW:

- Calculate the increase in dry weather flow (DWF) attributable to planned growth;
- Identify the point of discharge of these WwTWs;
- At each outfall point, identify the Flood Estimation Handbook (FEH) v1.0 catchment descriptors associated with the WwTW;
- Use FEH Statistical method to calculate peak 1 in 30 (Q30) and 1 in 100 (Q100) year fluvial flows;
- Calculate the additional foul flow as a percentage of the Q30 and Q100 flow.

A red/amber/green rating was applied to score the associated risk as follows:

GREEN - Additional flow ≤5% of Q30. Low risk that increased discharges will increase fluvial flood risk	AMBER - Additional flow ≥5% of Q30. Moderate risk that increased discharges will increase fluvial flood risk	RED - Additional flow ≥5% of Q100. High risk that increased discharges will increase fluvial flood risk

The following datasets were used to assess the risk of flooding:

- Current and predicted future DWF for each WwTW
- Location of WwTW outfalls
- Catchment descriptors from FEH CD-Rom v1.0

The hydrological assessment of river flows was applied using a simplified approach, appropriate to this type of screening assessment. The Q30 and Q100 flows quoted should not be used for other purposes, e.g., flood modelling or flood risk assessments.

10.3 Results

Table 10.1 reports the additional flow from each WwTW as a percentage of the Q30 and Q100 peak flow. This shows that additional flows from

the WwTW post development would have a negligible effect on the predicted peak flow events with return periods of 30 and 100 years.

Table 10.1 Summary of DWF as a % of Q30 and Q100 peak flows

WwTW	FEH Stat Q30 (m^3/s)	FEH Stat Q100 (m^3/s)	Additional Flow (m3/s)	Flow increase as % of Q30	Flow increase as % of Q100
Checkley	20.96	27.32	0.01	GREEN - 0.05	GREEN - 0.04
Strongford	96.14	112.83	0.01	GREEN - 0.12	GREEN - 0.11

10.4 Conclusions

The Level 1 and Level 2 Strategic Flood Risk Assessments for Stoke-on-Trent (2020/21) contain a more detailed assessment of flood risk. At each of the estimated point of discharge for WwTWs, the additional flow from growth makes up less than 5% of the Q30 flow and less than 5% of the Q100 flow. **The impact of increased effluent flows is not predicted to have a significant impact upon flood risk in any of the receiving watercourses.**

10.5 Recommendations

Table 10.2 Recommendations from the flood risk assessment

Action	Responsibility	Timescale
Proposals to increase discharges to a watercourse may also require a flood risk activities environmental permit from the EA (in the case of discharges to Main River), or a land drainage consent from the Lead Local Flood Authority (in the case of discharges to an Ordinary Watercourse).	STW	During design of WwTW upgrades

11 Environmental Impact

11.1 Introduction

Development has the potential to cause an adverse impact on the environment through a number of routes such as worsening of air quality, pollution to the aquatic environment, or disturbance to wildlife. Of relevance in the context of a Water Cycle Study is the impact of development on the aquatic environment.

A source-pathway-receptor approach can be taken to investigate the risk and identify where further assessment or action is required.

11.2 Sources of pollution

Water pollution is usually categorised as either diffuse or point source. Point source sources come from a single well-defined point, an example being the discharge from a WwTW. Section 9 models the WwTWs serving growth within SOTCC as point sources of pollution and predicts the likely concentration of pollutants downstream.

Diffuse pollution is defined as "unplanned and unlicensed pollution from farming, old mine workings, homes and roads. It includes urban and rural activity and arises from industry, commerce, agriculture and civil functions and the way we live our lives."

Examples of diffuse sources of water pollution include:

- Contaminated runoff from roads – this can include metals and chemicals
- Drainage from housing estates
- Misconnected sewers (foul drains to surface water drains)
- Accidental chemical/oil spills from commercial sites
- Surplus nutrients, pesticides and eroded soils from farmland
- Septic tanks and non-mains sewer systems

The most likely sources of diffuse pollution from new developments include drainage from housing estates, runoff from roads and discharges from commercial and industrial premises. The pollution risk posed by a site will depend on the sensitivity of the receiving environment, the pathway between the source of the runoff and the receiving waters, and the level of dilution available. After or during heavy rainfall, the first flush of water carrying accumulated dust and dirt is often highly polluting.

Whilst the threat posed by an individual site may be low, a number of sites together may pose a cumulative impact within the catchment.

Runoff from development sites should be managed by a suitably designed SuDS scheme, more information on SuDS can be found in section 11.6.2.

Potential impacts on receiving surface waters include the blanketing of riverbeds with sediment, a reduction in light penetration from suspended solids, and a reduction in natural oxygen levels, all of which can lead to a loss in biodiversity.

11.3 Pathways

Pollutants can take a number of different pathways from their source to a "receptor" – a habitat or species that can be impacted. This could be overland via surface water flow paths, via the river system, or via groundwater or a combination of all three.

11.4 Receptors

A receptor in this case is a habitat or species that is adversely impacted by a pollutant. Both the rivers and groundwater as well as being pathways, can also be considered to be receptors, and the impact on the ecological status of rivers as defined within the Water Framework Directive is the subject of Section 9. Groundwater bodies are also given a status under the WFD which is reported in Section 4.2 for the groundwater bodies with SOTCC.

Within the study area and downstream are many sites with environmental designations such as:

- Special Areas of Conservation (SAC)
- Special Protection Areas (SPA)
- Sites of Special Scientific Interest (SSSI)
- Ramsar sites (Wetlands of International Importance)
- Priority Habitats and Priority Headwaters

A description of these, and the relevant legislation that defines and protects them, can be found in section 3.5 and 3.6.

11.5 Assessment of point source risk

11.5.1 Screening

The Phase 1 WCS identified protected sites that may be at risk following a source-pathway-receptor approach. Sites within a 10km drainage range of each WwTW serving growth were noted. This water quality impact assessment has taken a different approach, extending the study down to the River Severn Estuary.

In order to identify which of the protected sites may be at risk, Flood Zone 2 from the Risk of Flooding from Rivers and the Sea mapping was used to define an area that was either beside a river or could be reasonable expected to receive surface water from a river during times of flood. Where a WwTW serving growth in the plan period was present in the catchment upstream of the protected site, this site was taken forward for further assessment.

Where there were no WwTW serving growth upstream, these protected sites were discounted as no deterioration would be predicted in a water quality model, and the impact would be expected to be minimal. However, in these cases the overall catchment water quality should be considered where for example they are designated for migratory fish species that may spend part of their lifecycle elsewhere in the catchment.

Whilst deterioration in water quality may not always lead to a significant impact at a protected site such as a SSSI, modelled deterioration can be used to highlight areas of risk for further analysis in the Habitats Regulations Assessment.

Table 11.1 contains a list of the protected sites (SSSIs, SACs, SPAs and Ramsar sites) that are within or downstream of Stoke-on-Trent, and adjacent to a watercourse. The final column in the table indicates if there is a WwTW serving growth during the plan period upstream of the site. Where the answer is no, they are not considered further. Where the answer is yes, the deterioration in water quality is predicted in section 11.5.2.

Table 11.1: screening of protected sites within and downstream of Stoke-on-Trent

Type of Receptor	Name	Reference	WwTW Upstream – further Assessment required? Y/N
SSSI	Alvecote Pools	SK255044	NO
SSSI	Belvide Reservoir	SJ863102	NO
SSSI	Blithfield Reservoir	SK058243	NO
SSSI	Braken Hurst	SK138221	NO
SSSI	Grace Dieu and High Sharpley	SK435171	NO
SSSI	Breedon Cloud Wood and Quarry	SK414213	NO
SSSI	Doxey and Tillington Marshes	SJ906243	NO
SSSI	Doley Common	SJ817216	NO
SSSI	Donington Park	SK414268	NO
SSSI	King's and Hargreaves Woods	SJ860401	NO
SSSI	Mercaston Marsh and Muggington Bottoms	SK269433	NO

Type of Receptor	Name	Reference	WwTW Upstream – further Assessment required? Y/N
SSSI	Dimminsdale	SK376216	NO
SSSI	Newton Burgoland Marshes	SK381089	NO
SSSI	Blackbrook Reservoir	SK459173	NO
SSSI	One Barrow Plantation	SK463171	NO
SSSI	Ashby Canal	SK364073	NO
SSSI	River Mease	SK264113	NO
SSSI	Shepshed Cutting	SK461185	NO
SSSI	Kedleston Park	SK319412	NO
SSSI	Old River Dove, Marston on Dove	SK237284	YES
SSSI	Pasturefields Salt Marsh	SJ991248	YES
SSSI	Lockington Marshes	SK489299	NO
SSSI	Gentleshaw Common	SK051111	NO
SSSI	Coalville Meadows	SK446151	NO
SSSI	Rawbones Meadow	SJ984225	NO
SSSI	Clayhanger	SK033046	NO
SSSI	Stowe Pool and Walk Mill Clay Pit	SK121101	NO
SSSI	Baswich Meadows	SJ950226	NO
SSSI	Boulton Moor	SK380316	NO
SSSI	Ticknall Quarries	SK359238	NO
SSSI	Mottey Meadows	SJ839132	NO
SSSI	Calke Park	SK364229	NO
SSSI	Stafford Brook	SK022193	YES
SSSI	Chasewater and the Southern Staffordshire Coalfield Heaths	SK028094	NO
SSSI	Cannock Chase	SJ984186	YES
SAC	Pasturefields Salt Marsh	UK0012789	YES
SAC	River Mease	UK0030258	NO
SAC	Mottey Meadows	UK0030051	NO

Type of Receptor	Name	Reference	WwTW Upstream – further Assessment required? Y/N
SAC	Cannock Chase	UK0030107	YES

11.5.2 Impact assessment

Figure 11.1 shows the location of protected sites downstream of the two WwTWs serving growth in the study area. Four sites were screened in on the basis that a deterioration in water quality at the WwTW could be experiences in the waterbody downstream of the WwTW and adjacent to the protected site. Two of these are also designated at Special Areas of Conservation.

Table 11.2 shows the distance downstream of each site. In each case the risk of a deterioration in water quality impacting the protected site is considered to be low.

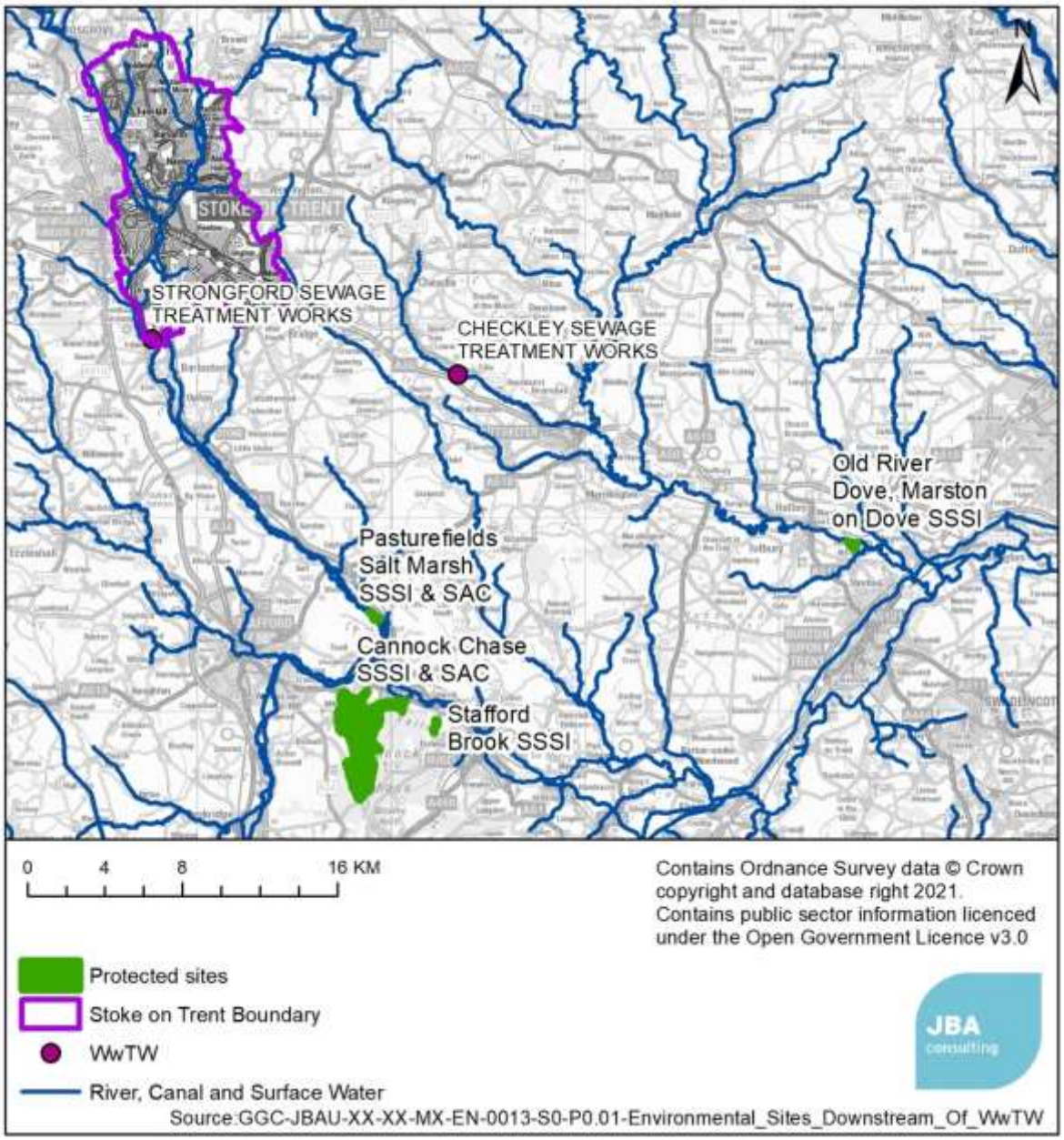


Figure 11.1 Protected sites downstream of WwTWs

Table 11.2 Assessment of impact on protected sites

Type of Receptor	Name	Reference	Approx. Distance Downstream	Comments
SSSI	Old River Dove, Marston on Dove	SK237284	25km	Site is downstream of Checkley WwTW. Based on distance downstream, and relatively small deterioration in water quality at the point of mixing – the risk of a significant deterioration in the watercourse adjacent to these sites and a resulting significant impact on a notified species is low
SSSI & SAC	Pasturefields Salt Marsh	SJ991248 / UK0012789	19km	Sites are downstream of Strongford WwTW. Based on distance downstream, and relatively small deterioration in water quality at the point of mixing – the risk of a significant deterioration in the watercourse adjacent to these sites and a resulting significant impact on a

Type of Receptor	Name	Reference	Approx. Distance Downstream	Comments
				notified species is low
SSSI & SAC	Cannock Chase	SJ984186 / UK0030107	25km	Low risk as above
SSSI	Stafford Brook	SK022193	26.5km	Low risk as above

11.6 Protection and mitigation

11.6.1 Groundwater Protection

Groundwater is an important source of water in England and Wales.

The Environment Agency is responsible for the protection of "controlled waters" from pollution under the Water Resources Act 1991. These controlled waters include all watercourses and groundwater contained in underground strata.

The zones are based on an estimate of the time it would take for a pollutant which enters the saturated zone of an aquifer to reach the source of abstraction or discharge point (Zone 1 = 50 days, Zone 2 = 400 days, Zone 3 is the total catchment area). The Environment Agency will use SPZs (alongside other datasets such as the Drinking Water Protected Areas (DrWPAs) and aquifer designations as a screening tool to show:

- areas where it would object in principle to certain potentially polluting activities, or other activities that could damage groundwater,
- areas where additional controls or restrictions on activities may be needed to protect water intended for human consumption,
- how it prioritises responses to incidents.

The EA have published a position paper outlining its approach to groundwater protection which includes direct discharges to groundwater, discharges of effluents to ground and surface water runoff. This is of relevance to this water cycle study where a development may manage surface water through SuDS.

For the Environment Agency's position paper, click here https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/692989/Envirnment-Agency-approach-to-groundwater-protection.pdf

Sewage and trade effluent

Discharge of treated sewage of 2m^3 per day or less to ground are called small sewage discharges (SSDs). The majority of SSDs do not require an environmental permit if they comply with certain qualifying conditions. A permit will be required for all SSDs in source protection zone 1 (SPZ1).

For treated sewage effluent discharges, the EA encourages the use of shallow infiltration systems, which maximise the attenuation within the drainage blanket and the underlying unsaturated zone. Whilst some sewage effluent discharges may not pose a risk to groundwater quality individually, the cumulative risk of pollution from aggregations of discharges can be significant. Improvement or pre-operational conditions may be imposed before granting an environmental permit.

The EA will only agree to developments where the addition of new sewage effluent discharges to ground in an area of existing discharges is unlikely to lead to an unacceptable cumulative impact.

Generally, the Environment Agency will only agree to developments involving release of sewage effluent, trade effluent or other contaminated discharges to ground if it is satisfied that it is not reasonable to make a connection to the public foul sewer. The EA would normally expect to only permit new private discharges where the distance to connect to the nearest public sewer exceeds the number of dwellings * 30m. So, for example, a development of 100 dwellings would need to be more than 3km from a public sewer. The developer would have to provide evidence of why the proposed development cannot connect to the foul sewer in the planning application. This position will not normally apply to surface water run-off via sustainable drainage systems and discharges from sewage treatment works operated by sewerage undertakers with appropriate treatment and discharge controls.

Deep infiltration systems (such as boreholes and shafts) are not generally accepted by the EA for discharge of sewage effluent as they bypass soil layers and reduce the opportunity for attenuation of pollutants.

Discharges of surface water run-off to ground at sites affected by land contamination, or from sites for the storage of potential pollutants are likely to require an environmental permit. This could include sites such as garage forecourts and coach and lorry parks. These sites would be subject to a risk assessment with acceptable effluent treatment provided.

Discharge of clean water

"Clean water" discharges such as runoff from roofs or from roads, may not require a permit. However, they are still a potential source of groundwater pollution if they are not appropriately designed and maintained.

Where infiltration SuDS schemes are proposed to manage surface runoff they should:

- be suitably designed,
- meet Government non-statutory technical standards for sustainable drainage systems – these should be used in conjunction with the NPPF and PPG; and
- use a SuDS management treatment train

A hydrogeological risk assessment is required where infiltration SuDS is proposed for anything other than clean roof drainage in a SPZ1.

Deep infiltration systems (such as boreholes and shafts) could be accepted by the EA for discharge of clean roof water via sealed system.

Separation of clean roof water and other runoff should be considered early stage of design in a project.

For the non-statutory technical standards for SuDS, click here https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards

Source Protection Zones in Stoke-on-Trent

The southeast of Stoke-on-Trent is covered by a Source Protection Zone, and three potential allocations lie within Zone 3. These are shown in Figure 11.2. The appropriate EA guidance for development in these zones contained in Table 11.3 should be followed.

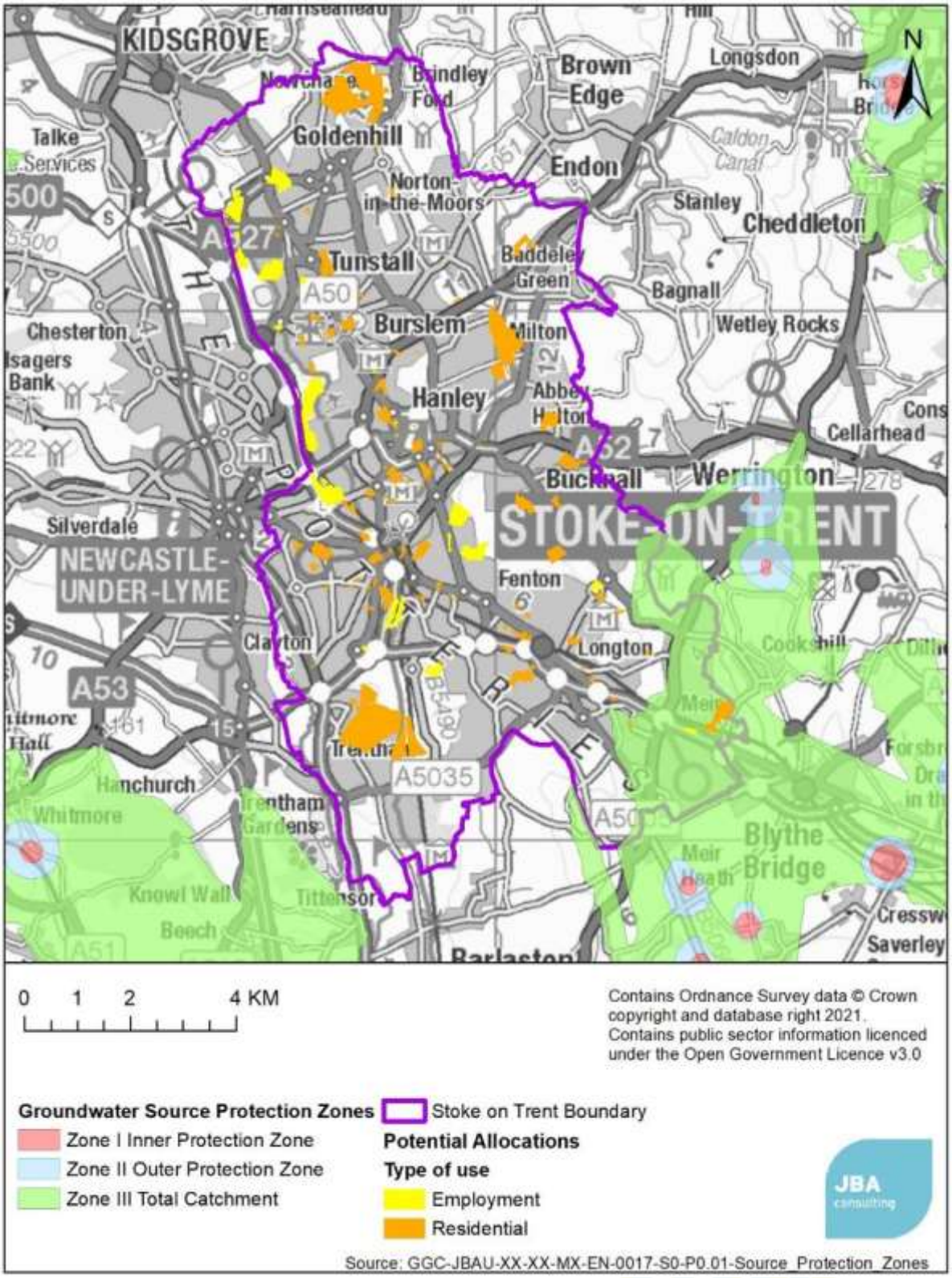


Figure 11.2 Source protection zones in the study area

Table 11.3 Preferred and strategic sites within Source Protection Zones

Source Protection Zone	Sites	Management advice / EA position statement
Zone 1 – Inner Protection Zone	No allocations identified	G2 – Inside SPZ1 all sewage effluent discharges to ground must have an environmental permit. G4 – Inside SPZ1 the EA will object to any new trade effluent, storm overflow from sewage system or other significantly contaminated discharges to ground where the risk of groundwater pollution is high and cannot be adequately mitigated. G12 – Discharge of clean roof water to ground is acceptable both within and outside SPZ1, provided all roof water down-pipes are sealed against pollutants entering the system from surface runoff, effluent disposal or other forms of discharge. The method of discharge must not create new pathways for pollutants to groundwater or mobilise contaminant already in the ground. No permit is required if these criteria are met. G13 – Where infiltration SuDS are proposed for anything other than clean roof drainage in a SPZ1, a hydrogeological risk assessment should be undertaken, to ensure that the system does not pose an unacceptable risk to the source of supply. SuDS schemes must be suitably designed.
Zone 2 – Outer Protection Zone	No allocations identified	A hydrogeological risk assessment is not a requirement for SuDS schemes, however they should still be "suitably designed", for instance

Source Protection Zone	Sites	Management advice / EA position statement
		following best practice guidance in the CIRIA SuDS Design Manual.
Zone 3 – Total Catchment	148 (Residential) 778 (Residential) ST2 (Employment)	A hydrogeological risk assessment is not a requirement for SuDS schemes, however they should still be "suitably designed", for instance following best practice guidance in the CIRIA SuDS Design Manual.

11.6.2 Surface Water Drainage and SuDS

Since April 2015, management of the rate and volume of surface water has been a requirement for all major development sites, through the use of Sustainable Drainage Systems (for further information, click here https://www.parliament.uk/documents/commons-vote-office/December%202014/18%20December/6.%20DCLG-sustainable-drainage-systems.pdf). Stoke-on-Trent City Council as Lead Local Flood Authority (LLFA), is a statutory consultee to the planning system for surface water management within major development, which covers the following development scenarios:

- 10 or more dwellings
- a site larger than 0.5 hectares, where the number of dwellings is unknown
- a building greater than 1,000 square metres
- a site larger than 1 hectare

SuDS are drainage features which attempt to replicate natural drainage patterns, through capturing rainwater at source, and releasing it slowly into the ground or a water body. They can help to manage flooding through controlling the quantity of surface water generated by a development, improve water quality by treating urban runoff and provide a useful function in aquifer recharge. SuDS can also deliver multiple benefits, through creating habitats for wildlife and green spaces for the community. SuDS also have the advantage of providing effective Blue and Green infrastructure and ecological and public amenity benefits when designed and maintained properly.

National standards on the management of surface water are outlined within the Defra Non-statutory Standards for Sustainable Drainage Systems, with local guidance specified by Stoke-on-Trent City Council. The CIRIA C753 SuDS Manual and Guidance for the Construction of SuDS provide the industry best practice guidance for design and management of SuDS.

For the non-statutory standards for SuDS, click here https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

For local guidance on SuDS, click here https://www.staffordshire.gov.uk/environment/Flood-Risk-Management/Documents/SuDS-Handbook.pdf

For the CIRIA SuDS manual, click here https://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx

For the CIRIA SuDS Manual and Guidance for the Construction of SuDS, click here https://www.ciria.org/ItemDetail?iProductcode=C768&Category=BOOK

11.6.3 Use of SuDS in Water Quality Management

SuDS allow the management of diffuse pollution generated by urban areas through the sequential treatment of surface water reducing the pollutants entering lakes and rivers, resulting in lower levels of water supply and wastewater treatment being required. This treatment of diffuse pollution at source can contribute to meeting WFD water quality targets, as well as national objectives for sustainable development.

This is usually facilitated via a SuDS Management Train of a number of components in series that provide a range of treatment processes delivering gradual improvement in water quality and providing an environmental buffer for accidental spills or unexpected high pollutant loadings from the site. Considerations for SuDS design for water quality are summarised in Table 11.4 below.

Table 11.4 Considerations for SuDS design for water quality

Objective	Consideration
Manage surface water close to source	• Where practicable, treatment systems should be designed to to be close to source of runoff • It is easier to design effective treatment when the flow rate and pollutant loadings are relatively low • Treatment provided can be proportionate to pollutant loadings and sensitivity of receptor • Accidental spills or other pollution events can be isolated more easily without affecting the downstream drainage system • Encourages ownership of pollution • Poor treatment performance or component damage/failure can be dealt with more effectively without impacting on the whole site
Treat surface water runoff on the surface	• Where practicable, treatment systems should be designed to be on the surface • Where sediments are exposed to UV light, photolysis and volatilisation processes can act to break down contaminants

Objective	Consideration
	• If sediment is trapped in accessible parts of the SuDS, it can be removed more easily as part of maintenance • It enables use of evapotranspiration and some infiltration to the ground to reduce runoff volumes and associated total contamination loads (provided risk to groundwater is managed appropriately) • It allows treatment to be delivered by vegetation • Sources of pollution can be easily identified • Accidental spills or misconnections are visible immediately and can be dealt with rapidly • Poor treatment performance can be easily identified during routine inspections, and remedial works can be planned efficiently
Treat surface water runoff to remove a range of contaminants	• SuDS design should consider the likely presence and significant of any contaminant that may pose a risk to the receiving environment • The SuDS component or combination of components selected should include treatment processes that, in combination, are likely to reduce this risk to acceptably low levels
Minimise risk of sediment remobilisation	• The SuDS design should consider and mitigate the risks of sediments (and other contaminants) being remobilised and washed into receiving surface waters during events greater than those which the component has been specifically designed for
Minimise impacts from accidental spills	• By using a number of components in series, SuDS can help ensure that accidental spills are trapped in/on upstream component surfaces, facilitating contamination management and removal.

Objective	Consideration
	• The selected SuDS components should deliver a robust treatment design that manages risks appropriately - taking into account the uncertainty and variability of pollution loadings, sensitivity of receptors and treatment processes

Managing pollution close to its source can help keep pollutant levels and accumulation rates low, allowing natural processes to be more effective. Treatment can often be delivered within the same components that are delivering water quantity design criteria, requiring no additional cost or land-take.

SuDS designs should control the 'first flush' of pollutants (usually mobilised by the first 5mm of rainfall) at source, to ensure contaminants are not released from the site. Best practise is that no runoff should be discharged from the site to receiving watercourses or sewers for the majority of small (e.g., less than 5mm) rainfall events.

Infiltration techniques will need to consider Groundwater Source Protection Zones (GSPZs) and are likely to require consultation with the Environment Agency. Other than roof water via a sealed system, deep bore and other deep soakaway systems are not appropriate in areas where groundwater constitutes a significant resource (that is where an aquifer yield may support or already supports abstraction). Deep infiltration should only be considered where all other methods of surface water disposal are exhausted and will require an enhanced treatment train. The maximum acceptable depth for "shallow infiltration SuDS is 2.0m below ground level, below this is considered "deep" as it bypasses the soil zone. A minimum of 1.2m clearance between the base of infiltration SuDS and peak seasonal groundwater levels is required.

Early consideration of SuDS within master planning will typically allow a more effective scheme to be designed. SOTCC have a Local SuDS Handbook which will be used by the LPA for reference when assessing planning applications.

For the Local SuDS Handbook, click here
https://www.staffordshire.gov.uk/environment/Flood-Risk-Management/Documents/SuDS-Handbook.pdf

11.6.4 Additional benefits

Flood Risk

The Strategic Flood Risk Assessment contains recommendations for SuDS to manage surface water on development sites, with the primary aim of reducing flood risk.

SuDS are most effective at reducing flood risk for relatively high intensity, short and medium duration events, and are particularly

important in mitigating potential increases in surface water flooding, sewer flooding and flooding from small and medium sized watercourses resulting from development.

Water Resources

A central principle of SuDS is the use of surface water as a resource. Traditionally, surface water drainage involved the rapid disposal of rainwater, by conveying it directly into a sewer or Water Recycling Centres.

SuDS techniques such as rainwater harvesting, allow rainwater to be collected and re-used as non-potable water supply within homes and gardens, reducing the demand on water resources and supply infrastructure.

Climate Resilience

Climate projections for the UK suggest that winters may become milder and wetter and summers may become warmer, but with more frequent higher intensity rainfall events. This would be expected to increase the volume of runoff, and therefore the risk of flooding from surface water, and diffuse pollution, and reduce water availability.

SuDS offer a more adaptable way of draining surfaces, controlling the rate and volume of runoff leaving urban areas during high intensity rainfall, and reducing flood risk to downstream communities through storage and controlled release of rainwater from development sites.

Through allowing rainwater to soak into the ground, SuDS are effective at retaining soil moisture and groundwater levels, which allows the recharge of the watercourses and underlying aquifers. This is particularly important where water resource availability is limited, and likely to become increasingly scarce under future drier climates.

Biodiversity

The water within a SuDS component is an essential resource for the growth and development of plants and animals, and biodiversity benefits can be delivered even by very small, isolated schemes. The greatest value can be achieved where SuDS are planned as part of a wider green landscape, providing important habitat, and wildlife connectivity. With careful design, SuDS can provide shelter, food, foraging and breeding opportunities for a variety of species including plants, amphibians, invertebrates, birds, bats and other animals.

Amenity

Designs using surface water management systems to help structure the urban landscape can enrich its aesthetic and recreational value, promoting health and well-being and supporting green infrastructure. Water managed on the surface rather than underground can help reduce summer temperatures, provide habitat for flora and fauna and act a resource for local environmental education programmes and working groups and directly influence the sense of community in an area.

11.7 Nutrient reduction options

11.7.1 Natural flood management

Natural Flood Management (NFM) is used to protect, restore and re-naturalise the function of catchments and rivers to reduce flood risk. A wide range of techniques can be used that aim to reduce flooding by working with natural features and processes in order to store or slow down flood waters before they can damage flood risk receptors (e.g. people, property, infrastructure, etc.). NFM involves taking action to manage flood and coastal erosion risk by protecting, restoring and emulating the natural regulating functions of catchments, rivers, floodplains and coasts. Techniques and measures, which could be applied include:

- Offline storage areas
- Re-meandering streams
- Targeted woodland planting
- Reconnection and restoration of functional floodplains
- Restoration of rivers and removal of redundant structures
- Installation or retainment of large woody material in river channels
- Improvements in management of soil and land use
- Creation of rural and urban SuDS

In 2017, the Environment Agency published an online evidence base to support the implementation of NFM and with JBA produced maps showing locations with the potential for NFM measures. These maps are intended to be used alongside the evidence directory to help practitioners think about the types of measure that may work in a catchment and the best places in which to locate them. There are limitations with the maps; however, it is a useful tool to help start dialogue with key partners.

Click here to view the Environment Agency online evidence base https://www.gov.uk/government/publications/working-with-natural-processes-to-reduce-flood-risk

Click here to view the JBA maps for potential locations for NFM measures https://naturalprocesses.jbahosting.com/

The European Regional Development Fund (ERDF) SUNRISE project (Stoke and Urban Newcastle Rediscovering Its Secret Environment) is a nature conservation project aimed at protecting, enhancing and restoring the connectivity between green spaces. Many of the projects within this involve removal of redundant structures, river restoration and other measures associated with NFM.

11.7.2 Multiple benefits of NFM

In addition to flood risk benefits, there are also significant benefits in other areas such as habitat provision, air quality, climate regulation and of particular note for the water cycle study - Water Quality.

Many NFM measures have the ability to reduce nutrient and sediment sources by reducing surface runoff flows from higher ground, reducing soil erosion, trapping sediment at the edge of agricultural land, or encouraging deposition of sediments behind natural dams upstream in watercourses.

Suitable techniques may include:

- Leaky dams
- Woodland planting
- Buffer strips
- Runoff retention ponds
- Land management techniques (soil aeration, cover crops etc).

Case Study – Black Brook Slow the Flow

Four engineered log dams were installed on Black Brook at an estimated cost of £2,000, funded by Natural England and the Environment Agency to restore Stanley Bank SSSI. The scheme aimed to improve habitat and reduce the risk of flooding. However, the scheme also resulted in reduced levels of phosphate and nitrate in Black Brook, with phosphate concentrations falling by 3.6mg/l. By 2035, it is predicted that 792m^3 of sediment will be stored in three ponds retained by the jams.

Reproduced from Case study 17. Black Brook Slow the Flow, St Helens, Norbury, Rogers and Brown, EA WwNP Evidence Base 2017. Photograph taken on 8 May 2015; courtesy of Matthew Catherall

11.7.3 Integrated Constructed Wetlands

An integrated constructed wetland (ICW) is an artificial wetland created for the purpose of treating polluted water, whether this is municipal wastewater, grey water from residential properties, or agricultural runoff.

They are usually unlined, free surface flow wetlands, designed to contain and treat influents within emergent vegetated areas.

Defra carried out a systematic review of the effectiveness of various wetland types, including ICWs for mitigating agricultural pollution such as phosphate and nitrate. The overall conclusion was that all wetland types are very effective at reducing major nutrients and suspended sediments, with the exception of nitrite in ICWs. Nitrate is only reduced when passing through overland buffer strips and through constructed

wetlands with vegetation, where the systematic review showed a mean reduction of 29% across the evidence included in the study.

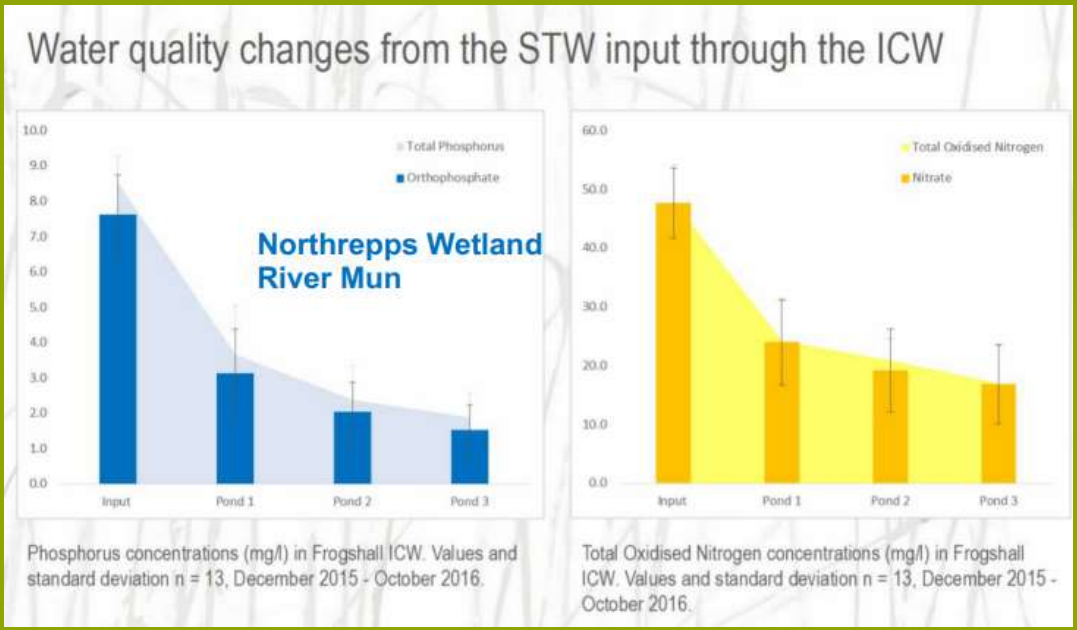
The mean reduction in Total Phosphorus across the evidence base was 78%.

Case Study – Frogshall ICW

The Upper River Mun in Norfolk was experiencing chronic pollution, and a loss in biodiversity in the river. Investigation found that nutrients from a Sewage Treatment Works upstream were contributing to this issue.

A pilot ICW was created consisting of three shallow ponds, filled with 18,000 emergent aquatic plants, and the outfall from the treatment works was diverted to pass through the wetland.

Early monitoring has shown that 90% of the phosphate is being removed by the wetland, and a large increase in biodiversity downstream observed.



Reproduced from "Stripping the Phosphate" a presentation by the Norfolk Rivers Trust (2018).

https://www.theriverstrust.org/media/2018/08/2.-Stripping-the-phosphate-David-Diggens-Norfolk-Rivers-Trust.pdf

11.7.4 Agricultural Management

There is a big potential to improve water quality by interventions aimed at agricultural sources, especially considering the measures already taken by STW to reduce their contribution to phosphate load.

Potential schemes could include:

- Buffer strips
- Cross slope tree planting
- Runoff retention basins
- Contour ploughing
- Cover crops

There is considerable overlap with NFM measures, and the challenges are also very similar. Exact impacts are difficult to measure, although modelling tools such as Farmscoper exist to help with this. Once a scheme is implemented it relies on the landowner to continue to maintain it in order to maintain the mitigation benefit.

Funding for agricultural interventions could come from Catchment Sensitive Farming or a Payment for Ecosystem Services approach.

Wessex Water and United Utilities have both recently used a reverse auction approach, which enables farmers to bid for funding to plant cover crops in winter to manage runoff from agricultural land.

To view the Farmscoper webpage, click here
https://www.adas.uk/Service/farmscoper

For further information on the reverse auction approach, click here
https://www.entrade.co.uk/

Case Study – Wessex Water - EnTrade

Wessex Water catchment team used EnTrade to invite farmers to bid to grow cover crops over winter to reduce the nitrogen leaching into the watercourse.

This avoided the need to upgrade Dorchester WwTW to provide the same nitrogen removal capacity.

A trial auction was held in 2015, and two further auctions have since taken place attracting 557 bids from 63 farmers to save 153 tonnes of nitrogen.

"Using EnTrade to create a market in measures to deliver reductions in nitrogen has delivered a 30% saving for Wessex Water compared to traditional catchment approaches."

Ruth Barden, Director of Environmental Strategy, Wessex Water

11.8 Conclusions

- WwTWs serving growth within Stoke-on-Trent are point sources of pollution in the study area.
- Four protected sites (SSSIs) two of which are also designated as SACs are downstream of the study area. Whilst these should be carefully considered in future plan making, the risk of a deterioration in water quality from an increase in wastewater discharge during the plan period is low.
- Development sites within Stoke-on-Trent could also be sources of diffuse pollution from surface runoff.
- SuDS are required on all sites and their design must consider water quality as well as quantity.

- Runoff from these sites should be managed through implementation of a SuDS scheme with a focus on treating water quality of surface runoff from roads and development sites
- Opportunities exist for these SuDS schemes to offer multiple benefits of flood risk reduction, amenity value and biodiversity, as well as opportunities for groundwater recharge to provide a water resources benefit.
- Stoke-on-Trent City Council as LLFA should be consulted at an early stage to ensure SuDS are implemented and designed in response to site characteristics and policy factors
- Although primarily an urban area, opportunities exist to implement natural flood management techniques to achieve multiple benefits of flood risk, water quality and habitat creation.

11.9 Recommendations

Table 11.5 Recommendations from environmental constraints and opportunities section

Action	Responsibility	Timescale
The Local Plan should include policies that require development sites to adopt SuDS to manage water quality of surface runoff.	SOTCC	Ongoing
The local plan should include policies that require all development proposals with the potential to impact on areas with environmental designations to be considered in consultation with Natural England (for national designations)	SOTCC	Ongoing
In partnership, identify opportunities for incorporating SuDS into open spaces and green infrastructure, to deliver strategic flood risk management and meet WFD water quality targets. (Some of this is ongoing as part of SUNRISE).	SOTCC, STW, EA	Ongoing
Developers should include the design of SuDS at an early stage to maximise the benefits of the scheme	Developers	Ongoing
Work with developers to discourage connection of new developments	SOTCC, STW, Developers	Ongoing

Action	Responsibility	Timescale
into existing surface water and combined sewer networks. Prevent connections into the foul network, as this is a significant cause of sewer flooding.		
Opportunities for Natural Flood Management that include schemes aimed at reducing / managing runoff should be considered to reduce nutrient and sediment pollution alongside reducing flood risk within Stoke-on-Trent.	SOTCC, EA, NE	Ongoing

12 Climate change impact assessment

12.1 Approach

An assessment was undertaken to assess the potential impacts of climate change on the assessments made in this water cycle study. This was done using a matrix which considered both the potential impact of climate change on the assessment in question, and also the degree to which climate change has been considered in the information used to make the assessment.

The impacts have been assessed on a Stoke-on-Trent area wide basis; the available climate models are generally insufficiently refined to draw different conclusions for different parts of Stoke-on-Trent or doing so would require a degree of detail beyond the scope of this study.

Table 12.1 Climate change pressures scoring matrix

Have climate change pressures been considered in the assessment?	Low Potential Impact	Medium Potential Impact	High Potential Impact
Yes - quantitative consideration	GREEN	AMBER	AMBER
Some consideration but qualitative only	GREEN	AMBER	RED
Not considered	AMBER	RED	RED

12.2 Impact assessment

Severn Trent Water recognise the threat of climate change in their WRMP but have not published a Climate Change Adaption Report since 2015.

Table 12.2 Scoring of climate change consequences for the water cycle study

Assessment	Impact of Pressure (source of information)	Have climate change pressures been considered in the Water Cycle Study?	RAG
Water resources	High	Yes – quantitative assessment within the WRMP. Climate change impacts on consumption have been calculated in accordance with UKWIR report "Impact of Climate Change on Water Demand" (2013).	AMBER

Assessment	Impact of Pressure (source of information)	Have climate change pressures been considered in the Water Cycle Study?	RAG
Water supply infrastructure	Medium - some increased demand in hot weather	Yes - qualitative assessment within the WRMP.	AMBER
Wastewater Collection	High - Intense summer rainfall and higher winter rainfall increases flood risk	This has not been considered in site-by-site assessments. This is likely to form part of the DWMP process in future.	RED
Wastewater treatment	Medium - Increased winter flows and more extreme weather events reduces flow headroom	This has not been considered in site-by-site assessments. This is likely to form part of the DWMP process in future.	AMBER
WwTW odour	Medium – higher temperatures will exacerbate existing odour control issues.	This has not been considered in site-by-site assessments.	AMBER
Water quality	Nutrients: High Sanitary determinands: Medium to High	Reduction in river low flow (summer) values could reduce dilatation available and increase deterioration in WQ due to growth.	AMBER
Flooding from increased WwTW discharge	Low	No - not considered	AMBER

12.3 Conclusions and Recommendations

The impact of Climate Change on water resources and water infrastructure are receiving increasing levels of attention by water companies and sewerage undertakers at a strategic level. This has not been included in assessments at a site level as detailed modelling has not been carried out. Consideration of changes in water and wastewater demand should be considered when carrying out detailed site assessments in the future.

There is a risk that lower river flows in the future could exacerbate water quality issues as there would be less opportunity for dilution of pollutants.

Table 12.3 Conclusions and recommendations from climate change assessment

Action	Responsibility	Timescale
When undertaking detailed assessments of environmental or asset capacity, consider how the latest climate change guidance can be included.	EA, STW, SOTCC	As required
Take "no regrets"* decisions in the design of developments which will contribute to mitigation and adaptation to climate change impacts. For example, consider surface water exceedance pathways when designing the layout of developments.	SOTCC and Developers	As required

* "No-Regrets" Approach: "No-regrets" actions are actions by households, communities, and local/national/international institutions that can be justified from economic, and social, and environmental perspectives whether natural hazard events or climate change (or other hazards) take place or not. "No-regrets" actions increase resilience, which is the ability of a "system" to deal with different types of hazards in a timely, efficient, and equitable manner. Increasing resilience is the basis for sustainable growth in a world of multiple hazards (Heltberg, Siegel, Jorgensen, 2009; UNDP, 2010).

13 Conclusions and recommendations

Table 13.1 Summary of conclusions from the study

Assessment	Conclusion
Water resources	• Additional information was provided on the status of ground waterbodies present in Stoke-on-Trent that wasn't included in Phase 1 and updated to the Abstraction Licencing System were presented. • No significant changes to the Severn Trent Water WRMP were identified. • STW's position from Phase 1 was restated and therefore the conclusion from Phase 1 that there is adequate water resource to serve growth in Stoke-on-Trent is still valid. • There is sufficient evidence to support the adoption of the tighter water efficiency target of 110 l/p/d allowed for in building regulations. • Policies to reduce water demand from new developments, or to go further and achieve water neutrality in certain areas, could be defined to reduce the potential environmental impact of additional water abstractions in Stoke-on-Trent, and also help to achieve reductions in carbon emissions.
Water supply infrastructure	• Within the study area, there is enough water resource to supply all the proposed developments. • No limitations on the provision of water supply infrastructure were identified by STW. • A site-by-site assessment has not been completed as part of this study. Individual sites should be assessed as part of the planning process, and early engagement between developers and STW is recommended to ensure that the water supply network has sufficient capacity locally to accommodate the additional demand without detriment to existing customers.
Wastewater collection	• Development in areas where there is limited wastewater network capacity will increase pressure on the network, increasing the risk of a detrimental impact on existing customers, and increasing the likelihood of

Assessment	Conclusion
	CSO operation (where present). Early engagement between developers and Severn Trent Water is required, and further modelling of the network may be required at the planning application stage. Furthermore, in STW networks, there are areas where the current network is a combined sewer system, and further separation of foul and surface water may be required, as well as suitably designed SuDS. • Wastewater infrastructure upgrades would be required for many of the development sites • Early engagement between developers, SOTCC and STW is recommended to allow time for the strategic infrastructure required to serve these developments to be planned.
Wastewater Treatment Works Flow Permit assessment	• There are two WwTWs that may serve growth during the plan period in Stoke-on-Trent. Both of these are expected to have capacity to accommodate this growth (alongside neighbouring authority growth). • In addition to hydraulic capacity, it is important to consider water quality considerations which are discussed in section 9 and 11.
Odour Assessment	• None of the potential allocations identified are close enough to a WwTW for nuisance odour to be a risk. Should further sites be identified, odour risk at these sites should be considered.
Water quality impact assessment	• The Environment Agency's RQP tool was used to predict the impact on water quality of increased discharge from WwTWs due to growth during the plan period. • Growth is unlikely to lead to a significant deterioration in Ammonia, BOD and Phosphate during the plan period, and growth alone will not prevent good ecological status being prevented in the future should improvements in upstream water quality be made.

Assessment	Conclusion
Flood risk from additional WwTW flow	• The impact of increased effluent flows at WwTW from any of the proposed development is not predicted to have a significant impact upon flood risk in any of the receiving watercourses.
Environmental Constraints and Opportunities	• A number of protected sites such as SSSIs and Priority Habitats are found within or downstream of the study area that should be carefully considered in future plan making. • WwTWs serving growth within Stoke-on-Trent are point sources of pollution in the study area. • Four protected sites (SSSIs) two of which are also designated as SACs are downstream of the study area. Whilst these should be carefully considered in future plan making, the risk of a deterioration in water quality from an increase in wastewater discharge during the plan period is low. • Development sites within Stoke-on-Trent could also be sources of diffuse pollution from surface runoff. • SuDS are required on all sites and their design must consider water quality as well as quantity. • Runoff from these sites should be managed through implementation of a SuDS scheme with a focus on treating water quality of surface runoff from roads and development sites • Opportunities exist for these SuDS schemes to offer multiple benefits of flood risk reduction, amenity value and biodiversity, as well as opportunities for groundwater recharge to provide a water resources benefit. • Stoke-on-Trent City Council as LLFA should be consulted at an early stage to ensure SuDS are implemented and designed in response to site characteristics and policy factors • Although primarily an urban area, opportunities exist to implement natural

Assessment	Conclusion
	flood management techniques to achieve multiple benefits of flood risk, water quality and habitat creation.
Climate Change	• The impact of Climate Change on water resources and water infrastructure are receiving increasing levels of attention by water companies and sewerage undertakers at a strategic level. This has not been included in assessments at a site level as detailed modelling has not been carried out by Severn Trent Water. Consideration of changes in water and wastewater demand should be considered when the LPA carry out detailed site assessments in the future. • There is a risk that lower river flows in the future could exacerbate water quality issues as there would be less opportunity for dilution of pollutants.

13.1 Recommendations

Table 13.2 below summarises the recommendations from each section of the report.

Table 13.2 Summary of recommendations

Aspect	Action	Responsibility	Timescale
Water resources	Continue to regularly review forecast and actual household growth across the supply region through WRMP Annual Update reports, and where significant change is predicted, engage with Local Planning Authorities.	STW	Ongoing
Water resources	Provide yearly profiles of projected housing growth to water companies to inform the WRMP.	SOTCC	Annually
Water resources	Use planning policy to require the 110l/person/day water consumption target permitted by National Planning Policy Guidance in water-stressed areas.	SOTCC	In Local Plan
Water resources	The concept of water neutrality has potentially a lot of benefit in terms of resilience to climate change and enabling all waterbodies to be brought up to Good status. Explore further with Severn Trent Water, and the Environment Agency how the Council's planning and climate	SOTCC, EA, STW	In Local Plan and Climate Change Action Plan

Aspect	Action	Responsibility	Timescale
	change policies can encourage this approach.		
Water resources	Water companies should advise SOTCC of any strategic water resource infrastructure developments within the Authority, where these may require safeguarding of land to prevent other type of development occurring.	STW, SOTCC	In Local Plan
Water supply	Undertake network modelling where appropriate to ensure adequate provision of water supply is feasible	STW,	As part of the planning process
Water supply	SOTCC and Developers should engage early with STW to ensure infrastructure is in place prior to occupation.	SOTCC, STW, Developers	Ongoing
Wastewater collection	Early engagement between developers, SOTCC and STW is required to ensure that where strategic infrastructure is required, it can be planned in by STW.	Developers, SOTCC, STW	Ongoing
Wastewater collection	Take into account wastewater infrastructure constraints in phasing development in	SOTCC, STW	As part of the planning process

Aspect	Action	Responsibility	Timescale
	partnership with the sewerage undertaker		
Wastewater collection	Developers will be expected to work with the sewerage undertaker closely and early in the planning promotion process to develop an outline foul Drainage Strategy for sites to the satisfaction of the LPA that the development will not increase sewer flooding or the frequency or duration of storm overflow operation. The Outline foul Drainage strategy should set out the following: What – What is required to serve the site Where – Where are the assets / upgrades to be located When – When are the assets to be delivered (phasing) Which – Which delivery route is the developer going to use s104 s98 s106 etc. The Outline Drainage Strategy should be submitted as part of the planning application submission, and	Developers, SOTCC, STW	Ongoing

Aspect	Action	Responsibility	Timescale
	where required, used as a basis for a drainage planning condition to be set.		
Wastewater collection	Developers will be expected to demonstrate to the Lead Local Flood Authority (LLFA) that surface water from a site will be disposed using a sustainable drainage system (SuDS) with connection to foul sewers seen as the last option. New connections for surface water to foul sewers will be resisted by the LLFA and the discharge rate should also be agreed with the LLFA. Where a surface water connection is proposed to the public sewerage network, it should be demonstrated to Severn Trent Water that there is no other technically feasible option by selecting options as high as possible within the surface water hierarchy.	Developers, LLFA, STW	Ongoing
Wastewater treatment	Consider the available WwTW capacity when phasing	SOTCC, STW	As part of planning process

Aspect	Action	Responsibility	Timescale
	development going to the same WwTW.		
Wastewater treatment	Provide Annual Monitoring Reports to STW detailing projected housing growth.	SOTCC	Annually
Wastewater treatment	STW to assess growth demands as part of their wastewater asset planning activities and feedback to the Council if concerns arise.	STW, SOTCC	Ongoing
Odour	Consider odour risk at sites when identifying new sites in the future	SOTCC	Ongoing
Water Quality	Provide annual monitoring reports to STW detailing projected housing growth in the Local Authority	SOTCC	Ongoing
Water Quality	Take into account the full volume of growth (from SOTCC and neighbouring authorities) within the catchment when considering WINEP schemes or upgrades at WwTW.	STW	Aligned with projected growth plan
Flood Risk Management	Proposals to increase discharges to a watercourse may also require a flood risk activities environmental permit from the EA (in the case of discharges to Main	STW	During design of WwTW upgrades

Aspect	Action	Responsibility	Timescale
	River), or a land drainage consent from the Lead Local Flood Authority (in the case of discharges to an Ordinary Watercourse).		
Environment	The Local Plan should include policies that require development sites to adopt SuDS to manage water quality of surface runoff.	SOTCC	In Local Plan
Environment	The local plan should include policies that require all development proposals with the potential to impact on areas with environmental designations to be considered in consultation with Natural England (for national designations	SOTCC	Ongoing
Environment	In partnership, identify opportunities for incorporating SuDS into open spaces and green infrastructure, to deliver strategic flood risk management and meet WFD water quality targets. (Some of this is ongoing as part of SUNRISE).	SOTCC, STW, EA	Ongoing

Aspect	Action	Responsibility	Timescale
Environment	Developers should include the design of SuDS at an early stage to maximise the benefits of the scheme	Developers	Ongoing
Environment	Work with developers to discourage connection of new developments into existing surface water and combined sewer networks. Prevent connections into the foul network, as this is a significant cause of sewer flooding.	SOTCC, STW, Developers	Ongoing
Environment	Opportunities for Natural Flood Management that include schemes aimed at reducing / managing runoff should be considered to reduce nutrient and sediment pollution alongside reducing flood risk within Stoke-on-Trent.	SOTCC, EA, NE	Ongoing
Climate change	When undertaking detailed assessments of environmental or asset capacity, consider how the latest climate change guidance can be included.	EA, STW, SOTCC	As required
Climate change	Take "no regrets"* decisions in the design of	SOTCC and Developers	As required

Aspect	Action	Responsibility	Timescale
	developments which will contribute to mitigation and adaptation to climate change impacts. For example, consider surface water exceedance pathways when designing the layout of developments.		

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